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CONTENTS

Vol No. - LV No-3 | Oct. - Dec., 2024

Editorial 05

Road Readiness – Is it Just a Phrase
MOHAN SUBRAMANIAN 15

Road Safety in India: An Overview and the Significant Role of Safety Professionals
Dr. VYOM SAXENA et al 20

Effect of Road Elements on Visual Attention of Drivers on Inter-Urban Roads
Dr. A. MOHAN RAO et al 26

Road Safety Consideration for National Highways
SANTOSH SIDHAYE 31

Transportation of Hazardous Chemicals
SRINIVASU METLAPALLI 33

Training Vs. Monitoring – The Synergy
MOHAN SUBRAMANIAN 46

Causes of Road Accident
SANDEEP DHAMONE 49

LPG Tanker Handling & Transportation Safety
ASIS MANDAL 57

Road Safety in Cement Truck Handling and Transportation
PRAKASH MOVADE et al 63

Road Safety Signages and Signs
SANDEEP SAMISHETTY 72

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EDITORIAL



Dear Readers,

Road safety continues to be a major public concern as it is a leading cause of death and injury in India. According to the Road Accident Report 2022, published by the Ministry of Road Transport & Highways, Government of India, a total of 4,61,312 road accidents occurred in the country during 2022, resulting in 1,68,491 deaths and 4,43,366 injuries. The accident data for the last 3 years show increasing trend.

According to the ministry's report, over-speeding, drunken driving, driving on the wrong side, and lane indiscipline are the major contributors to road accidents. Furthermore, adherence to traffic rules, road infrastructure, and enforcement mechanisms are some of the critical areas that demand immediate attention. Through a multipronged approach, we must strive to address these challenges effectively.

The National Safety Council supplements the government's efforts and promotes the Road Safety Campaign among its members and patrons across India every year. It is heartening to note that our members are enthusiastically supporting the campaign and spreading awareness about road safety among their employees and nearby communities. During the month-long January campaign, various activities are undertaken by many organizations, including the launch of a film on road safety, flag-off rallies, and the presentation of awards for road safety, among others.

I am happy to share that the NSC has produced a short film of 40 seconds duration, focusing on the importance of helmets for bike riders. The film was broadcasted on DD National during the campaign month to create safety awareness.

I am delighted to present this October-December 2024 issue of the Industrial Safety Chronicle as a special issue on Road Safety to mark the National Road Safety campaign, which is being observed from January 1st to 31st, 2025. In this issue, we have included various interesting articles on road safety contributed by experts. These include topics such as road safety in India and the significant role of safety professionals, the effect of road elements on the visual attention of drivers on inter-urban roads, road safety considerations for national highways, safe transportation of hazardous chemicals, road safety signages, and more.

We hope readers find this issue informative and useful.

Lalit Gabhane

Dr. Lalit R. Gabhane
Director General & Chief Editor


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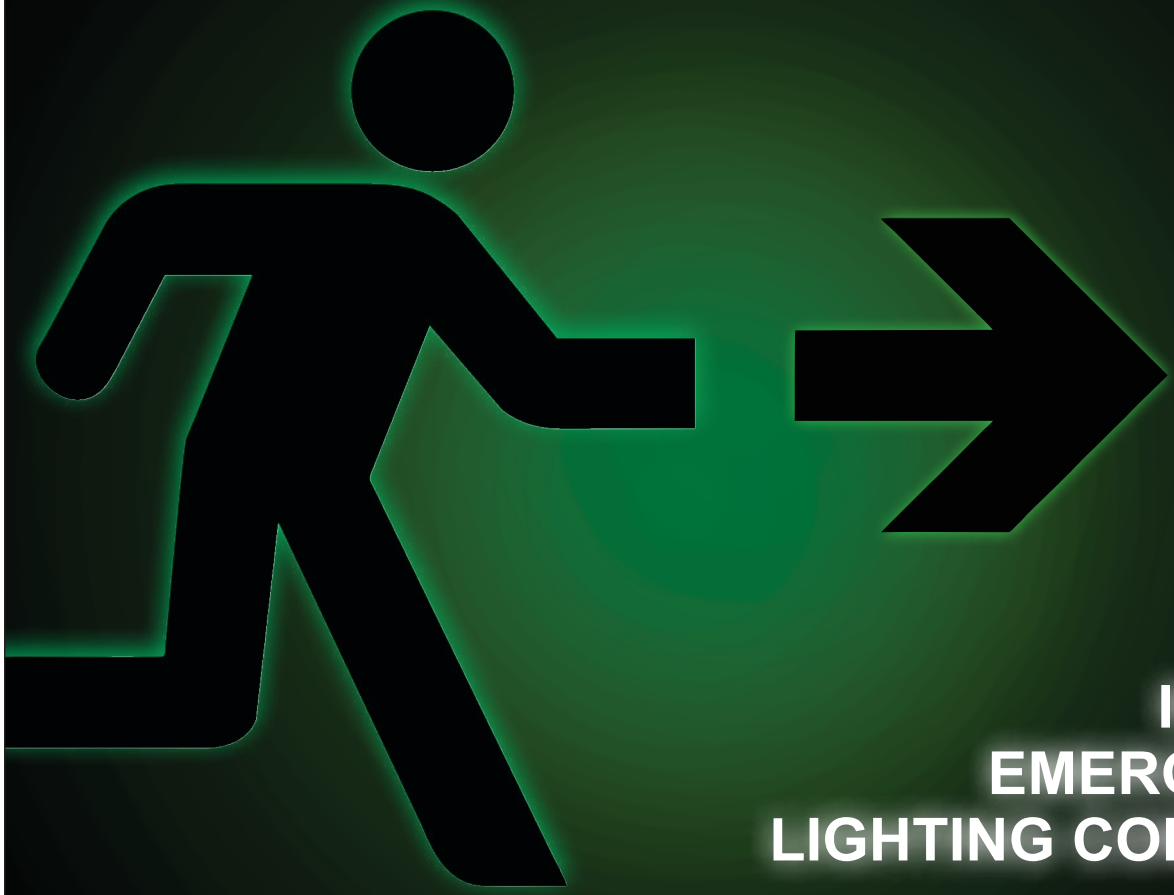
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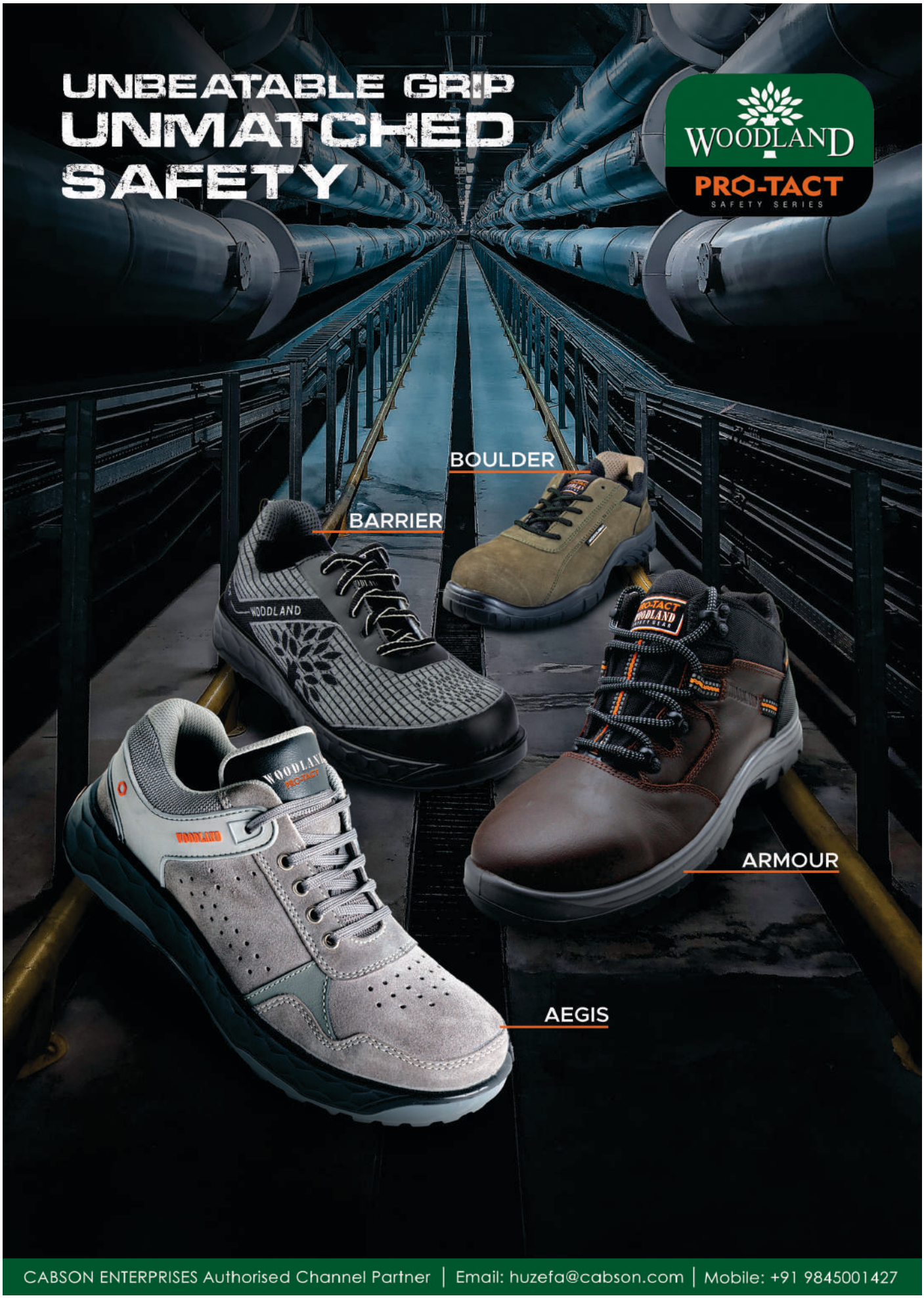
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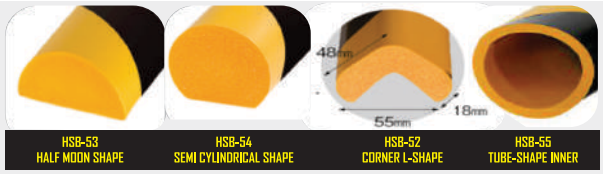
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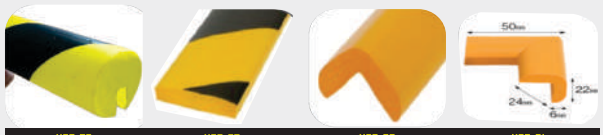




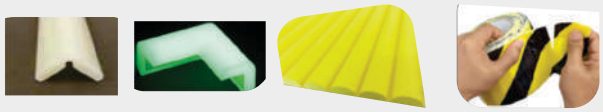




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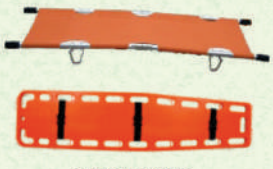
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Road Readiness – Is it Just a Phrase

MOHAN SUBRAMANIAM, Transmitr Sewa Foundation, Navi Mumbai, Maharashtra, Email: mohan@transmitr.in

Road Readiness is not merely a phrase; Road readiness is concerned with safety which is a critical and multifaceted issue that impacts lives, economies, and communities. In 2022, over 4.61 lakh road accidents were reported across India. These accidents tragically claimed the lives of over 1.68 lakh people. The significance of road readiness extends beyond simple adherence to rules; it encompasses a collective responsibility to prevent accidents and ensure the well-being of all road users.

1 Importance of Road Safety:-

1. **Safety of people:** Road safety measures are essential for protecting lives. Adhering to safety protocols can significantly reduce fatalities and prevent serious injuries
2. **Injury Prevention:** Implementing road readiness helps minimize injuries caused by accidents. For instance, wearing seat belts can reduce the risk of fatal injuries by up to 50% for front-seat occupants. This highlights the importance of educating individuals about safe driving practices and pedestrian awareness. The Union Minister for Road Transport and Highways, Nitin Gadkari , supported by the then joint secretary-Transport Abhay Dhamle, have been instrumental in pushing for increased safety standards in automobiles, including the introduction of airbags. They have been key figures in the implementation of various safety regulations. Thanks to the ministry which insisted upon certain minimum safety standards for automobile manufacturers (OEMs), otherwise there used to be a time when side view mirror and airbag for front seat occupant /passenger used to be optional and was available only at a cost.
3. **Economic Impact:** Road accidents impose a substantial economic burden on society, including medical expenses, property damage, and emergency services costs. By promoting road safety, these costs can be reduced, benefiting individuals and communities alike. The insurance third party premium pool is to mitigate or reduce the huge losses occurring due to accidents which otherwise will be a heavy burden on General Insurance companies.
4. **Traffic Flow and Efficiency:** Following traffic rules enhances the smooth flow of vehicles, reducing congestion and commute times. This efficiency is vital for maintaining order on roads and ensuring that emergency services can respond quickly in case of incidents. Also, those compliances like Driving Licence in order, motor insurance as per CMVR -1989 and other documents are a part of off-road compliances.
5. **Environmental Considerations:** Road readiness also attributes to environmental sustainability like promoting fuel-efficient driving which reduces emissions and conserves energy. This aspect of road safety is increasingly relevant when we refer to climate change. The Bharat Stage emission norms for automobiles is proof of this and alternate fuel vehicles in the anvil.

The following are few strategies that can effectively increase road safety awareness for safe driving:

1. **Workshops and Seminars:** Safety practitioners can collaborate with NGOs, schools, colleges to conduct workshops that create awareness about road safety. This will educate students about the dangers of reckless driving, speeding, and drunken driving. These sessions can instil a sense of responsibility among the youth.
2. **Advertisements and public announcements:** Government should fund informative advertisements to highlight safe driving practices and the consequences of unsafe road behaviour. Organising campaigns during Road Safety Week could add seriousness to road readiness.

   Road safety slogans printed on motor insurance policies etc can also be a good idea to promote road readiness.
3. **Build Awareness of Traffic Rules:** Conduct campaigns to inform drivers about existing traffic rules and the importance of adhering to them. This could involve distributing pamphlets or using social media platforms for outreach.
4. **Use of Technology as enabler for road readiness:** Drivers can use technology assistance to monitor safety aspects pertaining to vehicles. Vehicles can be equipped with advanced safety technologies such as lane departure warnings and frequent braking monitors. Implement telematics systems that provide drivers with feedback on their driving habits, encouraging safer practices through data-driven insights. These systems can significantly reduce human error, a major contributor to accidents.
5. **Strict Penalties for Violations:** Government should enforce strict penalties for traffic violations such as speeding and drunk driving which is in force nowadays. Regular checkpoints and increased police presence can help deter risky behaviour on the roads. It is pertinent to note that the transport industry and lorry driver community severely opposed to section 106/2, which specified that strict action would be taken for hit and run cases, but with opposition from drivers , the rule was withdrawn.

6. **Defensive Driving Courses:** Encourage drivers to participate in defensive driving courses that teach skills for anticipating and reacting to hazards effectively. Encourage drivers to be proactive about their vehicle's maintenance needs and foster a culture of safety on the roads. Educating drivers about the importance of regular inspections and timely repairs, empowers them to take responsibility for their vehicles' condition, ultimately contributing to safer driving environments. Simulator based skilling is also a good idea.
7. **Family Involvement:** Encourage families to adopt safe driving habits collectively, such as insisting on seat belt use for all passengers and designating a sober driver when necessary. Do not hand over the vehicle keys to your kins without a driving license.

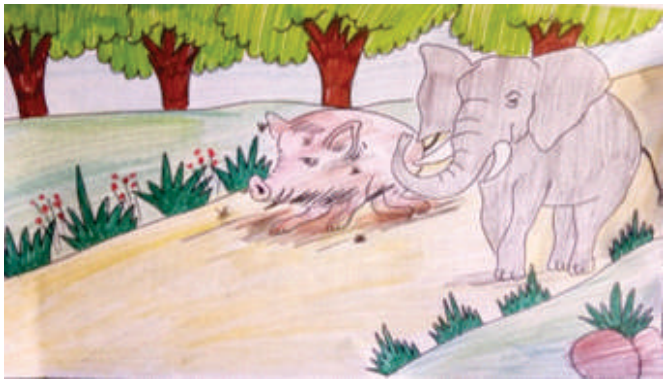
2 Addressing Road Rage:

While specific statistics on road rage incidents in India are limited, it's clear that it's a growing concern. The number of road rage incidents has been steadily increasing in recent years, fuelled by heavy traffic congestion, impatience, and a lack of adherence to traffic rules. These incidents can lead to serious consequences, including road accidents, physical injuries, and legal repercussions. To address this issue, various measures are being taken, such as stricter enforcement of traffic rules, public awareness campaigns, and improved road infrastructure

Connecting to this, is a story .... Once an elephant took a bath in a river and was walking on the road. When it neared a bridge, it saw a pig fully soaked in mud coming from behind. The elephant calmly moved to another side, let the dirty pig pass by and then continued its own journey. The unclean pig later spoke to elephant's friends in arrogance, "See how big I am; even the elephant was afraid of me and moved to one side to let me pass"



On hearing this, some elephants questioned their friend, the reason for its action. Was it out of fear? The elephant quietly smiled and replied, "I could have easily crushed the pig under my legs, but I was clean, and the pig was very dirty. By crushing it, my leg would become dirty and I wanted to avoid it.



Hence, I moved aside."

The story reveals: Realized souls will avoid contact with negativity not out of fear, but out of desire to keep away from impurity. You need not react to every opinion, every comment or every situation that can lead to road rage. Kick the drama and keep going ahead. Choose your battles wisely. Not everything deserves your time and attention. This extract (source the internet) depicts that when a person is driving, he should take ones' surrounding into consideration and should avoid agitation when other drivers are driving fast, slow, honking, passing remarks, tailgating etc. The driver should remain calm and composed and keep his concentration only on the road and not let anything effect his driving.

3 Infrastructure Improvements

Infrastructure plays a pivotal role in enhancing road safety. Well-designed roads with clear markings, adequate signage, and proper lighting significantly improve visibility and reduce confusion. Safe intersections, dedicated pedestrian, cyclist facilities, and well-maintained road surfaces, further contribute to safer roads. Traffic management systems, including intelligent traffic signals, speed cameras, and traffic calming measures, help regulate traffic flow and reduce the risk of accidents. Additionally, roadside safety features like guardrails, crash cushions, and proper trees management can mitigate the impact of collisions. The integration of advanced technologies, such as ADAS and connected vehicle technology, offers the potential to further enhance road safety by providing real-time information and automated safety features. By implementing these infrastructure improvements, we can create safer roads and reduce the number of road accidents.

(Source: The internet)

What are the most common causes of road accidents

The most common causes of road accidents can be attributed to various human behaviours, environmental factors, and vehicle conditions. Here are the key contributors:

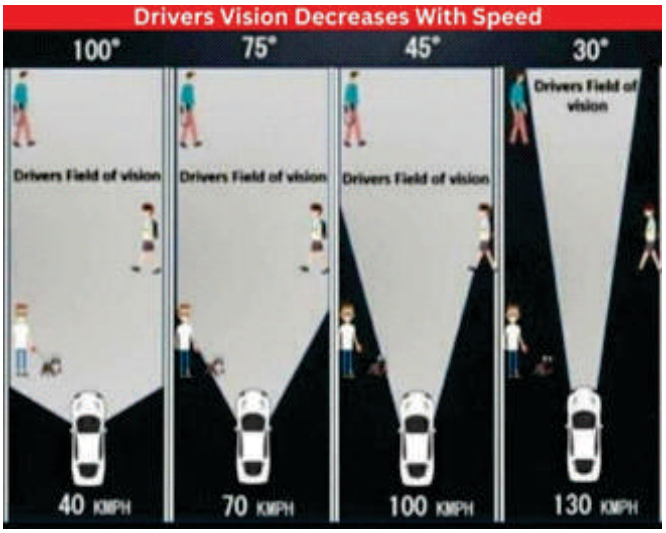
i) Distracted Driving

Distracted driving remains the leading cause of road accidents. This includes activities such as

texting, talking on the phone, eating, or adjusting the radio while driving, which significantly reduces a driver's focus and reaction time.

ii) Over Speeding

Driving above the speed limit is a prevalent cause of accidents. Higher speeds increase both the likelihood of an accident occurring and the severity of injuries sustained during a crash. Speeding reduces a driver's ability to react to sudden changes in traffic conditions. Speeding can affect the vision of the driver, called the tunnel effect.



iii) Intoxicated Driving Vs. Texting

Driving under the influence of alcohol or drugs impairs judgment and coordination, making it one of the most dangerous behaviours on the road. Intoxicated drivers are more likely to cause severe accidents. Interestingly a survey revealed that texting while driving has overtaken drink and drive.

iv) Reckless Driving

Reckless driving often leads to collisions due to a lack of regard for safety rules, for example overtaking from left, trucks plying in the first lane (All heavy commercial vehicles are directed to drive in the last lane) etc.

v) Failure to Obey Traffic Signals

Disobeying traffic laws, such as driving during stop signals or red lights , is a common cause of crashes. These violations often lead to high-impact collisions at intersections, in some cases motorists take it for granted the 'free left turn' and speed ahead. The Motor Vehicles (Amendments) Bill 2019 has called for stricter penalties for violations.

vi) Poor Weather Conditions

Adverse weather conditions like rain, fog, or snow can make roads slippery and reduce visibility, increasing the risk of accidents. Drivers often fail to adjust their driving behaviour in response to these conditions even though rains and foggy whether are expected every year.

vii) Driving Fatigue

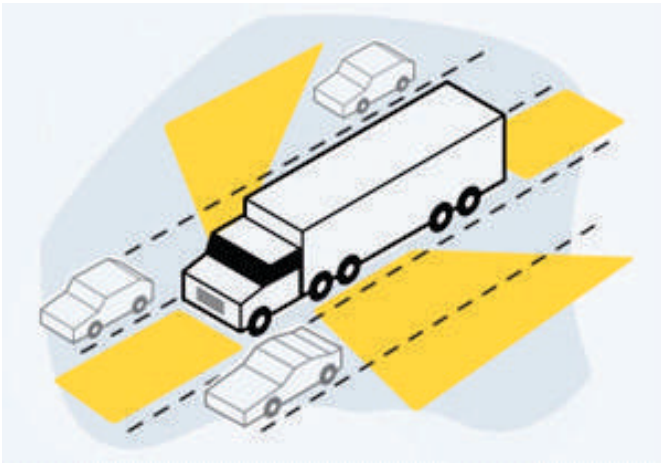
Long hours of driving can cause fatigue which can impair any driver's capability to concentrate and react when necessary. Lack of proper rest can lead to drowsy driving incidents. In case of trucks, driving during night is not recommended and some logistic firms are adhering to this.

viii)Not Using Seatbelts

Failure to wear seatbelts increases the risk of serious injury or death in an accident. Seatbelts are crucial for protecting occupants during collisions.

ix) Poor Road Conditions/Blind Spots

Potholes, debris, and poorly maintained roads can contribute to accidents by causing drivers to lose control of their vehicles. Truckers experience blind spots and are unfortunately blamed for careless driving.



What role does vehicle maintenance play in road safety

Vehicle maintenance plays a crucial role in ensuring road safety by preventing mechanical failures and enhancing the overall performance of a vehicle. Here are the key aspects of how proper maintenance contributes to safer driving:

i) Prevention of Mechanical Failures

Regular maintenance allows for early detection and resolution of potential issues that could lead to accidents. Components such as brakes, tyres, and steering systems must be routinely inspected and maintained to ensure they function properly. For instance, worn-out brake pads can significantly increase stopping-distances, raising the likelihood of collisions. "Musical instruments like the Tabla or the Harmonium would not know the kind of sounds the instrument is producing, because this is the concern of the player". Same holds true for drivers who must take due responsibility.

ii) Strict adherence to Safety Standards

Regular maintenance also helps ensure that vehicles comply with safety regulations set by authorities. This includes emissions testing and other inspections that contribute to both road safety and environmental protection. Safety is sometimes ignored by lorry drivers in order to meet deadlines and scheduled deliveries.

iii) Tyre Safety

Tyres are the only part of a vehicle that makes direct contact with the road, making their condition critical for safety. Regular checks on tyre pressure and tread depth can prevent blowouts and improve traction, especially in adverse weather conditions. Underinflated or worn tires can lead to loss of control, increasing the risk of accidents. The prudent way would be tyre rotation

iv) Safety System Functionality

Modern vehicles are equipped with advanced safety features like airbags and anti-lock braking systems (ABS). These systems require regular inspections to ensure they are functioning properly. If these safety features are not well-maintained, they may not deploy effectively during an accident, compromising occupant safety.

v) Structural Integrity

Routine inspections can identify structural issues such as rust or damage to the chassis that could compromise a vehicle's ability to protect its occupants in a crash. Addressing these issues promptly enhances the vehicle's overall safety.

Also in the Road transport sector, violation of section 93 of CMVR-1989, on overall dimensions of motor vehicles is diluted .

4 Role of Technology to Improve Road Safety

Technology plays a transformative role in improving road safety through various innovative solutions that enhance vehicle performance, driver awareness, and traffic management. Here are some key ways technology contributes to safer roads:

i) Advanced Driver Assistance Systems (ADAS)

Collision Avoidance: ADAS technologies, such as automatic emergency braking (AEB) and forward collision warning systems, help prevent accidents by alerting drivers to potential collisions and automatically applying brakes if necessary. Studies have shown that AEB can reduce rear-end crashes by up to 50% 5.

Lane Keeping Assistance: Systems like lane departure warning (LDW) and lane keeping assistance (LKA) help drivers maintain their lane, significantly reducing the risk of sideswipe and head-on collisions. Research indicates that these systems can reduce relevant crashes by atleast 30%.

It has been found that commercial vehicle drivers resist use of cameras or other monitoring devices in their vehicle , hence it would be advisable to train them the importance of safety alongside utility of technology tools. Though it is unfortunate that companies do not have a budget for training and development.

ii) Vehicle Connectivity and IoT

Real-Time Data Sharing: Connected vehicles equipped with Internet of Things (IoT) technology can communicate with each other and traffic infrastructure, providing real-time information about road conditions, traffic patterns, and potential hazards. This connectivity enhances situational awareness for drivers.

Smart Traffic Management: IoT devices enable smart traffic management systems that optimize traffic flow and reduce congestion. For instance, adaptive traffic signals can adjust their timing based on real-time traffic data, improving safety at intersections.

iii) Artificial Intelligence (AI) and Machine Learning

Accident Prediction: AI algorithms analyze vast amounts of data from various sources to identify high-risk areas and predict potential accidents. This proactive approach allows for targeted interventions, such as increased police presence or infrastructure improvements in identified hotspots.

Driver Monitoring Systems: AI-driven driver monitoring systems can detect signs of fatigue or distraction, alerting the driver to take necessary actions. These systems enhance focus and reduce the likelihood of accidents caused by human error .

iv) Enhanced Safety Features

Blind Spot Detection: Technologies that detect vehicles in a driver's blind spot provide warnings when it is unsafe to change lanes, thereby reducing the risk of collisions during lane changes .

Pedestrian and Cyclist Detection: Advanced systems designed to detect pedestrians and cyclists help prevent accidents involving vulnerable road users. These features often work in conjunction with AEB to mitigate crashes when a collision is imminent .

v) Educational Tools , Mobile Applications

Driver Awareness and Education though is preferred with practical sessions, but alternate mode like mobile application etc. can contribute to training and development. Apps designed for drivers can provide education on safe driving practices, track driving behaviour, and offer feedback on performance. Such tools

encourage responsible driving habits and increase awareness of road safety risks.

Virtual Driving Simulators: These simulators allow drivers to experience various road conditions and scenarios in a controlled environment, enhancing their understanding of safe driving practices without real-world risks .

5 Conclusion :

Road safety is far more than a mere phrase; it embodies a comprehensive approach to safeguarding lives and enhancing the quality of life within communities. It requires ongoing education, infrastructure improvements, adherence to regulations, and a shared commitment from all road users to create safer environments for everyone involved in transportation activities.

For the Truck Driver Pilot community life probably goes on this way for they always wondered Why 'HONOUR & RESPECT' for them is a commodity or rather is in short supply. Their sadness is deep within, and it was a kind of dissatisfaction which makes them indulge in sometimes wrong doings – probably in the search for some permanence.

Also fleet driver management is not just lip service or armchair discussions. Road Safety is all about 'follow up' measures post training and detailing, not just reporting or making statistics on casualties and deaths. Counselling truckers is an art. Peace and harmony are the propellers of all senses which can get rid of Durbuddhi i.e., evil thoughts. Disciplined driving is a directive which should come straight from your heart.

In this article that details on road readiness ,we are tempted to ask if discipline can be achieved vide enforcement (helmets and seat belts) or education . The fact is that both education on road safety and enforcement of rules must go hand in hand for welfare of people and society.

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Road Safety in India: An Overview and the Significant Role of Safety Professionals

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Abstract: Road safety is a pressing concern in India, with a staggering number of fatalities and injuries occurring annually. This article presents an in-depth analysis of the major causes of road accidents in India, including human, institutional, external, and aggravating factors. Furthermore, it explores various interventions proposed by scholars and experts to enhance road safety, such as public awareness campaigns, strict enforcement of traffic rules, investment in better road infrastructure, and the role of safety professionals. Additionally, recent policy initiatives at the national, state, and local levels are examined, highlighting efforts to reduce road accidents, injuries, and fatalities. The safety professionals can play a definite role in the efforts towards road accident prevention and consequence mitigation. Addressing road safety in India requires a comprehensive approach encompassing infrastructure improvements, law enforcement, public education, and changes in driver behaviour

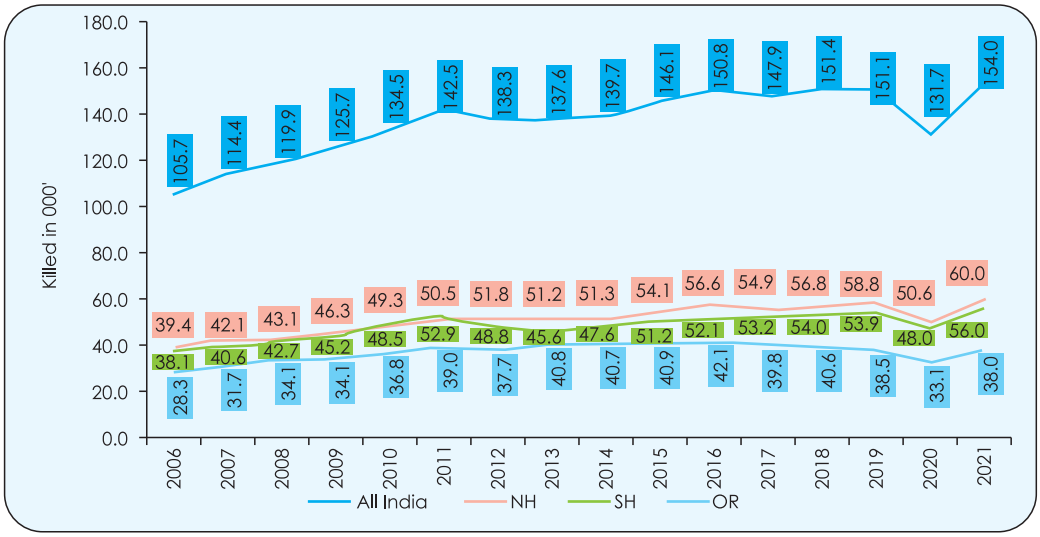
Keywords: Road Safety, Indian Roads, Human Factors, Road Safety Legislations, Road Accidents.

1. Introduction

Road safety is a critical issue in India, marked by alarming accident rates and a substantial loss of life and property. India's roads consistently rank among the deadliest in the world, with over 150,000 annual fatalities and numerous injuries. According to the WHO's Global Status Report on Road Safety 2023, while the global road traffic fatalities decreased by 5% annually to 1.19 million between 2010 and 2021 (with 108 UN member nations observing a decline even when the global motor vehicles fleet grew by over 160%), India experienced a 15% increase in road traffic fatalities during this period [1]. It is, therefore, imperative to have a comprehensive overview of the state of road safety in India, the underlying factors contributing to the problem, and potential solutions. Addressing road safety in India requires a multi-faceted approach that encompasses improved infrastructure, stricter law enforcement, public education, and changes in driver behaviour. Reducing road accidents and fatalities in India is a significant challenge but a vital one to ensure the well-being of the population.

1.1 Major causes of road accidents in India:

With India boasting one of the world's largest road networks, the importance of road safety is heightened. The rapid motorization and increasing urbanization, driven by robust economic growth, have exacerbated the issue. Indian roads experience on an average 1,130 accidents and 422 fatalities each day, or approximately 47 accidents and 18 deaths every hour [2]. Figure 1 gives the trends in the numbers of persons killed in road accidents in the period from 2006 -2021 in India.



NH-National Highways, SH- State Highways, OR-Other Roads

Fig. 1 Trends in road accidents fatalities (Source: MoRTH, 2021)

Several important factors compromise road safety in India, contributing to a high rate of accidents and fatalities (Fig 2). These factors are multifaceted and often interrelated, making road safety a complex issue in the country.

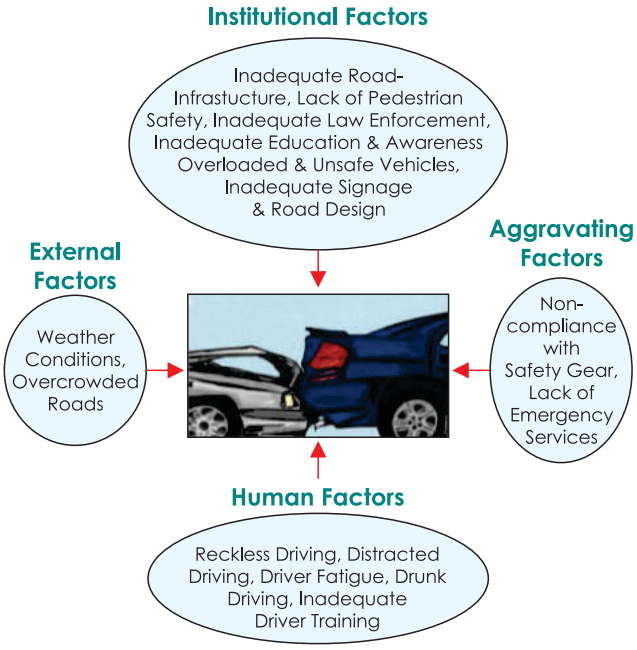


Fig. 2. Major causes of road accidents in India

The major factors contributing to road accidents in India cab be grouped under four major categories as discussed below:

(I) Human Factors:

One of the most significant factors contributing to road accidents in India is reckless driving. This includes over-speeding, aggressive driving, improper overtaking, and disregard for traffic rules [2,23]. Many drivers do not follow basic road etiquette. The use of mobile phones while driving is a prevalent and dangerous practice. Drivers often engage in texting, talking on the phone, or using mobile apps, diverting their attention from the road.

Long working hours and inadequate rest for professional drivers, particularly in the trucking and transport industry, can lead to driver fatigue, impairing their ability to react to road hazards. Driving under the influence of alcohol or drugs remains a major issue in India. The resultant impaired judgment and reaction times increase the likelihood of accidents. The quality of driver training in India varies widely. Many new drivers may not receive proper education about road safety, leading to a lack of awareness and skill.

(ii) Institutional Factors:

Poorly designed and maintained road infrastructure is a significant challenge. Potholes, inadequate signage, improper road markings, and the lack of proper drainage systems contribute to accidents. The poor state of road infrastructure in India has been well-documented [3]. This puts those on foot at significant risk. Inadequate pedestrian safety is a pressing concern and unfortunately, an oft-neglected subject, with factors such as deficient pedestrian crossings and encroachments on footpaths contributing to accidents [4].

Weak enforcement of traffic laws is a widespread problem. Many traffic violators escape penalties due to corruption within the law enforcement system, fostering a sense of impunity. Weak enforcement of traffic laws allows errant drivers to evade penalties [5]. Recent introduction of digital and automatic devices in major cities has helped in containing this concern to some extent. A lack of awareness about road safety rules and regulations is common among the general public. Many people are unaware of the importance of following traffic rules and guidelines. A lack of public awareness and knowledge regarding road safety has been documented [6].

Overloaded trucks and poorly maintained vehicles are common sights on Indian roads that pose significant dangers [7]. These vehicles are prone to accidents and can pose significant dangers to other road users. Overloaded trucks and poorly maintained vehicles. Poorly designed roads, inadequate signage, and improper road design contribute to confusion among drivers and increase the risk of accidents

(iii) External Factors:

India experiences a wide range of weather conditions, from heavy monsoon rains to fog and dust storms. These weather events can reduce visibility and make roads more dangerous. Congestion is a common problem in urban areas, leading to slower traffic flow and increased frustration among drivers, which can result in aggressive driving and accidents.

(iv) Aggravating Factors:

There are certain factors that can aggravate the damage due to the road accident. Many motorcyclists and scooter riders do not wear helmets, and car occupants may not use seat belts, even though it is legally required. Non-compliance with these safety measures increases the risk of injury in accidents. In many areas, there is a lack of quick and efficient emergency response services. Delayed medical attention can be a critical factor in the survival and recovery of accident victims.

Figure 3 gives a bar diagram depicting Road Accidents by different types of Traffic Rules Violation during 2021.

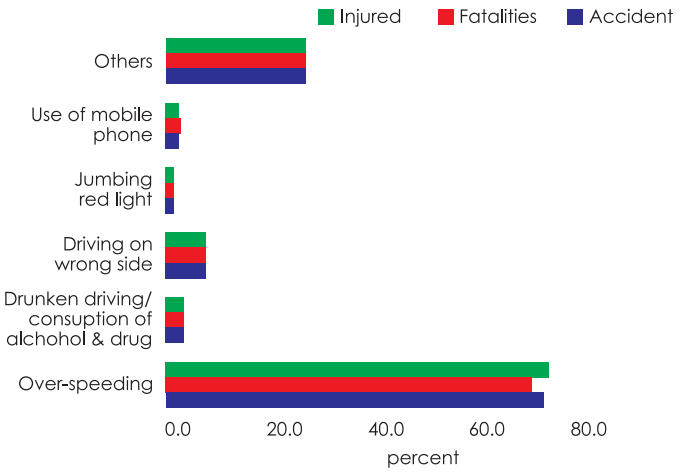


Fig 3. Road Accidents by type of Traffic Rules Violation during 2021 (Source: MoRTH2021)

2. Interventions for Road Safety

Addressing road safety in India is a multifaceted challenge and various interventions have been proposed and emphasised by various authors for enhancing road safety. Public awareness campaigns have been recognized as a powerful tool to educate the public about road safety, targeting drivers, pedestrians, and school children [8]. Strict enforcement of traffic rules, against drunk driving, over-speeding, and mobile phone use while driving, etc., is crucial [9,21].

The need for investment in better road design, maintenance, and construction is well-documented [10]. The integration of technology, such as traffic cameras and digital monitoring systems, can enhance law enforcement and road safety [11]. Stricter safety standards for vehicles, including regular inspections, are suggested to reduce accidents caused by poorly maintained vehicles [12]. Enhancing driver education and training programs can instil better driving habits and awareness of road safety [13]. Local communities can play a vital role in promoting road safety by reporting unsafe road conditions and organizing safety initiatives [14].

3. Role of Safety Professionals in Enhancing Road Safety

Safety professionals play a crucial role in enhancing road safety in India by focusing on various aspects of accident prevention and post-incident care. Their expertise and efforts are essential for implementing, enforcing, and promoting measures that can significantly reduce accidents and save lives and creating a safer road environment and minimizing the impact of accidents.

Health and safety professionals can design comprehensive road safety programs for organizations with vehicle fleets or transportation-related operations. These programs encompass safe driving practices, vehicle maintenance, and adherence to traffic laws. Safety professionals can advocate for improved road safety policies both within their organizations and in collaboration with relevant authorities. They can participate in the development of corporate or government policies aimed at enhancing road safety.

Safety Professionals can conduct risk assessments to identify potential hazards and risk factors related to transportation and commuting. By understanding the risks, they can develop strategies to mitigate them. Health and safety professionals can analyse accident data to identify trends and patterns. By doing so, they can make data-driven decisions to improve road safety, such as addressing high-risk routes or vehicle types. They can conduct research to understand the specific factors contributing to accidents in different regions of India. This data-driven approach can help authorities make informed decisions regarding road safety measures. By analysing accident data, they can identify root causes and underlying factors and develop strategies accordingly to address prevalent issues.

Safety specialists can develop and maintain emergency response protocols for road-related accidents. This includes protocols for immediate response, communication, and providing medical care to accident victims. In the unfortunate event of an accident, health and safety professionals can lead the investigation process to determine the contributory factors, particularly, the human factors. Their findings can help in devising corrective actions to prevent future incidents. Safety professionals can play a role in developing and improving emergency response systems and mechanisms. They can work to reduce response times and improve the quality of medical care provided to accident victims.

Road safety professionals can contribute by conducting thorough road safety audits and assessments. They can identify hazards and recommend improvements to road infrastructure, such as better signage, proper lane markings, and the installation of traffic signals. These experts can also ensure that roads are designed with safety in mind, taking into account factors like visibility, road curvature, and pedestrian access [15]. They can significantly contribute to enhance road safety by conducting safety audits and inspections of transportation systems, routes, and vehicles to identify areas for improvement, such as dangerous intersections, signage issues, or maintenance deficiencies.

Health and safety professionals can design and implement driver training programs that focus on safe driving behaviours, defensive driving techniques, and adherence to road safety rules and regulations. They may also organize workshops and awareness campaigns to promote responsible driving. Moreover, safety professionals can devise strategies for effectively monitoring the compliance with relevant safety regulations and policies. This includes ensuring adherence to seat belt and

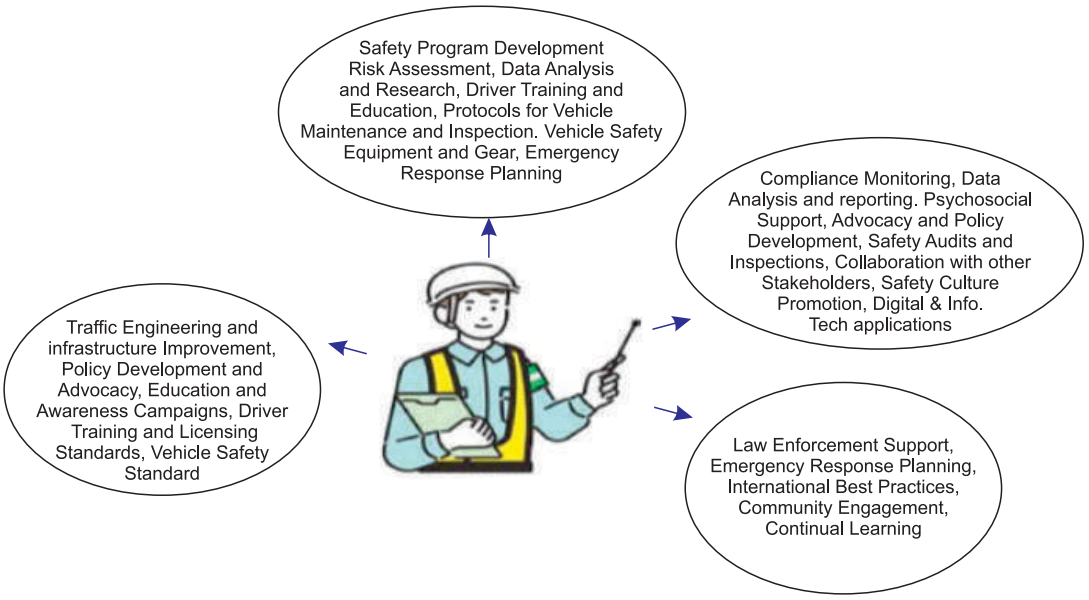
helmet requirements, alcohol and drug testing policies, and other safety-related regulations. They can develop mechanisms to ensure that driving schools adhere to safety standards and that licensing tests are rigorous. This ensures that only competent drivers are allowed on the road, reducing the risk of accidents.

Safety experts can contribute to the development and enforcement of safety standards for vehicles. They can collaborate with regulatory bodies to ensure that vehicles meet safety requirements, such as having airbags, anti-lock braking systems, and proper child safety features. Safety professionals can establish protocols for the regular maintenance and inspection of vehicles to ensure they are safe and roadworthy. This includes latest scientific procedures and fail-safe mechanisms for checks on brakes, tires, lights, and other essential components. They can ensure that the necessary safety features and gear, such as seatbelts, airbags, child safety seats, and reflective vests for employees who work on or near roads, etc. meet the proper and latest standards.

Health and safety professionals often work closely with other stakeholders, including government agencies, law enforcement, and transportation organizations, to implement road safety measures and best practices. Collaboration with law enforcement agencies too is crucial. Road safety professionals can work with the police to improve enforcement of traffic laws. This includes supporting efforts to correctly detect and penalize drunk driving, over-speeding, and other dangerous behaviours. Engaging with local communities is essential. Road safety professionals can involve communities in road safety initiatives, encourage them to report unsafe road conditions, and organize safety awareness programs.

Safety experts can foster a culture of safety within organizations, emphasizing the importance of road safety among employees and stakeholders, encouraging them to prioritize safety in all transportation activities. Following a road accident, health and safety professionals can offer psychosocial support to employees who may have experienced trauma. They can facilitate access to counselling services and support networks. Promoting road safety awareness is a vital part of reducing accidents. Road safety professionals can design and implement educational campaigns targeting various demographics, including school children, drivers, and pedestrians. They can use their expertise to craft effective messages and programs to change behaviours and promote safety.

Safety professionals can stay updated on international best practices and share this knowledge with local authorities. Learning from the experiences of other countries can provide valuable insights into what works and what doesn't. Safety professionals can actively participate in the development of road safety policies and advocate for their implementation. They can work with government agencies and non-governmental organizations to push for stricter traffic laws and regulations. This might include advocating for laws related to seatbelt use, helmet use, and the prohibition of mobile phone use while driving. The multiple roles that safety professionals can play in enhancing the road safety is depicted in Figure 4.



4. Recent Policy Initiatives in Road Safety in India

Various policy initiatives have been introduced at the national, state, and local levels to address the issue of Road safety in India. These initiatives aim to reduce road accidents, injuries, and fatalities by improving infrastructure, enforcement, and public awareness. However, the success of these policies depends on effective implementation, law enforcement, and continued efforts to address the multifaceted challenges of road safety in India. Some important policy initiatives in road safety in India:

4.1 Motor Vehicles (Amendment) Act, 2019:

This landmark legislation significantly increased fines for traffic violations, including over speeding, drunk driving, and not wearing seat belts or helmets [16]. It introduced stricter penalties for road offenses to serve as a deterrent and improve compliance with traffic rules.

4.2 National Road Safety Policy (2010):

The National Road Safety Policy outlines a comprehensive framework to improve road safety in India. It includes measures for infrastructure development, traffic management, and road user behaviour. The policy sets ambitious targets for reducing road fatalities [17].

4.3 The National Road Safety Strategy (2019-2030):

This long-term strategy aims to reduce road traffic fatalities by 50% in India over the next decade. It emphasizes five pillars of road safety: road safety management, safer roads and mobility, safer road users, post-crash care, and safer vehicles [18].

4.4 Bharat New Car Safety Assessment Program (BNCAP):

On 22 August 2023 the Bharat NCAP was launched by Union Transport Ministry and will commence from October 2023. BNCAP is on the lines of Euro NCAP and Global NCAP, mandates crash test of vehicles at a speed of 64 km/h, which is the average speed in India, for frontal impacts. Crash test facilities are set up and frequently revised on the official site BNCAP [19, 22]. It aims to enhance vehicle safety standards in India. It mandates safety features in vehicles, such as airbags, anti-lock braking systems (ABS), and electronic stability control (ESC), to improve occupant safety.

4.5 Pradhan Mantri Surakshit Sadak Yojana (PMSSY):

Launched in 2016, PMSSY focuses on making highway road infrastructure safer. It identifies black spots and accident-prone areas and allocates funding for necessary safety improvements, such as better signage and road repairs [20].

Besides, road safety audits, Integrated Traffic Management Systems (ITMS), public awareness campaigns including "Sadak Suraksha Jeevan Raksha" and "Road Safety Week," aiming to create awareness about safe road behaviours, Children's Safety Initiatives like the "School Area Road Safety Assessment and Improvement" (SARSAI), Compulsory Helmet Laws for Two-Wheeler Riders, Compulsory Seat Belt Laws, Strict Drunk Driving Laws etc are other initiatives in place for enhancing road safety.

5. Ultramodern Traffic Management Techniques for Upgraded Road Safety in India

As the world embarks on leading edge initiatives like smart cities and autonomous vehicles, India has shown keenness in the context of modernizing its roads and enhancing safety by adopting intelligent methods for traffic management for advancing its push towards stepping up its road safety indices. This will translate into a significant step towards improving the on-road environment in India. The current Indian regime is earnestly mulling to accelerate the drive to embrace futuristic tools to expand revenue from road transportation, diminish transportation-associated economic losses, curb accidents, synchronize traffic movement, and curtail traffic snarls. Technologies which India has implemented or is researching with an aim to implement such approaches include smart traffic signalling systems, Intelligent Transportation Systems (ITS), Advanced driver-assistance system (ADAS), self-driving cars, advanced surveillance systems using sensors like LiDAR, the Internet of Things (IoT) and mobile and web apps to improve citizen engagement in traffic management.

The intent is to hasten the incorporation of smart tools like predictive analytics through machine learning and other artificial intelligence (AI)-based technologies, centralized cloud-based management of traffic information and databases, secure communication protocols, and quantum computing, specifically in spheres connected with road safety. For this, India has a goal to rapidly overcome bottlenecks such as infrastructure upgradation, data consolidation, and technology integration. With India's own satellite navigation system (IRNSS), an actionable repository of geographical information, especially road-associated data, can be compiled for the use of ITS and AI systems in road management to enhance road safety. IRNSS also shows the potential to help Indian authorities in gathering precise location data to provide a strong base for comprehensive traffic monitoring and for inculcating accuracy in road traffic navigation.

6. Conclusion

Road safety in India demands urgent attention and concerted efforts from various stakeholders. The analysis of major causes reveals complex interplay of human, institutional, external, and aggravating factors contributing to accidents and fatalities. Effective interventions, including public awareness campaigns, stricter law enforcement, infrastructure enhancements, and the involvement of safety professionals, offer promising avenues for improvement. Furthermore, recent policy initiatives demonstrate governmental commitment to addressing this critical issue. However, the success of these initiatives hinges on their effective implementation, law enforcement, and ongoing efforts to tackle the multifaceted challenges of road safety. By adopting a comprehensive approach and fostering collaboration among policymakers, law enforcement agencies, safety professionals, and the public, India can make significant strides towards reducing road accidents and ensuring the well-being of its citizens.

FINANCIAL SUPPORT AND SPONSORSHIP: Nil

CONFLICT OF INTEREST: There are no conflicts of interest.

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Effect of Road Elements on Visual Attention of Drivers on Inter-Urban Roads

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Abstract: In the present study, Eye Tracking is used to study the Gaze Behavior of car drivers on Intern-urban roads in India. The driver's visual patterns are analysed against each attraction/distraction. The study outcomes will help understand the driver behaviour/actions contributing to road crashes. Parameters such as Blink, Saccades, Fixations, Pupil Dilation, and Preview distances have been used to evaluate the impact of different road elements on driver behaviour. Elements like Shops and Advertisement Hoardings are found to be a major source of distraction for drivers. Also, an increase in drivers' fatigue on Monotonous roads is observed.

Keywords: Driver Behavior, Eye Tracking, Gaze behaviour, Fixations, Saccades

1 Introduction

The study of eye movement has been introduced previously. Ibn al Haytam first acknowledged the rapid eye movements during looking at fast-moving objects[1]. In the 1700s, various authors described these quick eye movements by Porterfield, while Wells described them as nystagmus[2]. In 1879, Javal developed a device to measure these eye movements and was the first to distinguish the saccades and fixations. Hartridge and Thompson (1948) created the first eye-tracker in a helmet structure[3]. In 1967, Yarbus expanded the research to oculometry leading to extensive studies of more eye-based parameters[2]. The modern era of eye-tracking began in the 1970s through the ground-breaking studies by Young and Sheena[4]. Since then, eye-tracker use has rapidly increased in every field, including driver behavioural studies using ocular parameters. Kapitaniak et al. (2015) & Kaminski et al. (2012) highlighted that most of the work done had been limited to simulated testing instead of focusing on the on-field variations and numerous possible scenarios and their impact on driver behaviour[5].

1.1 Driving Process and Associated Challenges

Driving is a complex task that is broken down into three steps. Drivers must comprehend the circumstances, make a decision, decisively act and appropriately in light of the circumstances. The most complex and crucial step is analysing the issue, which entails identifying various environmental variables, comprehending their significance, and estimating their future effects. The driver's perception greatly influences the following stages regarding his understanding of the circumstance and, to some degree, their

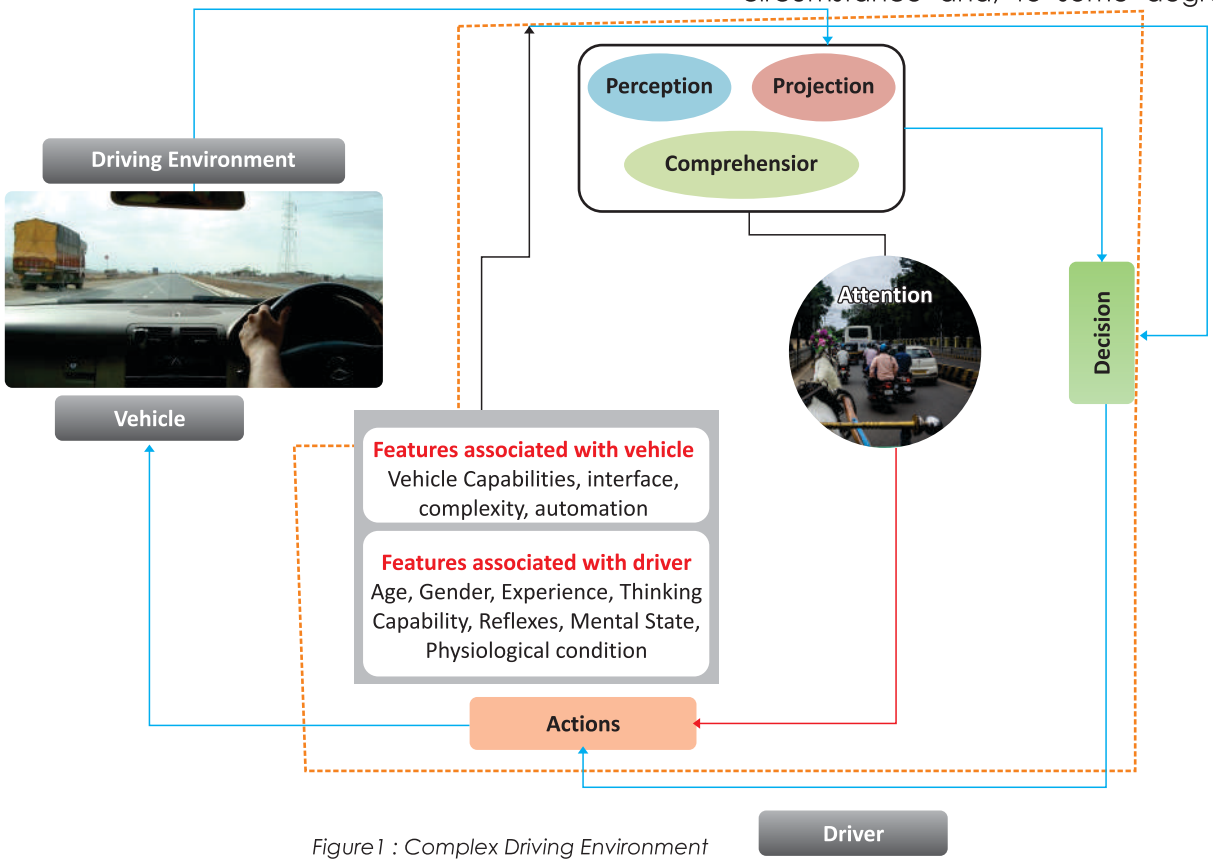


Figure1 : Complex Driving Environment

choice. Because of this, the driver's attention is a crucial factor in determining his/her driving effectiveness and capacity for timely, appropriate action. In complex scenarios, the driver's attention's impact drastically increases to save life and property[6]. briefly shows the complexity of elements in the driving environment. This complexity is often misinterpreted or unstressed due to the lack of understanding towards the interaction of the complex human mind with the driving environment.

2 Drivers' Vision

The expression "window to the soul of a body"—often used to describe the human eye—explains well how the bulk of a person's physiological and psychological conduct is determined. A person's eyes are a significant reflection of his emotional, needs, and physical state, which are vital in determining an individual's behaviour. We use our eyes to perceive knowledge about anything and almost everything we need or want to know, whether or not performing any meaningful act. The importance of eyes has also been established in image detection and video processing through various past studies[7-10].

2.1 Driver's Gaze

Driver's gaze is an essential aspect of studying eye movements and also being able to determine the various parameters like developed stress, perceived information, and ability to make timely decisions of a person. It is vital in increasing generic traffic safety on dangerously life-consuming roads.

2.2 Gaze Tracking

The 18th century was a pivotal time for the growth of interest in gaze studies in the uncharted field of eye tracking. The early eye trackers also included contact lenses with a hole for pupils to detect eye movements[11]. It is found that the subject tends to focus on the relevant areas of any task provided to him rather than gazing all along the visible FOV (Field of View) as we generally expect[12]. In the 1970s and afterwards, eye-tracking research expanded rapidly[13]. The eye-tracking process involves recognising the presence of the eyes, locating them, then following their movement. The pupil or iris centre is generally used to determine the eye's position[14]. A gaze tracker works on localising and tracking the gaze direction[15,16].

3 Data Collection & Methodology

3.1 Study Corridor

The road section selected for the study is a typical interurban highway located in the National Capital Region (NCR) catering to traffic from Faridabad to Gurgaon, it is a four-lane Divided Road passes through the Faridabad-Gurgaon it has a Toll Plaza at Bandhwari, Haryana, three runs were completed. Another road Delhi to Jaipur is National Highway connecting Delhi and Jaipur. To account for variations in traffic characteristics, six runs were conducted on the NH-48 Delhi-Gurgaon Road via the Kherki-Daula Toll Plaza from 38.00 km to a 44.00 km stretch over two different days with Five different drivers.

3.2 Eye Tracking & Tobii Pro Lab Analyzer

Tobii Pro Glasses 2, a head-mounted instrument with an apparent field of view spanning 82 degrees horizontally and 52 degrees vertically, was used to gather and interpret the data. Area of Interest and Time of Interest were developed to explain why drivers' attention patterns change as road segments change. The gaze motions were classified using the IVT Filter at a threshold of 100 degrees per second. All variables, including blink rate, pupil size, head position, and gaze coordinates, were captured using the software at a resolution of 1920 x 1080 at 100 Hz. All Parameters were analysed and segregated with geometry elements, and logged event data were also extracted, marking a Fixation on an Object or occurrence of an event.

4 Data Analysis

4.1 Segmentation of Driver's Field of View

Area of Interest is nothing but a specific area in the Field of Vision of a driver segregated for some desired purpose. Area of Interest (AOIs) allow us to classify gazes based on their purpose by defining particular areas with some significant meaning. Based on various studies, it has been stated that the AOIs allow the researchers to address whether the driver is dedicating excessively or lack of attention to the areas concerning where he is looking and enables us to comment on the rationality of the driver's gaze. Present study the driver field of vision area is divided into 9 AOIs purpose of visit of an area inside the Field of Vision as shown in , all the AOIs summarized below:

1. Frontal vision (FV)
2. Right side mirror (RSM)
3. Left Side Mirror (LSM)
4. Rear View Mirror (RVM)
5. Odometer (ODO)
6. Stereo (STE)
7. Strip above Frontal Vision (SAFV)
8. Right Portion Except for the Mirror (RPEM)
9. The Left Windshield Portion (LWP)

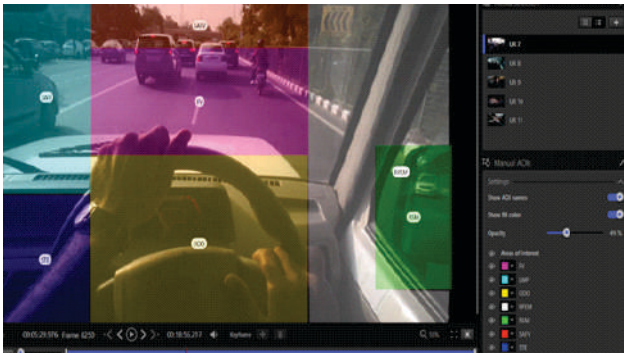


Figure 2: Typical AOIs Created using Tobii Pro Lab Analyser software on 4-Lane Divided Road

Appropriate AOIs and TOIs were marked considering the variations of the purpose of gaze visits and sections of the road which were further segregated among different zones in FOV based on the purpose of gaze. represents the segmented gaze of different AOIs based on the lane configuration of different inter-urban roads.

Table1: AOI Gaze Visit Summary of 4-Lane and 6-Lane Road Sections

AOIs	Total Time (Seconds)		AOIs	AOIs
	4L	6L	4L	6L
FV	2578	2947	95.5	93.7
LSM	2	4	0.1	0.1
LWP	37	71	1.4	2.3
ODO	8	2	0.3	0.1
RPEM	50	73	1.9	2.3
RSM	5	2	0.2	0.1
RVM	1	28	0.1	0.9
SAFV	16	19	0.6	0.6
STE	2	0	0.1	0.0

Table1 of the Gaze Visit summary shows that FV ranging from 93 to 95 present is the dominant AOI. This AOI is frequently called the FOV on the Road Centre (RC) and is anticipated to include the most attention. The proportion of gaze visits in the FV will decline, increasing driver distraction. Compared to 4-lane roads, FV is reduced on 6-lane roads by 93.7%, which indicates that drivers are more distracted on 6-lane roads. Similar visits are recorded in the RPEM for the 6-Lane Road, this value should be as low as possible because driving distractions come from various sources. The driver must make frequent gazes at the mirror areas, such as RSM, LSM, and RVM, to be aware of his surroundings and to be in a position to avoid any potential conflicts. Gaze in ODO regions should also be more to follow the posted speed limits.

4.2 Impact of Road Geometry on Driver's Gaze

Driver's gaze is an essential aspect of studying eye movements and also being able to determine the various parameters like developed stress, perceived information, and ability to make timely decisions of a person. It is vital in improving road safety on increasingly non-forgiving roads.

Table 2 presents a fair distribution of driver gaze while driving on a straight road. However, it also shows the relevant dominance of RPEM and LWP regions while driving at intersections or in queues at intersections due to the presence of crossing pedestrians, signals on both sides and lack of need to be focused entirely on the FV region owing to which the FV reaches to only about a 90 per cent in intersection portion. However, the drivers seem much more aware and reluctant to get distracted, so a massive 97% of gaze concentration is in the FV region while manoeuvring on curve portions. Hence, road geometry plays a vital role in deciding where the driver is concentrating; any changes in particular elements like the radius of the curve, queue length at the Intersection, or Length of Midblock, the dispersion of gaze visits will display much more exaggerated changes in the driver's gaze concentrations. It observed that the driver's gaze is more oriented on the Right Side on the Right Curve sections than its orientation towards the Left side on the Left Curves.

Table 2 : Summary of Driver AOIs Gaze Visit on different road geometry

Type of Road	Straight Road		Road Curve		Road Intersection	
AOIs	Total (s)	%age	Total (s)	%age	Total (s)	%age
FV	3754.38	95.65	184.41	96.68	238.38	90.68
LSM	3.69	0.09	0.64	0.34	0.11	0.04
LWP	55.55	1.42	3.45	1.81	9.49	3.61
ODO	1.75	0.04	0.00	0.00	0.56	0.21
RPEM	62.60	1.59	1.25	0.65	10.86	4.13
RSM	5.60	0.14	0.00	0.00	0.07	0.03
RVM	19.77	0.50	0.24	0.13	1.40	0.53
SAFV	21.79	0.56	0.76	0.40	2.02	0.77
STE	0.07	0.00	0.00	0.00	0.00	0.00

Gaze behaviour on the straight road sections is often more or less bit even distributed over the entire FOV and tends to increase towards the centre of the FOV as the stress increases on the driver. Also, at Intersection, a very hugely spread gaze plot is observed. Table 3 presents the driver gaze pattern at different road geometry.

Table 3 : Summary of Driver AOIs Gaze Visit on different road geometry

Section Number	Geometry Type	Gaze Count Left of CL	Gaze Duration Left of CL	Gaze Count Right of CL	Gaze Duration Right of CL	Gaze Count Below the CL	Gaze Duration Below the CL	Gaze Count Above the CL	Gaze Duration Above the CL
S1	Straight 4L	9.8	4.6	90.2	95.4	1.4	0.6	98.6	99.4
S2	Straight 4L	16.2	14.4	83.8	85.6	0.9	0.5	99.1	99.5
S3	Straight 4L	16.7	12.2	83.3	87.8	0.6	0.6	99.4	99.4
S4	Straight 6L	17.1	18.5	82.9	81.5	0.5	0.3	99.5	99.7
S5	Straight 6L	6.7	4.3	93.3	95.7	0.8	0.5	99.2	99.5
S6	Straight 6L	39.6	34.3	60.4	65.7	72.2	70.4	27.8	29.6
S7	Straight 6L	38.0	35.8	62.0	64.2	62.4	55.3	37.6	44.7
Average		20.6	17.7	79.4	82.3	19.8	18.3	80.2	81.7
I1	Intersection	19.6	8.6	80.4	91.4	0.5	0.4	99.5	99.6
I2	Intersection	35.1	36.4	64.9	63.6	0.6	0.2	99.4	99.8
Average		27.3	22.5	72.7	77.5	0.5	0.3	99.5	99.7
LC1	Left Curve	0.6	0.0	99.4	100.0	0.2	0.0	99.8	100.0
LC2	Left Curve	1.5	0.0	98.5	100.0	1.1	0.0	98.9	100.0
LC3	Left Curve	3.7	0.0	96.3	100.0	0.0	0.0	100.0	100.0
Average		1.9	0.0	98.1	100.0	0.4	0.0	99.6	100.0
RC1	Right Curve	35.7	42.8	64.3	57.2	0.5	0.0	99.5	100.0
RC2	Right Curve	27.4	14.7	72.6	85.3	0.0	0.0	100.0	100.0
RC3	Right Curve	54.3	49.6	45.7	50.4	0.7	0.0	99.3	100.0

Table 3 reflects the difference in Indian Mixed traffic conditions with left-hand side driving compared to the western countries with the right-hand side driving through gaze concentration split among the visual axis in FOV as 20.6% gaze visits in the left while 79.6% in the right side of the visual axis. Also, only 19.8% of visits are below the central visual axis, which reflects the in-vehicle distractions. Most of the gaze visits can be observed in the region above and right of the horizontal and vertical visual axis in the FOV, respectively. Also, while manoeuvring on curves, the gaze samples indicate a complete shift towards the right side of the visual axis while driving on left turns, while only 64.3 of the gaze visits are on the right side of the optical axis while manoeuvring on the right-hand curves. At toll booths, the gaze visits are entirely confined above the central visual axis, while about 75% of gaze visits were in the right domain of the FOV.

5 Conclusion

The critical part where drivers prefer to perform extensive fixations as low as feasible to manage the segment safely has been recognised as curves. It also implies that there shouldn't be any eye-catching features on the curve that don't significantly help the driver. Further research demonstrates that average blink and fixation durations dramatically decrease on curves, which supports the increased danger factor for drivers on curves. Blink Frequency reduces significantly on bends for an experienced driver, and a threshold shall be decided based on further studies on the reasonable sufficiency of driving skills of a driver.

The commercial buildings and hoardings along the road have been found to place a considerable cognitive burden on the drivers, as indicated by pupil dilation when fixating on them. As it can be clearly noticed that the elements are much closely covered in the field of view of a driver on a Four-lane road compared to that of a Six-Lane Road, the preview distances on 4-Lane Road become larger than the 6-Lane Road for the majority of fixations. The Advertisement hoardings, Shops, Pedestrians and Settlements along the road have similar preview distances with Road Signs which is a major concern leading to excessive distractions along the road. Also a very distant preview distant suggest that the Distracting elements are providing a higher cognitive load on the driver for an excessive amount of time.

Gaze behaviour is one of the most essential variables when considering the human component. When the formal learning and training thresholds have been defined and implemented, possible risks can be significantly reduced. The future work would be aimed on establishing the threshold towards safer driving parameters based on the gaze studies.

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Road Safety Considerations for National Highways

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The United Nations has declared the third decade of this century, 2021 to 2030, the 'Decade of Action for Road Safety'. The UN aims to improve global road safety by 2030, with the ambitious target of preventing at least 50% of road traffic deaths and injuries.

The UN Sustainable Development Goals (SDGs) have incorporated road accidents as a parameter for sustainable development. SDG 3.6 sets the goal of halving the number of global deaths and injuries from road traffic accidents by 2030. Similarly, SDG 11.2 aims at providing access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older people.

Deaths in road accidents are a serious national loss for India. Road Traffic Crashes (RTCs) are the largest cause of deaths due to unintentional injuries in India, contributing to 43.7% of fatalities. National Highways comprising 2.1% of the total road length caused 45 deaths per 100 km of road length in 2022. Over-speeding is by far the single largest cause of deaths on national highways. Driving on the wrong side and driving in inebriated conditions are the two other important causes. Two-thirds of the road accident fatalities happen in rural areas with over 80% of the victims being males. Non-motorised road users such as pedestrians and cyclists as well as motorcyclists and persons with disabilities or reduced mobility and orientation are called Vulnerable Road Users (VRU). The VRUs are often victims of road accidents.

Scientifically designing and building roads and improving behavioural aspects of drivers and VRUs are two important aspects in the prevention of road accidents. Road maintenance plays an important role in accident prevention.

Some of the important aspects of geometrical design that have a bearing on the incidents of road accidents are as follows:

Road Curve Radii: Horizontal curves should be designed considering the centrifugal force the turning vehicle will experience. Superelevation and grip between the road surface and the tyre play an important role in this design. Superelevation is a function of road horizontal alignments, design speed, natural conditions and curve radius. It is the traverse slope that is designed as higher on the outer side and lower on the inner side. Good engineering practice is to provide the superelevation traverse slope between 2.0 % to 3.0 %.

Another important aspect of road curve design is the visibility. This becomes important in hilly terrain where the number of lanes on either side is less, and the gradient compromises the manoeuvrability of the vehicles. The smaller the curve radius, the higher the possibility of accidents to occur on roads.

Road Gradients: Roads with steep gradients were found to be related to higher accident rates. Often, the judgemental error of the driver is the cause of the accident. Incorrect gear placement on an upward slope, vehicle accidentally reversing or skidding back despite the hand break on an upward slope and driver losing control on a downslope due to excess acceleration are the prime reasons for these accidents.

Lane Configurations: Accident investigations indicate a positive correlation between the number of lanes and accidents. Lane width may have an impact on the accident propensity of a road. Wider lanes provide comfort to the driver resulting in higher vehicle speed causing accidents. A lane width of 3.5 m to 3.6 m is optimal.

Sight Distance: Inadequate sight distance can cause higher accident rates as it is related to the reaction and decision to be taken by the driver to handle and deal with any unforeseen circumstances or objects which the driver may encounter on the roadway. Sight distance is known as the carriageway's visible distance that can be seen and recognized on both vertical and horizontal planes by vehicle drivers.

Shoulder Width: Shoulders are used as a free space to allow vehicles on roads to stop out of the main road traffic flow for vehicle break-down incidences or other emergencies. In case of control loss over the vehicle, shoulders are used as a backup carriageway to take back vehicle control. Crash barriers along the road and trees planted along the road (avenue plantation) have a bearing on the severity of accidents.

Median Width and Type: Road medians maintain directional traffic separation. A properly designed first lane and median can provide space for a temporary halt and right turn or clockwise U-turn. Illegal median breaking significantly increases accident risk. A median width of 4 m is found to reduce accident risk. Indian Road Congress (IRC) has prescribed median width as per the number of lanes for roads designated as national highways and expressways. IRC has stipulated the height and variety of median plantations as per the road category and width of the median.

Some of the important aspects of road maintenance that have a bearing on the incidents of road accidents are as follows:

Signages: Maintenance of signboards and road furniture is important, ensuring that the reflectivity of the boards is adequate such that the signboard is legible during foggy conditions, haphazard growth of

vegetation at times may cover critical information on the sign boards. Drivers may suddenly slow down to read not so visible board causing collision from the vehicles in the same lane.

Lane Markings: Lane marking, delineators are important to keep the vehicle safely within the demarked lane. Worn-out lane marking and zebra crossings, non-visible indications for speed breakers and curb stones will lead to accidents.

Road Furniture: Maintenance of road furniture is important to reduce the probability of an accident and in case of an accident, severity of damage. Improper riveting and inadequate lapping at the joint of the crash barrier may not be able to withstand the impact of a collision, hanging signals or signage poles pose a threat to vehicles speeding on the carriageway. Stray lane separators scattered across lanes invites accidents.

Signal Lights and Street lights: Cross sections and grade separators have signal lights, warning lights and diversion indicators where road construction is in progress. Incorrectly operating signal lights cause accidents. At major intersections, adequate illumination and visibility are essential at nighttime. High mast lighting and higher power streetlights prevent dark spots which in turn can prevent accidents.

Carriageway and Alignment: The propensity of accidents due to potholes on the carriageway is well known. National highways are not supposed to have speed breakers but, in some cases, inappropriately laid carriageways act as speed breakers causing accidents. Inappropriately merging traffic at junctions where small village or state roads meet national highways perpendicularly leads to accidents.

Behavioural aspects are associated with road accidents in two ways, i.e. causes of accidents and ways to prevent them. Some of these aspects are discussed below:

Drunken driving: Drunken driving is by far the largest behavioural aspect of road accidents. Motor Vehicle Act has provided for severe punishment for drunken driving though it is yet to prove as an effective deterrent.

Sleep deficiency: To earn extra money, some drivers exert their bodies beyond their capacity during tourist season and freight season. The highest number of accidents have been reported early morning 3 am to 5 am.

Wrong Side Driving: One of the social impacts of road development is that the linear barrier created by the highway causes the local population to take detours to reach places where people must travel longer distances. This prompts them to drive in the wrong direction causing accidents. In western Maharashtra's sugarcane belt, tractor trolleys carrying huge piles of sugarcane are driven in the wrong direction causing accidents and road blockages.

Behavioural interventions for accident prevention: Black spots where frequent accidents happen on national highways are identified by the authorities. Road junctions, grade separators, narrow bridges, etc. where vehicles are expected to slow down, behavioural scientists have used pictures of panicked persons at a frequency adjusted for the design speed of the road for about 300 m prior to the black spot. In some cases, truck owners are requested to paint a social message on the rear side of the truck that reminds the driver following the truck about the importance of safe driving. Tata and Mahindra have conducted behavioural studies to design verbal warnings to alert drivers about road mirage and road fatigue. In these studies, a camera tracked the pupil and eyelid movement of the driver to assess his behaviour.

As seen from the above discussion, multiple aspects cause road accidents. Stakeholders ranging from road designers, construction contractors, operations and maintenance contractors, vulnerable road users and long-distance freight and passenger service drivers may contribute to both accidents and prevention. Awareness generation among all stakeholder groups is the key to effectively reducing road accidents and fatalities. As responsible citizens, we all have this responsibility to generate awareness about the causes of road accidents and contribute to reducing property damage and loss of life.

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Transportation of Hazardous Chemicals

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Abstract:

Road Safety in Transportation of Hazardous Chemicals. A lot of substances and items are transported by road, sea, rail and air every day. The biggest hazard is created by the transportation of hazardous substances with flammable, or toxic properties. The hazard level increases if such substances are transported through densely populated areas. Traffic intensity, the technical condition of vehicles, drivers' errors or ignorance and non-compliance with legal regulations are examples of factors that can lead to potential failures in the transport sector. Accidents can cause an uncontrolled release of dangerous gases or liquids, resulting e.g. in environmental degradation or a hazard to humans. The article presents the issues related to the hazards presented by road transportation of hazardous materials. Examples are shown of potential effects of accidents and hazard zones arising due to a release of selected hazardous substances, such as chlorine, ammonia, petrol, diesel oil or LPG, etc.

Methods of Chemical Transportation



1 Understand the complexity in transportation of Hazardous chemicals

Understanding Hazardous Chemicals in Transport.	Risks and Consequences of Poor Safety in Transportation	Regulatory Framework for Road Safety in Transportation	Best Practices for Ensuring Road Safety	Technological Innovations for Improving Road Safety
• Chemicals are classified into various categories based on their physical, chemical, and biological properties. • Flammable substances (e.g., gasoline, propane, • Corrosive materials (e.g., acids or bases) or materials. • Toxic substances (e.g cyanides) that can cause death or serious health effects when inhaled, ingested, or absorbed through the skin. • Explosives (e.g., dynamite) that can result in dangerous reactions, often with catastrophic effects. • Radioactive materials (e.g., uranium, radium) that emit harmful radiation.	• Some of the Risks include: • Spills and Leaks. • Fires and Explosions • Toxic Exposure. • Impact on Wildlife and Ecosystems. • Public Safety	• The European Union (EU) ADR Agreement: The Accord européen relatif au transport international des marchandises dangereuses par route (ADR) • The United Nations (UN) Globally Harmonized System (GHS) • The US Department of Transportation (DOT) • Occupational Safety and Health Administration (OSHA) • International Maritime Dangerous Goods (IMDG) and International Civil Aviation Organization (ICAO) • Hazardous waste transportation rules	• Proper Training and Certification of Drivers. • Proper Vehicle and Equipment Maintenance. • Appropriate Packaging and Labeling. • Route Planning and Traffic Management. • offsite Emergency Response Plans. • Technology and Automation. • TREM CARD Availability • Communication to local authorities. • Maintain spill control management and secondary containment provision along with the vehicle • Fire suppression system availability with the vehicle	• Real-time monitoring systems. • Automated braking and collision avoidance systems. • Telematics and GPS. • Real time monitoring of driver behaviors through AI tools.



2 Challenges and future Outlook

While significant progress has been made in improving road safety for hazardous chemical transport, challenges remain:

Human error: Despite rigorous raining, human error remains a significant factor in accidents. Continuous efforts to improve driver training, safety culture, and regulations are crucial.

Infrastructure limitations: Some roads may not be suitable for heavy or specialized vehicles, posing a challenge to effective route planning.

Climate change: Extreme weather conditions, such as floods, heatwaves, and storms, can create unpredictable hazards for the transportation of chemicals, requiring adaptive strategies.

In the future, autonomous vehicles and the use of more sustainable transportation methods (such as rail or pipelines) may help reduce risks. Continued innovation in safety technology, stricter enforcement of regulations, and better risk management practices will further enhance safety.

Conclusion:

The transportation of hazardous chemicals by road presents significant risks, but through rigorous safety measures, proper training, technology, and regulatory oversight, these risks can be managed effectively. As global industries grow and the need for hazardous chemicals expands, the implementation of robust safety practices and emergency protocols will remain essential for safeguarding the public, environment, and workers involved in this vital part of the supply chain.



3 Transport Emergency (TREM) Card

Emergency Contact Number :		
SAFETY & EMERGENCY INFORMATION:		
(i)	PRODUCT NAME	--
(ii)	SYNONYM	--
(iii)	CAS NO.	--
(iv)	HAZARDOUS INFORMATION & PICTOGRAMS	--
(v)	SIGNAL WORD	--
(vi)	HANDLING INSTRUCTION	--
(vii)	PRECAUTIONARY NOTES TO DRIVERS / CLEANERS	--
(viii)	FIRST AID	--
(ix)	FIRE PROTECTION	--
(x)	SPILL HANDLING	--
(xi)	NOTE	--



4 The Offsite transportation requirements involve proper awareness about:

Container: This shall be appropriate leak-proof material with mechanical stability.

Labelling of the Container: To identify the chemical, describe the possible hazard and the remedial measures/first –aid required in case of accidental spills.



Transportation of vehicle: To identify the chemical displaying the telephone number of the contact person / controlling agency in case of emergency; etc. Through labelling.

Transporter Selection: To have technical competence and the relevant skills and other requirements.

License: To carry application and No objection certificate documents are relevant licenses.

Emergency Procedure: To have knowledge about actions to be taken in case of spills or accidents.

Reference:

IS 18149:2023, provides guidelines on classification, packaging, labelling and marking, handling, documentation, role of stakeholders, training, transportation, emergency action and provisions for segregation.

Transportation of Hazardous material shall be under Central Government under the rules Motor Vehicles Act, 1988.



* * *

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Earth Clamp (SS 304) with Visual Indication (Spiral Cable 5/10 Mtrs.Length) Model No.: ECVI-0912



Electro Static Discharge Touch Pad Model No.SDTP-0223



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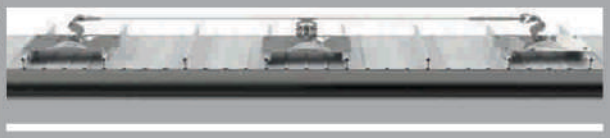
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Training Vs. Monitoring – The Synergy

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"Quality control not only begins but also ends with training. Monitoring enhances quality and improves performance".

This article is pertaining to only drivers of long-haul trucks, giving an overview of training and monitoring. Training drivers and monitoring them are the two pillars for improving driver quality. The quality of drivers is a crucial determinant of road safety, transportation efficiency, and the well-being of all road users. To elevate the standard of driving, two complementary approaches stand out: 'training and monitoring'. While training equips drivers with the necessary skills and knowledge, monitoring ensures the consistent application of those skills in real-world scenarios. These two aspects, though distinct, work in tandem to create a culture of responsible and proficient driving.

1 Training Drivers: Building necessary Foundation

Training is the first step in shaping competent drivers. It involves teaching individuals the rules of the road, the mechanics of operating a vehicle, and the ethical responsibilities of driving. Effective driver training programs go beyond basic instruction and focus on creating a well-rounded understanding of driving practices. For instance, new drivers must learn the theoretical aspects of traffic laws and the practical skills of manoeuvring vehicles under various conditions. Advanced training programs for professional drivers may include defensive driving, fuel-efficient driving techniques, and how to handle emergencies. Simulation-based training and real-world supervised practice sessions further enhance learning by exposing drivers to diverse scenarios. Good training not only builds technical proficiency but also instils a sense of responsibility. Drivers who understand the consequences of reckless behaviour, such as speeding or distracted driving, are more likely to prioritize safety over convenience. Furthermore, training programs tailored to specific needs, such as for bus drivers, delivery personnel, or heavy vehicle operators, help address the unique challenges of different driving roles and meeting work deadlines.

2 Monitoring Drivers: Ensuring Accountability

Training, while essential, is not enough to ensure quality driving in the long term, it has to be substantiated with monitoring. Once a driver is on the road, continuous monitoring becomes critical. Monitoring ensures that the skills and principles imparted during training are applied consistently and effectively. It also identifies gaps in performance and areas that require improvement. Driver monitoring encompasses a range of strategies, from manual supervision to the use of advanced technology. For professional drivers, telematics systems track parameters like speed, braking patterns, and fuel usage, providing insights into driving behaviour. Dashcams and GPS systems enable real-time monitoring, ensuring that drivers adhere to regulations and avoid unsafe practices.

For highway drivers, periodic checks such as driving record reviews or refresher courses help maintain high standards. Behavioural monitoring, such as observing how a driver interacts with other road users, is another critical aspect. Monitoring is not only a tool for accountability but also a mechanism for feedback. Drivers can use data from monitoring systems to self-assess and make improvements, fostering a culture of self-discipline.

3 The Interdependence of Training and Monitoring

While training and monitoring are distinct, their effectiveness is maximized when they complement each other. Training lays the groundwork by imparting essential skills, while monitoring reinforces and refines these skills over time. Together, they create a cycle of continuous improvement.

For example, a driver who has undergone thorough training may still develop bad habits over time, such as texting while driving. Regular monitoring can detect these behaviours early and trigger corrective measures, such as counselling or additional training sessions. Conversely, monitoring data can help design training programs, highlighting common issues and areas requiring greater emphasis.

The synergy between training and monitoring is particularly important in professional settings. Fleet operators, for instance, can use monitoring systems to evaluate driver performance and reward safe practices. This approach not only improves driving standards but also boosts morale and fosters a sense of responsibility among drivers.

4 Methods of Training and Monitoring

1. Identifying potential hazards: Skilling drivers to recognize potential hazards like pedestrians, cyclists, blind spots, oncoming traffic etc.
2. Assessing and managing risk: Teaching drivers to assess the level of risk involved in overtaking and taking steps to manage that risk, such as slowing down or cancelling the overtaking manoeuvre.
3. Classroom instruction: Providing classroom instruction on safe overtaking techniques, hazard perception, and risk management.
4. Simulator training: Using driving simulators to practice overtaking manoeuvres in a safe and controlled environment.
5. On-road training: Providing on-road training with a certified instructor to practice safe distance

keeping, overtaking manoeuvres in real-world scenarios etc.

6. Feedback and assessment: Making drivers demonstrate their learnings. Providing feedback and assessment on drivers' and use this as a tool for ensuring quality conscious, productive drivers.

5 Benefits of Training

The responsibility of assessing a driver's capabilities does not end with their appointment. Training is a critical step in equipping drivers with the skills and knowledge needed for their specific roles. However, the effectiveness of training must also be measured, and psychometric assessments play a vital role in this process. Improving driver quality is not a one-time effort but a continuous process that requires a balance between training and monitoring. Training offers numerous benefits for truck drivers, enhancing their safety, efficiency, and overall job performance.

Here are some key advantages:

- **Enhanced Safety:** Training equips drivers with the knowledge and skills to operate large vehicles safely, reducing the risk of accidents and injuries. It covers topics such as defensive driving techniques, hazard perception, and emergency response procedures.
- **Improved Efficiency:** Training can help drivers optimize their routes, improve fuel efficiency, and minimize downtime. This leads to cost savings for both drivers and trucking companies.
- **Increased Revenue Potential:** Skilled and experienced drivers are assets to companies and can bring productivity and revenue.
- **Reduced Stress and Fatigue:** Training can help drivers manage stress and fatigue, which are common challenges in the trucking industry. Techniques such as stress management and sleep hygiene can improve driver well-being and reduce the risk of accidents.
- **Career Advancement:** Training can open doors to career advancement opportunities for truckers, such as specialized driving roles (e.g., hazmat, oversize loads) or supervisory positions.
- **Legal Compliance:** Training ensures that drivers are up to date with the latest regulations and industry best practices, helping them avoid costly fines and legal issues.
- **Enhanced Job Satisfaction:** Training can make driving more enjoyable and fulfilling by providing new challenges and opportunities for growth.

By investing in training, truck drivers can significantly improve their safety, efficiency, and overall job satisfaction, while also contributing to a safer and more efficient transportation system.

6 Training Solutions

1. **Defensive Driving Courses:** Defensive driving courses can teach drivers how to anticipate and respond to potential hazards, including blind spots.
2. **Blind Spot Awareness Training:** Specific training programs can be designed to raise awareness about blind spots and teach drivers how to check their blind spots effectively.
3. **Mirror Adjustment Training:** Training can be provided on how to adjust mirrors properly to minimize blind spots.
4. **Behind-the-wheel training:** Provide drivers with on-road training, where they can practice braking and steering techniques in a real-world setting.
5. **Driver Education Programs:** Training programs can incorporate technology, such as simulators or virtual reality, to teach drivers about reaction time management and safe driving practices.

Post-Training Assessments: Measuring Progress and Effectiveness vide technology

After training, evaluations (monitoring vide camera or telematics) can be used to determine whether drivers have developed the cognitive and situational skills required for safe and efficient driving. For instance, has a defensive driving course improved their ability to anticipate and avoid potential hazards? Have stress management techniques been taught during training helped them remain calm under pressure? Does the driver resort to frequent braking? These questions can only be answered through targeted assessments and monitoring devices. Vehicles can be equipped with driver assistance systems that provide alerts and warnings to drivers about potential hazards, including blind spots.

7 Benefits of Monitoring

Monitoring truck drivers offers significant advantages. By tracking driver behaviour, companies can identify and address risky habits, leading to enhanced safety and accident reduction. Real-time location tracking enables efficient route optimization, minimizing travel time and fuel consumption. This leads to lowering the operational costs and increasing the on-time deliveries. Furthermore, monitoring helps ensure compliance with regulations, such as hours-of-service limits, and provides valuable data for driver performance evaluation and improvement. While respecting driver privacy is crucial, these benefits contribute to a safer, more efficient, and more profitable trucking industry. Monitoring will be an advantage to post-training evaluations, that will

ensure that drivers are not only theoretically aware of how to handle emergencies but are also practically capable of doing so. This is particularly important for drivers in high-stakes roles, such as ambulance drivers, school bus operators, and long-haul truckers, chemical laden carriers where even a single error can have catastrophic consequences. Feedback systems can be implemented to provide drivers with feedback on their driving habits, including their ability to detect and respond to weather conditions.

8 Challenges faced by Monitoring

Despite their importance, monitoring does face challenges. Monitoring, on the other hand, can be perceived as invasive, leading to resistance from drivers. Technology can also enhance training through virtual reality simulations and online learning platforms, but this may be an expensive proposition that companies are not ready for. Transparency and fairness are key for monitoring and any wavering in these aspects can damage trust factor. Using monitoring for the right purpose is key and drivers should be informed about the purpose of monitoring and how the data will be used, without causing insecurity in their minds. Strategic moves such as incentives, rather than punitive measures must be adopted to encourage compliance and cooperation. Some drivers may perceive monitoring as intrusive or unnecessary, leading to resistance which in turn would have a cascading effect on retention.

9 Recommendations

It is highly recommended to inculcate or instil cognitive Skills and situational brilliance which is the core of safe driving.

Driving is a cognitively demanding activity that requires continuous mental engagement. Drivers must process a multitude of inputs, including traffic signals, the behaviours of other road users, and the condition of the road itself. Situational brilliance—the ability to quickly analyse a situation and make the right decision—is especially critical in emergencies, such as a pedestrian suddenly stepping onto the road or a vehicle unexpectedly swerving into their lane. Psychometric assessments are recommended as they are designed to evaluate the relevant skills. For instance, tests measuring reaction time, attention span, and multitasking ability can predict how well a driver will respond to sudden situations. Similarly, problem-solving and decision-making tests assess a driver's ability to evaluate risks and choose the safest course of action. Addressing road rage is a vital aspect of safe motoring which is mostly a result of frustration in truck drivers. Training can play a significant role in helping drivers develop safe and responsible overtaking habits. By combining technology and training, drivers can be better equipped to manage roll overs and reduce the risk of accidents.

10 Conclusion

While technology can provide valuable tools for hazard detection, it's not a substitute for proper driver training. Fostering a work environment where drivers feel comfortable reporting mistakes and near-misses is essential for continuous improvement. Analysing driver performance data can help identify common mistakes and tailor training scenarios to address them effectively (route, vehicle application, cargo loading pattern etc) Encouraging active participation from drivers in the training process allows them to share experiences and learn from each other. Regularly evaluating and refining training programs ensures they remain relevant and address evolving safety challenges. In addition to training, it's also important for long-haul truck drivers to have a basic understanding of vehicle mechanics. Familiarity with concepts like torque, centre of gravity, gradability, and power-to-weight ratio can help them appreciate the capabilities and limitations of their trucks. Modern trucks are complex machines that require careful operation, unlike their simpler predecessors. Therefore, investing in regular training modules with a follow-up system to assess knowledge retention is crucial for ensuring driver safety and overall operational efficiency, especially when it comes to transporting perishables.

In conclusion, a combination of robust training programs and effective driver monitoring systems is essential for ensuring the safety and efficiency of the trucking industry. By investing in these areas, companies can cultivate a safer driving culture, reduce accidents, and improve overall operational performance, besides facilitating 'quality & compliance'.

The driver on the highway is safe not with technology alone but coupled with Responsibility.

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* * *

Causes of Road Accident

SANDEEP N. DHAMONE, Dy. Director, National Safety Council, Navi Mumbai, Maharashtra, Email: sndhamone@nsc.org.in

Road accidents are multi-causal and are the result of interplay of various factors. These can broadly be categorized into those relating to (1) Human error, (2) Road environment and (3) Vehicular condition.

These factors act in an interactive manner to cause road accidents. Any strategy for designing the counter measures for accidents should therefore be based on a safe systems approach which simultaneously recognizes the importance of traffic legislation for promoting safe road user behaviour, safe road designs (lane width, shoulder presence, number of lanes, median, vehicle design, etc) and safe vehicle design.

"Traditionally, for any accident or crash, the major causes could be 'driver/human', 'road infrastructure' or 'vehicle-related factors'. Sometimes, there might be combinations of these factors which might lead to accidents. Among these major factors, 'driver/human'-related factors or errors dominate," said Nagendra R Velaga, associate professor (transportation systems engineering), department of civil engineering, Indian Institute of Technology (IIT), Bombay.

Examples of such human/driver factors include — rash driving, fatigue/sleep deprivation (particularly for long-haul truck drivers), speeding (due to certain reasons like time pressure or time constraints to reach the destination), on-board distractions (eg: using digital devices such as mobile phones while driving), driving under influence of alcohol and drugs, among other, said Velaga. (PUBLISHED ON OCT 25, 2020 12:13 AM IST in Hindustan times for details visit this link) https://www.hindustantimes.com/mumbai-news/india-had-most-deaths-in-road-accidents-in-2019-report/story-pikRXxsS4hptNVvf6J2g9O.html

1 Human Error

Accidents caused by human error include (i) cases of accidents caused by traffic rule violations, (ii) driving without valid driver license and (iii) non-use of safety devices.

1.1 Traffic rules violations

Road accidents during 2021 and 2022 attributable to various types of traffic rules violations is given in Table 1.1.

Table 1.1: Road accidents by type of traffic rules violation during 2021 and 2022

Sl. No.	Traffic Rules Violation	Number of Accidents	Persons Killed	Persons Injured	% change in 2022 over 2021		
					Number of Accidents	Persons Killed	Persons injured
1	Over-speeding	3,33,323 (2,95,522)	1,19,904 (1,07,236)	3,22,795 (2,80,285)	12.8	11.8	15.2
2	Drunken driving/ consumption of alcohol & drugs	10,080 (9,150)	4,201 (3,314)	8,809 (7,509)	10.2	26.8	17.3
3	Driving on wrong side/ Lane indiscipline	22,586 (21,491)	9,094 (8,122)	21,745 (20,351)	5.1	12.0	6.8
4	Jumping red light	4,021 (2,203)	1,462 (679)	3,450 (1,905)	82.5	115.3	81.1
5	Use of Mobile Phone	7,558 (6,530)	3,395 (2,982)	6,255 (5,394)	15.7	13.8	16.0
6	Others	83,744 (77,536)	30,435 (31,639)	80,312 (69,004)	8.0	-3.8	16.4
Total		**4,61,312 (4,12,432)**	**1,68,491 (1,53,972)**	**4,43,366 (3,84,448)**	**11.9**	**9.4**	**15.3**

Note: figures in brackets are related to year 2021.

1,19,904 person killed in 2022 due to Over-speeding		https://www.youtube.com/watch?v=mvKzur1p6ic
4,201 person killed in 2022 due to Drunken driving/ consumption of alcohol & drugs		https://www.youtube.com/watch?v=2ZjTx509cYo
9,094 person killed in 2022 due to Driving on wrong side/ Lane indiscipline		https://www.youtube.com/watch?v=RCaNah5tyNk
1,462 person killed in 2022 due to Jumping red light		https://www.youtube.com/watch?v=SblE95b_IwY
3,395 person killed in 2022 due to Use of mobile phone while driving		https://www.youtube.com/watch?v=YrgemIuYRKM

Please scan above QR code to watch such type road accident.

Road accidents attributable to various types of traffic rules violations reveals that 'over speeding' constitute the main violation associated with accidents, fatalities and injuries, in 2022.

During 2022, 'over speeding' accounting for 72.3 percent of the total road accidents, 71.2 percent of total deaths and 72.8 percent of total injuries. The number of accidents, fatalities and injuries due to "over speeding" increased by 12.8 percent, 11.8 percent and 15.2 percent respectively

in 2022 relative to 2021 (Table 1.1). 'Driving on wrong side' was the second highest cause of the total road accidents during 2022 accounting for 4.9 percent. What is most significant is that in 2022, accidents, deaths and persons killed on account of over speeding, drunken driving, jumping red light using mobile phone, all registered an increase compared to 2022 which underlines the need for stricter enforcement of the Motor Vehicle Act.

1.2 Driving without valid driver license

Vehicles driven by untrained and unqualified drivers are a serious traffic hazard and can cause accidents, death and injuries. Though the problem is basically an enforcement issue, it must also be addressed with better facilities and opportunities for training/skilling and evaluation/testing.

The details of road accidents involving drivers without valid license and learner's license is presented in Table 1.2.

Table 1.2: Road accidents by type of license – 2021 to 2022

Sl.No.	Type of Licence	No. of accidents	% change in 2022 over 2021
1	Valid driving licence	3,20,235(2,90,261)	10.3
2	Learner's licence	18,298(19,184)	-4.6
3	Without valid licence	35,925(37,182)	-3.4
4	Not known	86,854(65,805)	32.0
Total		**4,61,312 (4,12,432)**	11.9

During 2022, road accidents involving drivers with learners' license and without valid license together constituted 11.8 per cent of total accidents (Table 1.2). The number of accident cases involving drivers without valid driving license had reduced from 37,182 in 2021 to 35,925 in 2022, registered a decline of 3.4 percent corresponding to same period last year.

Accidents involving learner's license reduced from 19,184 in 2021 to 18,298 in 2022, registering a reduction of about 4.6 percent over 2021. It may be seen that in 69.4 percent of the road accidents cases, the drivers were having valid driving licenses.

1.3 Non use of safety devices – Helmets and Seatbelts

Non usage of safety devices such as helmets and seatbelts do not cause accidents but are critical for averting fatal and grievous injuries in the event a road accident occurs. As per data received from States/UTs, the accident related deaths on account of Non-use of Helmets and Seat Belts at the All India level are summarized in the Table 1.3 below.

Table 1.3: No of persons killed due to non-use of safety devices (helmets and seat belts) during 2021 – 2022

Sl.No.	Non-use of safety devices	No. of person killed		% change in 2022 over 2021	
		Drivers	Passengers	Drivers	Passengers
1	Helmets	35,692 (32,877)	14,337 (13,716)	8.56	4.52
2	Seatbelts	8,384 (8,438)	8,331 (7,959)	-0.63	4.67

Non-usage of safety devices such as helmets and seat belts are critical for averting fatal and grievous injuries in the event of road occurrence accidents. Helmets are mandatory for all motorists on two-wheelers, barring few exemptions.

During 2022, a total of 50,029 persons were killed who were not wearing helmet, of which 35,692 (71.3%) persons were drivers and 14,337 (28.7%) were passengers. Similarly, for the same period, 16,715 persons were killed who were not wearing seat belt. Out of 16,715, 8,384 (50.2%) were drivers and remaining 8,331 (49.8%) were passengers (Table 1.3). The table 1.3 reveals that 1,01,891 persons who got injured in road accidents, were not wearing helmet and 42,303 persons injured in road accidents were not using seat belt in 2022.

The causes related to the category of road environment include (i) accidents happening in a particular geographical area (residential, commercial institutional etc), (ii) those related to the type of road features including straight, curved, steep etc, (iii) type of junction & type of traffic control, (iv) weather condition etc.

2.1 Road Accidents classified by Type of neighbourhood

Accident by type of neighbourhood (Residential area , institutional area and market/ commercial area, open area etc) at the All India level are summarized in the Table 2.1.

Indicators of neighbourhoods reveals that, there was an increase in number of accidents, fatalities and injuries in 2022 relative to 2021 (Table 2.1). Residential area, institutional area and market/ commercial area tend to have traffic congestion and hence, higher exposure to road accidents. The data for 2022, however, reveal that 47.7 percent of accidents, 55.1 percent of death and 48.2 percent of injuries occurred in open area, i.e., locations which normally do not have any human activities in the vicinity (Chart 3.3). Residential area was in the second place with 18.7 per cent of total accidents, and 17.8 per cent of total fatalities and 17.8 percent of total injuries. Market/ commercial area accounted for 14.3 per cent of total accidents and 11.8 percent of fatalities.

Institutional area accommodating institutions such as schools, colleges, hospitals or large government establishments also tend to have traffic congestion on account of vehicular and pedestrian traffic. The share of accidents occurring in institutional area in the total accidents is lower than expected. It may be explained in terms of better enforcement of traffic rules in residential, institutional and commercial areas. Open areas, normally, would be expected to have a lower enforcement presence, thereby prone to dangerous driving and traffic rules violations.

2.2 Road Accidents classified by road features

Accident by type of Road features at the All India level for 2021-22 are summarized in the Table 2.2 .

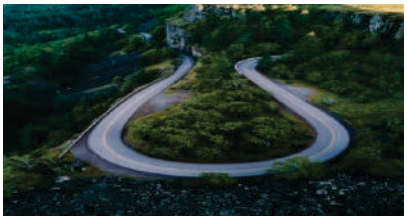
Table 2.1: Accident classified by type of neighbourhood (Residential area, institutional area and market/ commercial area, open Area etc) at the All India level for 2021-22

Sl.No.	Type of neighbourhood	Total Accidents	Persons killed	Persons Injured	% change in 2022 over 2021		
					Total Accidents	Persons killed	Persons Injured
1	Residential Area	86,292 (76,791)	29,950 (26,921)	78,906 (69,725)	12.4	11.3	13.2
2	Institutional Area	29,384 (28,167	10,223 (9,754)	28,452 (26,150)	4.3	4.8	8.8
3	Market/ Commercial area	66,125 (57,855)	19,950 (17,656)	61,335 (53,237)	14.3	13.0	15.2
4	Open Area	2,19,988 (1,93,273)	92,772 (83,489)	2,13,878 (1,80,438)	13.8	11.1	18.5
5	Others	59,523 (56,346)	15,596 (16,152)	60,795 (54,898)	5.6	-3.4	10.7
Total		**4,61,312 (4,12,432)**	**1,68,491 (1,53,972)**	**4,43,366 (3,84,448)**	**11.9**	**9.4**	**15.3**

Table 2.2: Accidents, Persons killed and injuries by road feature – 2021 – 2022

Sl. No.	Road feature	Number of Accidents	Persons Killed	Persons Injured	% change in 2022 over 2021		
					Number of Accidents	Persons Killed	Persons injured
1	Straight road	3,09,247 (2,78,218)	1,11,815 (1,02,623)	2,97,694 (2,59,402)	11.2	9.0	14.8
2	Curved road	54,593 (49,581)	20,573 (19,120)	55,866 (48,888)	10.0	8.0	14.0
3	Bridge	14,111 (12,709)	6,258 (5,337)	13,062 (11,546)	11.0	17.3	13.1
4	Culvert	7,384 (6,663)	3,473 (2,960)	6,309 (6,029)	11.0	17.0	5.0
5	Potholes	4,446 (3,625)	1,856 (1,481)	3,734 (3,103)	22.6	25.3	20.3
6	Steep grade	4,475 (3,967)	2,056 (1,635)	4,089 (3,398)	13.0	26.0	20.0
7	Ongoing road works /Under construction	9,211 (9,075)	4,054 (4,014)	7,955 (7,539)	1.5	1.0	5.5
8	Others	57,845 (48,594)	18,406 (16,802)	54,657 (44,543)	19.0	10.0	23.0
Total		**4,61,312 (4,12,432)**	**1,68,491 (1,53,972)**	**4,43,366 (3,84,448)**	**11.9**	**9.4**	**15.3**

Road accident by Road feature examples:

1,11,815 person killed in 2022 on Straight road		1,856 person killed in 2022 on Potholes	
20,573 person killed in 2022 on Curved road		2,056 person killed in 2022 on Steep grade	

6,258 person killed in 2022 on Bridge		4,054 person killed in 2022 on road near to On-going road works/ Under construction	
3,473 person killed in 2022 on Culvert			

Road features such as sharp curves, potholes and steep grade tend to be accident prone because it may require skill, extra care and alertness to negotiate these road features. During 2022, there were marginal increase in number of accidents, fatalities and injuries on curved roads, potholes, bridges, culvert and steep grade as compared to 2021 (Table 2.2). In respect of straight roads, accident parameters revealed an increasing trend.

The data for 2022 reveals that 67.0 per cent of accidents occurred on straight roads, whereas accidents on curved roads, pothole roads and steep grade together accounted for 13.8 per cent of the total road accidents. Vehicle speed tends to be high on straight roads in open areas which corroborates the high percentage of road accidents, persons killed and injured (varying in the range of 66-67%) on these roads. The data, however, suggests that road safety measures must not be ignored in even straight road stretches which are normally considered to be less risky. Road sections where construction work was in-progress had accounted for 2.0 per cent of total accidents in 2022. The categories of the Curved Road, Culvert, Potholes and ongoing road works/ works under construction etc. need to be the focus of attention for the engineers maintaining these roads at the National/State and local levels with safety signages installed at the appropriate spots.

2.3 Accidents by road junction type & traffic control

Accident by type of road junction at the All India level for 2021 & 22 are summarized in the Table 2.3 below.

Table 2.3: Accident by type of road junction at the All India level for 2021- 2022

Sl. No.	Road Junction type	Number of Accidents	Persons Killed	Persons Injured	% change in 2022 over 2021		
					Number of Accidents	Persons Killed	Persons injured
1	T-Junction	39,871 (37,020)	12,101 (11,783)	37,174 (34,092)	7.7	2.7	9.0
2	Y-Junction	16,704 (15,527)	5,677 (5,384)	15,432 (13,671)	7.6	5.4	12.9
3	Four arm Junction	19,898 (18,703)	5,772 (5,739)	17,628 (16,216)	6.4	0.6	8.7
4	Staggered Junction	15,002 (14,111)	5,415 (5,160)	13,533 (12,678)	6.3	4.9	6.7
5	Round about Junction	11,410 (13,210)	4,051 (4,603)	10,636 (12,147)	-13.6	-12.0	-12.4
6	Others	3,58,427 (3,13,861)	1,35,475 (1,21,303)	3,48,963 (2,95,644)	14.2	11.7	18.0
Total		**4,61,312 (4,12,432)**	**1,68,491 (1,53,972)**	**4,43,366 (3,84,448)**	**11.9**	**9.4**	**15.3**

Road accident by Road feature examples:

12,101 person killed in 2022 on T-Junction		5,415 person killed in 2022 on Staggered Junction	

5,677 person killed in 2022 on Y-Junction		4,051 person killed in 2022 on Round about Junction	
5,722 person killed in 2022 on Four arm Junction			

Road junctions are points where traffic merges and hence are prone to accidents. However, the data furnished by States/UTs reveals that only 22.3 percent of the accidents took place at various types of junctions, whereas 77.7 percent of the accidents took place in the "Others" category in 2022 as mentioned in the Table 2.3. Similarly, about 19.6 percent of fatalities took place on various junctions in 2022. Within the Junction's category, "T-Junction" accounts for the largest share of accidents, persons killed and injured.

All junctions types have different type of traffic control measures such as traffic light signals, police controlled signals, Stop sign signals, flashing signals/blinkers and uncontrolled signals. The All India position with respect to Accidents, persons killed and injured by type of traffic control is given in Table 2.4 below,

Table 2.4: Accidents, persons killed and injured by type of traffic control 2021- 2022

Sl. No.	Traffic Control type	Number of Accidents	Persons Killed	Persons Injured	% change in 2022 over 2021		
					Number of Accidents	Persons Killed	Persons injured
1	Traffic light signal	9,746 (8,573)	2,238 (2,226)	8,913 (7,484)	13.7	0.5	19.1
2	Police Controlled	8,804 (7,256)	2,421 (2,070)	7,733 (6,634)	21.3	17.0	19.0
3	Stop Sign	5,060 (4,494)	1,842 (1,595)	4,510 (3,914)	12.6	15.5	15.2
4	Flashing Signal/ Blinker	4,927 (5,093)	1,658 (1,705)	4,414 (4,616)	-3.3	-2.8	-4.37
5	Uncontrolled	74,348 (73,155)	24,857 (25,073)	68,833 (66,294)	1.6	-0.9	3.8
6	Others	3,58,427 (3,13,861)	1,35,475 (1,21,303)	3,48,963 (2,95,644)	14.2	11.7	18.0
Total		**4,61,312 (4,12,432)**	**1,68,491 (1,53,972)**	**4,43,366 (3,84,448)**	**11.9**	**9.4**	**15.3**

Different junctions have different types of traffic control measures such as traffic light signals, police-controlled signals, stop sign signals, flashing signals/ blinkers and uncontrolled signals. The Table 2.4 reveals that highest number of accidents, persons killed and injured took place on 'uncontrolled crossings'. which accounted for 16.1% of the total accidents, 14.8% of the people killed and 15.5% of the people injured in 2022. Further, it is noted that the maximum reduction of accidents on junctions took place under the category of "Flashing signal/blinker" in the accident, persons killed and persons injured category.

2.4 Accidents by weather condition

Accident reported by type of weather condition at the All India level for 2021-22 are summarized in the Table 2.5 below:

Table 2.5: Road accidents by weather condition – 2021- 2022

Sl. No.	Weather Condition	Number of Accidents	Persons Killed	Persons Injured	% change in 2022 over 2021		
					Number of Accidents	Persons Killed	Persons injured
1	Sunny/clear	3,42,516 (2,99,305)	1,19,585 (1,05,805)	3,32,586 (2,84,176)	14.4	13.0	17.0
2	Rainy	38,329 (36,432)	14,773 (14,455)	36,950 (33,416)	5.2	2.2	10.6
3	Foggy &misty	34,262 (28,934)	14,583 (13,372)	30,796 (25,360)	18.4	9.1	21.4
4	Hail/ sleet	4,083 (3,911)	1,871 (1,872)	3,621 (3,296)	4.4	-0.1	9.9
5	Others	42,122 (43,850)	17,679 (18,468)	39,413 (38,200)	-3.9	-4.3	3.2
Total		**4,61,312 (4,12,432)**	**1,68,491 (1,53,972)**	**4,43,366 (3,84,448)**	**11.9**	**9.4**	**15.3**

Weather condition affects road surface condition and the visibility of the drivers, thereby increasing the chances of mishaps. Adverse weather conditions such as heavy rain, thick fog and hail storms make driving riskier as visibility reduces and road surface gets slippery. The data of road accidents for 2022, however, showed almost three fourth of the accidents and fatalities took place under sunny/clear weather (Table 2.5). Accidents under adverse weather conditions such as rainy, foggy and hail/sleet accounted for 16.6 percent of total road accidents during 2022.

3 Accidents classified by Vehicular condition

The third category of vehicular condition includes cases of accidents associated with overloading and the age of the vehicles.

3.1 Accidents in over-aged vehicles

Old vehicles are prone to breakdowns and are more prone to malfunction and lack of safety. The summary of road accidents, persons killed and injuries categorized by age of the vehicles involved during 2021 and 2022 is presented in Table 3.1 below

Table 3.1 : Accidents classified according to age of impacting vehicle during 2021 - 2022

Sl. No.	Age of Impacting Vehicles	Number of Accidents	Persons Killed	Persons Injured	% change in 2022 over 2021		
					Number of Accidents	Persons Killed	Persons injured
1	Less than 5 years	1,38,171 (1,26,704)	50,762 (46,543)	1,36,598 (1,22,042)	9.23	9.06	11.92
2	5-10 years	1,32,893 (1,16,046)	46,105 (41,168)	1,31,185 (1,12,582)	14.51	11.99	16.52
3	10-15 years	58,005 (53,781)	21,493 (20,291)	56,949 (49,511)	7.85	5.92	15.02
4	15 years & above	49,766 (45,563)	20,936 (19,389)	45,251 (40,294)	9.22	7.9	12.30
5	Age not known	82,477 (70,130)	29,195 (26,485)	73,383 (59,605)	17.60	10.23	23.11
Total		**4,61,312 (4,12,432)**	**1,68,491 (1,53,972)**	**4,43,366 (3,84,448)**	**11.9**	**9.4**	**15.3**

*Total may not tally due to non-reported of data from Chandigarh.

Age of vehicles involved in road accidents is meant to throw some light on prevalence of aged or over-aged vehicles on the roads. Old vehicles tend to have break downs more frequent malfunction lack of safety. In 2022, a total of 1,38,171 road accidents happened involving vehicles less than 5 years and the highest number of death i.e. 50,762 reported involving vehicles less than 5 years.

3.2 Overloading

Overloaded trucks are known to cause accidents due to (i) Truck tyres bursting from excess weight; (ii) Brakes wearing out due to friction caused by the overloading; (iii) Road collapses caused by overloaded trucks; (iv) Roll-over of trucks caused by the centre of gravity shifting from overloading; (v) Excess weight adding momentum to a truck travelling downhill and severely slowing it down when travelling up an incline. An overloaded truck whose weight is shifted to the rear of the truck, makes steering much more difficult; Also, partially loaded tanker trucks carrying liquids that slosh back and forth, upset the natural centre of gravity of the truck.

In short, overloaded trucks or those with improperly secured loads can be a hazard to all other vehicles on the road. Another frequently observed feature is vehicles with loads protruding/hanging posing serious traffic hazard, risking itself and other road users.

Each state has independent control over the legal load limits for trucks. Those trucks which are oversized or over the weight limits are required to obtain a special permit, display appropriate caution warnings, drive during specific hours etc.

Overloaded vehicles and vehicles with loads protruding/hanging are road traffic hazard, risking accident for itself and for other road users. Overloaded vehicles accounted for a share of 6.1 percent of total accidents, 7.2 percent of total killed and 6.5 percent of the injured in 2022. Further, it is inferred that largest number of accidents, accident related deaths, and injuries had reported in the category of normally loaded vehicles.

Table: 3.2 Accidents classified according to Load Condition during the calendar year 2021- 2022.

Sl. No.	Load condition	Number of Accidents	Persons Killed	Persons Injured	% change in 2022 over 2021		
					Number of Accidents	Persons Killed	Persons injured
1	Normally loaded	2,76420 (2,43,840)	93,975 (84,914)	2,79,064 (2,37,282)	13.36	10.67	17.60
2	Overloaded/ handing	28,033 (25,020)	12,181 (11,011)	28,741 (25,518)	12.04	10.62	12.63
3	Empty	71,032 (68,353)	28,974 (27,534)	62,568 (59,411)	3.9	5.22	5.31
4	Not known	85,827 (75,219)	33,361 (30,513)	72,993 (62,237)	14.10	9.33	17.28
Total		**4,61,312 (4,12,432)**	**1,68,491 (1,53,972)**	**4,43,366 (3,84,448)**	**11.9**	**9.4**	**15.3**

Conclusion

Road safety is a matter of immense concern to everyone. Therefore, the on-going efforts of the Government in this regard and stakeholder's commitments are essential for curtailing fatalities and injuries in road accidents.

Ref. : "Report on Road accidents in India-2022" published by the Ministry of Road Transport & Highways, GoI

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NATIONAL SAFETY COUNCIL OF INDIA





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LPG Tankers Handling & Transportation Safety

ASIS KUMAR MANDAL, Dy. Manager (Safety), IndianOil Petronas Pvt. Ltd., Haldia, W.B., Email: safetyhaldia@indianoilpetronas.in

Overview

IndianOil Petronas Private Limited (IPPL) is a premier joint venture established by two Fortune 500 oil giants: Indian Oil Corporation Limited (IOCL) and Petroleum Nasional Berhad (Petronas), Malaysia's National Oil Company. Formed under a Joint Venture Agreement facilitated by the Ministry of Petroleum and Natural Gas, IPPL was officially incorporated on 3rd December 1998, with equal 50:50 equity participation from its partners.

Over the last two decades, IPPL has earned a reputation as a trusted supplier of Industrial and Automotive LPG and terminal services. It stands as a symbol of safety, operational excellence, and reliability, making it a preferred partner for customers across a wide range of industries.

Vision

- To emerge as the leading brand and the largest Terminal Service Provider and Parallel Marketer of LPG in India.
- To maximize stakeholder returns through performance optimization, adherence to world-class safety standards, and fostering a productive and happy work environment.
- To expand into allied businesses such as retailing Auto LPG and exploring non-fuel opportunities to create additional value.

Key Operations and Facilities

State-of-the-Art Terminal: Haldia Terminal (West Bengal)

- Commissioned: 2001.
- Area: Spread across 79.78 acres.
- Functionality:
  - ♦ Handles Propane, Butane, and LPG through ocean tankers.
  - ♦ Offers storage, bulk LPG loading for oil companies, and LPG cylinder bottling services.
  - ♦ Supplies Propane and Butane for industrial applications, ensuring global standards of quality and value-for-money services.
- Transportation Fleet:

  Bulk Tankers: 1,650 bulk tankers facilitate the safe transportation of LPG and related products.

  Packed Trucks: 345 trucks ensure efficient delivery of LPG cylinders to customers.

Commitment to Excellence

IPPL's infrastructure, operational standards, and customer-centric approach make it a leader in the LPG supply chain. Key offerings include:

- Safe and efficient transportation through bulk tankers, pipeline transfers, and packed truck services.
- Innovative solutions to meet industrial demands.
- Unwavering adherence to safety protocols, minimizing risks across operations.

Guidelines to Safe LPG Tanker/ Packed Trucks Transportation: TREM CARD

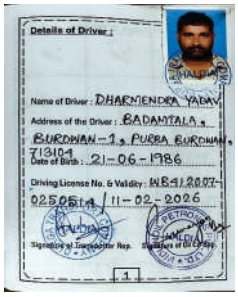
This document serves as a vital record for all IPPL LPG tanker drivers, emphasizing safety throughout the transportation process. It outlines essential information on driver details, statutory testing dates, name & address of the transporter including authorized signature & stamp, LPG properties, hazards, handling procedures, emergency responses, first aid, important numbers, and emergency contact information.

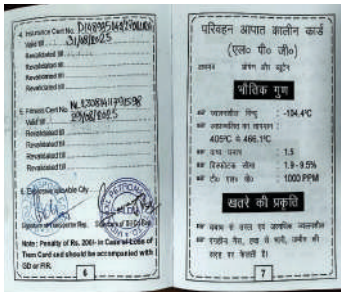
1. **Driver Details with Transporter Authorization:**

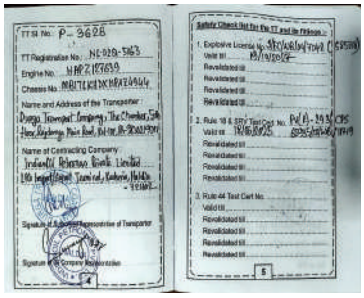
   Accurate Records: Maintain accurate and updated drivers' authorization, including transporter name & address, contact details, and driver's license information, for efficient communication during emergencies.

2. **Vehicle Critical Fittings: The tanker is equipped with essential safety fittings:**

   Pressure Relief Valves prevent excessive pressure buildup within the tanker. Emergency Shut-off Valves allow for immediate isolation of the LPG in case of an emergency. Valid testing dates with revalidated dates are mentioned on each respective TREM card provided by IPPL.



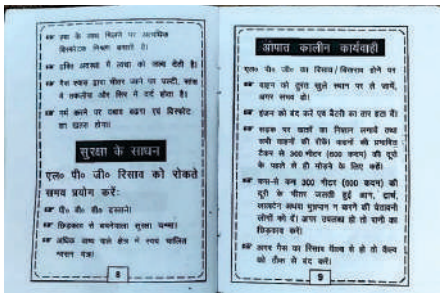




(Note: Pages 2 & 3 of the IPPL TREM card book are for change of driver information update.)

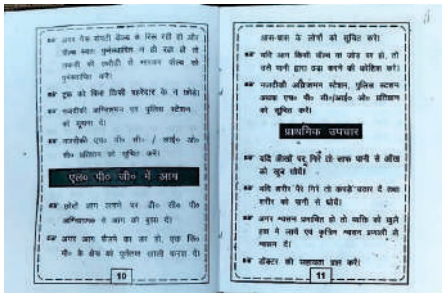
3. Essential Documents Valid Dates:

Mentioned important dates like Explosive License number with valid date, Rule 18 for SRV testing certificate number with valid and revalidation dates. Insurance and Fitness Certificates number with valid till dates.



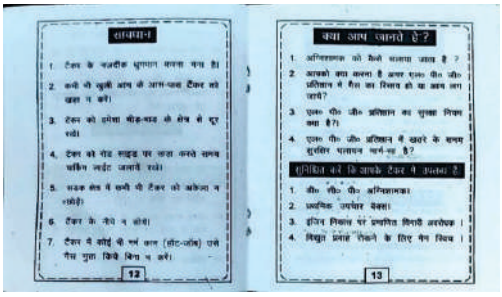
4. Chemical Properties of LPG:

Written detailed about LPG properties like a blend of propane and butane, is a highly flammable, colorless gas, is heavier than air and can accumulate in low-lying areas, posing a significant explosion risk, details are explained in preferable language like Hindi or Bengali.



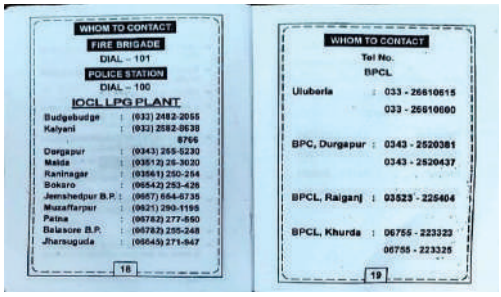
5. Potential Hazards of LPG:

All potential hazards associated with LPG like Fire and Explosion, Asphyxiation, and Frostbite are explained for better understanding.



6. Safe Handling Practices:

Especially during Loading and Unloading, submission of the key to the operator, proper grounding, and bonding to prevent static electricity buildup with smooth operations. Safe Distances to maintain safe distances from other vehicles, pedestrians, and ignition sources during transportation are explained in this.



7. Emergency Response:

Detailed emergency response plan in case of leakage/spillage of LPG, steps to be followed all are guided in the TREM card in detail.

8. First Aid Procedures:

Procedures to be followed in case of frostbite & inhalation are given.

9. Important Cautions and Contact Information:

Emergency Services numbers like police, fire brigades, etc. with IOCL Emergency Contacts of different locations are provided.

Road Safety:

Various kinds of training are conducted in IPPL throughout the year like

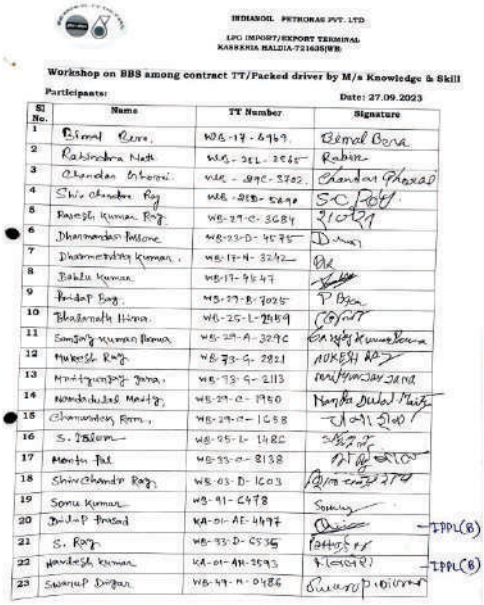
- **Defensive Driving:** Practice defensive driving techniques, anticipating potential hazards and maintaining a safe following distance.
- **Distraction-Free Driving:** Avoid distractions such as mobile phones, eating, or drinking while driving.



Fig: Defensive driving & distraction-free driving training by M/s Hindustan Stimulator.

- **Fatigue Management:** Ensure adequate rest and avoid driving while fatigued. Restriction in night driving and overspeeding.





INDIANOIL PETRONAS PVT. LTD
LPG IMPORT/EXPORT TERMINAL
KARKHNIA HALDIA-721635(WB)

Workshop on BBS among contract TT/Packed driver by M/s Knowledge & Skill

Participants: Date: 27.09.2023

Sl No.	Name	TT Number	Signature
1	Bimal Bera	WB-17-6969	Bimal Bera
2	Rabindra Nath	WB-24L-2645	Rabin
3	Chandan Ghosal	WB-39C-3702	Chandan Ghosal
4	Shiv Chandra Ray	WB-25D-5890	SC Roy
5	Rajesh Kumar Ray	WB-29-C-3684	Rajesh
6	Dharmendra Tellone	WB-23-D-4575	Dharmendra
7	Dharmendra Kumar	WB-17-4-3242	Dharmendra
8	Bablu Kumar	WB-17-4647	
9	Pradip Roy	WB-29-B-7025	P Roy
10	Bhabanath Hirna	WB-25-L-2589	
11	Sanjay Kumar Barua	WB-29-A-3296	
12	Mukesh Ray	WB-73-G-2821	MUKESH RAY
13	Mrityunjay Jana	WB-73-G-2113	
14	Nandadulal Maity	WB-29-C-1980	Nandadulal Maity
15	Chamundeshwari	WB-29-C-1688	
16	S. Tiburu	WB-25-L-1482	
17	Manik Pal	WB-33-C-8138	
18	Shivchandra Ray	WB-03-D-1603	
19	Sonu Kumar	WB-91-6478	Sonu
20	Dilip Prasad	KA-01-AE-4477	IPPL(B)
21	S. Ray	WB-33-D-6536	
22	Avidesh Kumar	KA-01-AH-3593	IPPL(B)
23	Swarup Dutta	WB-49-M-0486	

Fig: Fatigue management & Behavior Based Safety by M/s Knowledge & Skill

- **OISD-154 Refresher Training:** Conducted by site safety personnel daily.





Fig: OISD-154 refresher training with traffic signal discussion

- **PCVO training as per CMV Rule-09 conducted by RTO approved Agency**





Fig: PCVO training is being conducted by RTO approved agency for both packed & Tanker crews

- **Regulatory Compliance:** Adhere to all applicable traffic laws and regulations related to the transportation of hazardous materials by the Haldia Divisional Traffic Department.

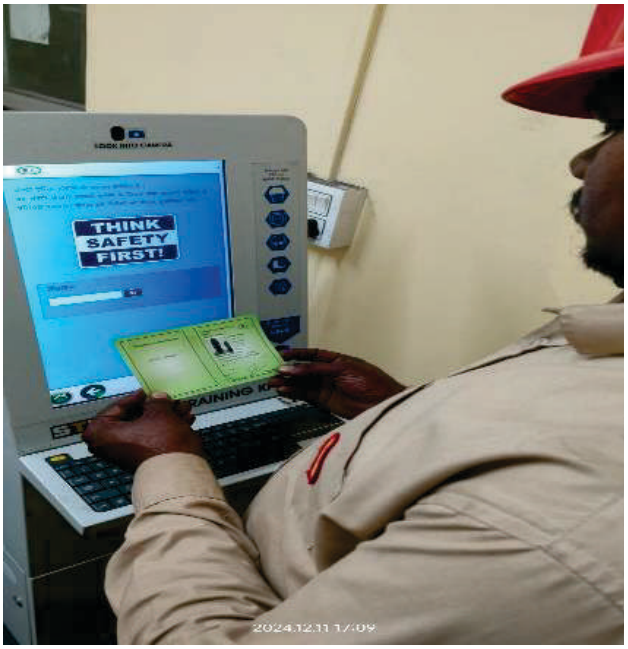


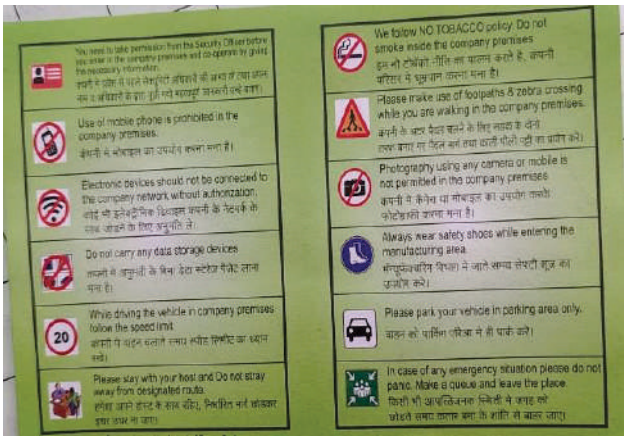


Fig: "Safe Drive Nation: Road Guardians" program by WB Sub-divisional Traffic Police for TT crew

- **Kiosk Training:** To enhance safety and efficiency, we've implemented a mandatory kiosk training program for all ex-terminal drivers seeking plant

entry for loading operations. This comprehensive program covers crucial aspects such as LPG safety, plant safety protocols, speed limits, transportation safety, standard operating procedures for loading, extinguisher usage, and siren code interpretations. This initiative aims to improve driver awareness, minimize risks, and ensure smooth and secure loading operations within the plant.





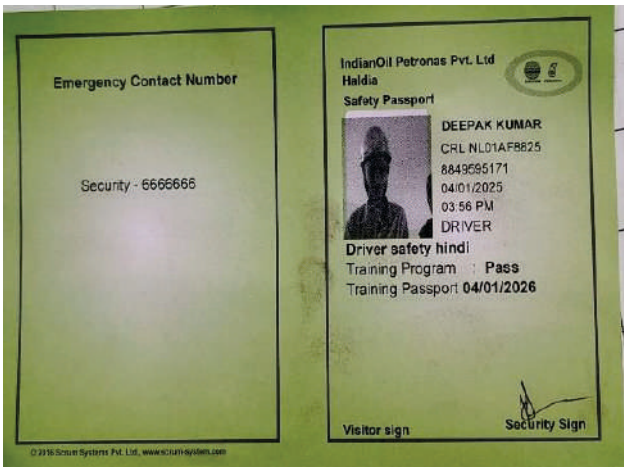


Fig: Driver with Kiosk Training Card after training, card both side details.

Emergency Preparedness - Mock drill by truck drivers:

To ensure safe LPG transport, drivers of both tanks and packed cylinders must participate in regular emergency mock drills. These drills simulate various scenarios such as accidents, fires, and spills, training drivers to react effectively, testing emergency plans, and identifying areas for improvement. By boosting driver confidence and enhancing their ability to handle emergencies, these drills significantly improve safety in LPG transportation.

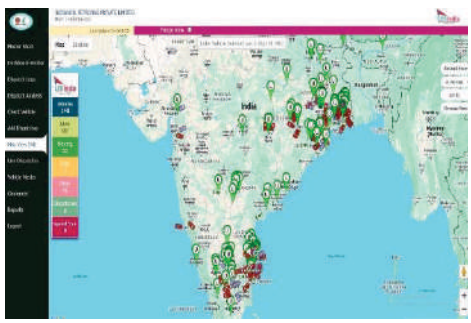






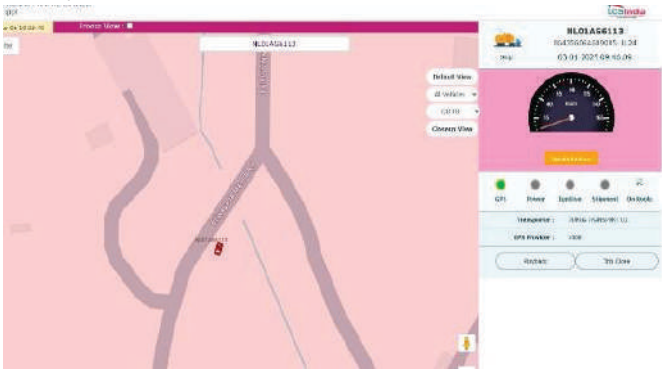
Fig: Mock drill with truck drivers

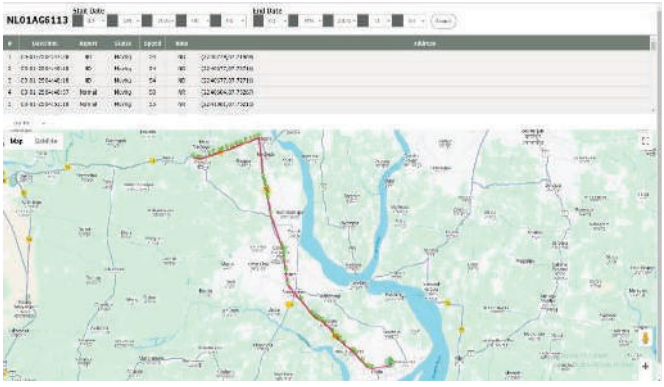
GPS Monitoring of LPG Tankers



To enhance safety during LPG transportation, Global Positioning Systems (GPS) are employed. These systems enable real-time monitoring of tanker movement, including speed, night driving, continuous driving duration, unauthorized stoppages, harsh braking, and

adherence to approved routes. Alerts generated for any violations are immediately investigated by a dedicated team, who contact the transporter to verify the reasons. Daily reports summarizing all violations are then submitted to the safety team for further action. This proactive monitoring system significantly improves safety by identifying and mitigating potential risks associated with LPG transport.





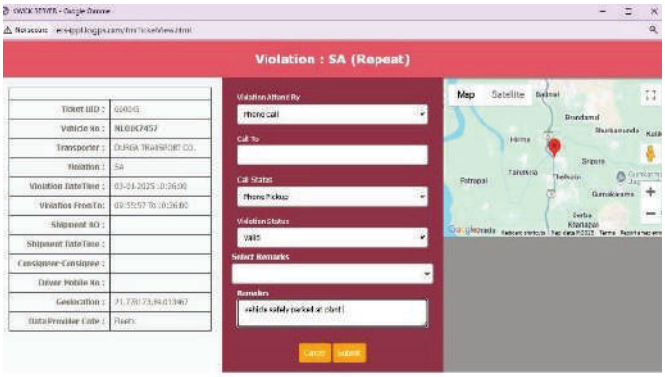


Fig: Speed monitoring, Route map monitoring & report generating format for any violation generated

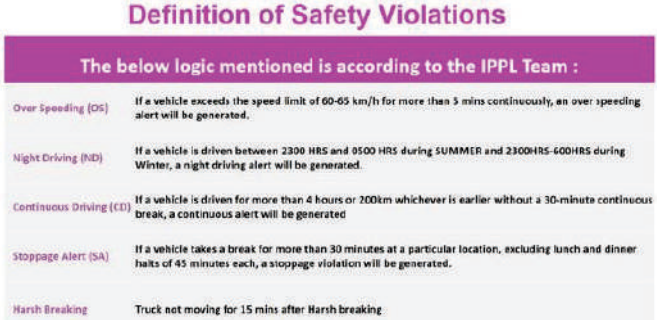


Fig: Type of violations monitored

VehicleNo	Transporter	Product	Alert Type	Speed(Km/Hr)	Violation Date	Actual STime	Actual ETime	Duration
NL01L4304	BRIGHT GAS AGENCY	PROPANE	SA	0	2025-3-1 12:00	NA	NA	NA
NL01G4099	DURGA TRANSPORT CO.	PROPANE	SA	0	2025-3-1 18:09	NA	NA	NA
NL02Q5157	DURGA TRANSPORT CO.	PROPANE	OS	62	2025-3-1 21:07	NA	NA	NA

Calling Time	Call To	Response	Call Status Remark	Violation Remarks
12:06:29	Spoc1	GOOD	Answerd	SPOC said that Vehicle stopped for refreshment.
18:28:04	Spoc1	GOOD	Answerd	SPOC said that vehicle parked at safe location/ stopped due to no entry zone.
21:15:19	Spoc1	GOOD	Answerd	SPOC said that he will instruct to driver to control OS

Fig: Daily VTS Violation Report with details monitoring data & transporter remarks

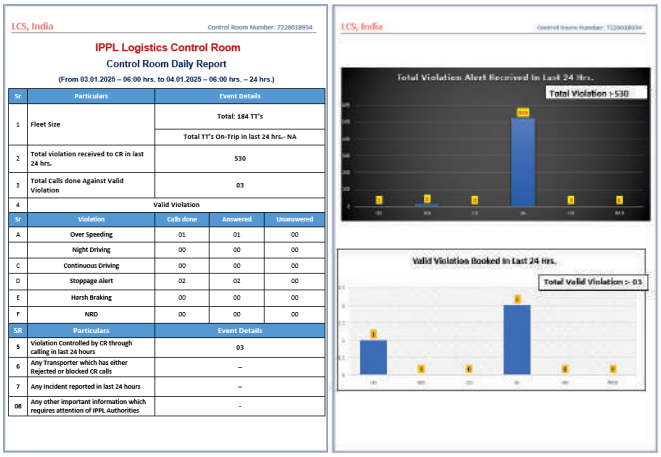


Fig: Violation Report shared by dedicated VTS monitoring Team

Ensuring Safe Transportation: Route Map-

IPPL prioritizes safe and efficient LPG transportation. For every customer/supplier, our team meticulously analyzes road conditions, identifies safe stoppages, and locates secure resting areas to create dedicated route maps. Tanker drivers are obligated to follow these routes, while our monitoring team utilizes a Vehicle Tracking System (VTS) to ensure adherence and intervene promptly in emergencies. This comprehensive approach enhances safety, optimizes delivery times, ensures regulatory compliance, and improves customer service.



PHYSICAL VERIFICATION OF IPPL TO THE ORION INDANE MART
POINT TO POINT ROUTE MAP SEGMENTWISE DISTANCE of RT-2161-244908-1
NAME OF THE RECEIVING LOCATION THE ORION INDANE MART

From	To	One Way	Cumulative Distance Route Segment	RTD	4 To 6 Axle One Way	4 To 6 Axle Two Way
11/19/24, 10:21 AM						
1	IPPL	Kolaghat	56.438076018758	56.438076018758	T	0	0
2	Kolaghat	Howrah SDSL park	51.503940752286	107.94201677104	T	0	0
3	Howrah SDSL park	Barrokpore	31.905047279071	139.84706405011	T	0	0
4	Barrokpore	Choumatha bazar	45.468103056221	185.31516710634	T	0	0
5	Choumatha bazar	Krishnanagar chowrasta more	38.279763155342	223.59493026168	T	0	0
6	Krishnanagar chowrasta more	Betai plaseey more	50.07213779663	273.66706805831	T	0	0
7	Betai plaseey more	THE ORION INDANE MART (GODOWN End)	29.332931941692	303	T	0	0
8	THE ORION INDANE MART (GODOWN End)	Betai plaseey more	29.332931941692	332.33293194169	F	0	0
9	Betai plaseey more	Krishnanagar chowrasta more	50.07213779663	382.40506973832	F	0	0
10	Krishnanagar chowrasta more	Choumatha bazar	38.279763155342	420.68483289366	F	0	0
11	Choumatha bazar	Barrokpore	45.468103056221	466.15293594988	F	0	0
12	Barrokpore	Howrah SDSL park	31.905047279071	498.05798322896	F	0	0
13	Howrah SDSL park	Kolaghat	51.503940752286	549.56192398124	F	0	0
14	Kolaghat	IPPL	56.438076018758	606	F	0	0

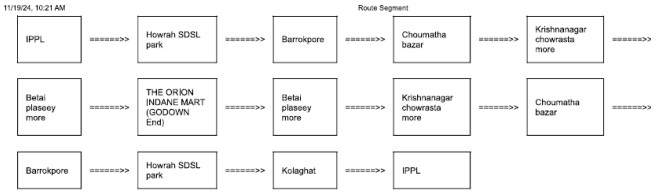


Fig: Route map decided by the IPPL dispatch team & transporter for 'THE ORION INDANE MART (GODOWN END) supply with all details

Promoting Driver Wellness: LPG Tanker Driver Health Checkup Program

IPPL prioritizes driver well-being. We collaborate with the TCI Foundation to conduct annual health camps. These camps encompass a wide range of services, including interpersonal communication sessions, STI screening, ICTC services, condom social marketing, general health checkups, and eye examinations. This comprehensive program aims to improve driver health, enhance road safety, boost safe transportation, and demonstrate our commitment to drivers' well-being and social responsibility.





Enhancing Driver Safety through a WhatsApp Group

We, IPPL created a WhatsApp group for drivers which is a valuable tool for improving safety. By sharing safety videos, information on LPG characteristics, and upcoming health camps, a strong foundation. To further enhance this initiative, consider incorporating interactive elements like polls and quizzes to engage drivers. Encourage open communication by allowing them to ask questions and share their experiences.

Clear group rules and designated moderators will ensure smooth and productive discussions. Personalize reminders for health camps and training programs and consider offering incentives to encourage participation. By fostering a positive and supportive safety culture, IPPL effectively leverages this platform to enhance driver safety and create a more proactive and defensive driving group.





Fig: WhatsApp group joining QR displayed at main gate, all drivers are invited to join the group.

Through continuous investment in growth, safety, and sustainability, IPPL aligns itself with India's energy goals, ensuring a lasting contribution to the nation's progress.

Haldia Terminal, as a flagship facility, exemplifies the company's dedication to operational excellence, maintaining IPPL's position as a market leader in LPG services in India.

* * *

Road Safety in Cement Truck Handling and Transportation

PRAKASH MOVADE, Head – ESG, UltraTech Cement Limited, Pune, Email: santosh.shidhaye@gmail.com
NISHA JAIN, Unit Head, UltraTech Cement Limited, Pune



1 Introduction

Cement Industry is one of the largest industries of the world, cement is an essential component of infrastructure development and most important input of construction industry, particularly in the government's infrastructure and housing programs, which are necessary for the country's socioeconomic growth and development. It is also the second most consumed material on the planet. The Indian cement industry is the second largest producer of cement in the world.

The handling and transportation of cement trucks present unique Road Safety challenges involving a complex logistics network that depends on the safe and efficient movement of cement trucks. Ensuring road safety in this sector is important not only to reduce accidents but also to protect human lives, reduce environmental risks and maintain the smooth flow of operations.

This article outlines the key safety considerations, key challenges, potential risks, and best practices for cement truck handling and transportation.

2 Key Safety Challenges

The handling and transportation of cement trucks inside the plant premises having various safety challenges that impact operational efficiency and the well-being of drivers, operators, and plant staff. This report summarizes the key safety challenges and highlights critical areas for improvement.

i Regulatory Compliance:

Adherence to Regional Transport Office (RTO) regulations, local city norms, and vehicle fitness standards is critical for maintaining safe and lawful operations of on-road vehicles. Compliance with these requirements ensures that vehicles meet safety, emission, and operational guidelines as mandated by government authorities.

ii Systematic Traffic Flow:

Managing organized and Systematic traffic movement from plant entry to exit is critical for maintaining a safe working environment, a well-structured traffic management system minimizes the risk of accidents by clearly defining and separating routes for pedestrians, passenger vehicles, and logistics vehicles. Segregating traffic lanes helps prevent collisions, reduces congestion, and enhance overall operational efficiency.

iii Vehicle Reversing:

Reversing vehicles within plant premises pose significant safety risks, often leading to accidents involving personnel, equipment, or infrastructure. To mitigate these hazards, implementing a well-planned transportation flow with a single-entry and exit route.

iv Driver Fatigue and Health:

Driver fatigue, poor health, and medical conditions compromise driving performance and increase the risk of accidents. Fatigue leads to reduced reaction times, impaired judgment, and lack of concentration, while medical conditions such as vision problems, neurological disorders can affect a driver's ability to operate a vehicle safely.

v Poor Road Infrastructure:

Road accidents are significantly influenced by various infrastructure-related issues. Uneven road surfaces, the absence of proper signage, potholes, and poorly designed intersections create hazardous driving conditions that increase the risk of collisions. Poor visibility due to inadequate lighting and heavily dense plantation, particularly at night or adverse weather conditions. Dust emissions from unmetalled roads not only reduce visibility but also create serious health risks.

vi Over speeding and Lane Discipline:

Over-speeding remains one of the primary causes of road accidents in India, leading to significant loss of life and property. Effective enforcement of speed limits and strict adherence to lane discipline are critical measures to mitigate this risk.

vii High-Risk Journey Routes:

Identifying, High-traffic routes and areas with challenging conditions which poses risks to transportation safety. Identifying and analysing these risks is essential to mitigate accidents and ensure the safe movement of vehicles. Factors such as heavy congestion, poor road conditions, inadequate signage, sharp turns and unavailability of emergency services can greatly increase the likelihood of accidents.

viii Driver's Behaviour:

Dealing with issues such as alcohol consumption, unsafe driving behaviour, lack of defensive driving skills, adherence and acceptance of plant road safety rules and insufficient awareness of plant safety procedures.

ix Traffic Management:

Managing traffic flow with ensuring FIFO (First In-First Out) for vehicle loading can be challenging in a high-volume demand condition, fluctuating market demand and plant availibility.

x Operational Hazards:

There are multiple operational hazards in cement loading activity which includes:

- Vehicles reversing at truck loading points for lane changing can cause accidents.
- The unintentional movement of vehicles by drivers, such as rolling the vehicle while loading, can lead to collisions or injuries
- The process of bulker lid opening and closing and cement trucks tarpaulins covering exposes Drivers/workers to fall risks.
- Drivers resting or sitting in unauthorized areas while truck loading, unloading or tarpaulin covering takes place could be exposed to accidents if the area becomes operationally active.
- Accident due to parked vehicle rollout in sloping surface area at truck loading, bulker loading, lid opening-closing point & parking in truck yard.

xi On-Road Vehicle Tracking:

Tracking vehicles on the road presents several challenges, particularly in ensuring safety and accurate location tracking. One of the key issues is managing unauthorized vehicle use or route deviations, which can lead to operational inefficiencies, increased fuel consumption, and potential security risks. Implementing technologies such as real-time GPS tracking, geofencing, and driver authentication systems can help mitigate these risks. Geofencing creates virtual boundaries, triggering alerts if a vehicle leaves a designated area, while authentication systems prevent unauthorized drivers from operating vehicles.

xii Paper Challan Dependency:

Paper-based challans required drivers to get down from their vehicle's multiple times for documentation, increasing process delays and risks. Implementing a digital challan (e-invoicing) eliminates this need, ensuring a faster, more efficient, and safer process for drivers.

3 Infrastructure Developement for Road Transportation Safety In The Plant

To ensure safe and efficient road transportation operations within the plant premises, several safety infrastructure enhancements have been implemented:

- Well-Maintained smooth and durable concrete roads to minimize wear and tear on vehicles and reduce the risk of accidents.





- Dedicated Pedestrian and Vehicle Segregation walkways and routes are marked to ensure safe movement of personnel, reducing the risk of collisions.





- Clearly visible Road Safety Signages provision on prominent locations with essential safety instructions and directions to drivers and pedestrians.









- Road safety awareness posters are strategically placed to reinforce safe driving practices and traffic rules.



- Road dividers are provision to make separate lanes of traffic, preventing collisions and managing smooth and uninterrupted vehicle flow.
- Speed Breakers installation at key points to control vehicle speeds, enhancing safety near critical areas.





- Traffic signals provision at junction points to regulate vehicle movement at intersections criss-cross movement and to avoid accidents

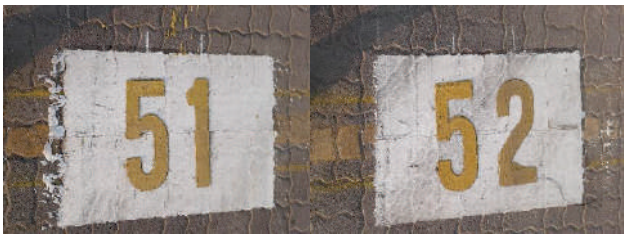


- Convex Mirrors are provided to enhance visibility around blind spots and sharp corners, reducing collision risks



  - Reflective Studs for Lane Visibility: Enhances lane markings' visibility, especially at night or in low-light conditions.

- Reflective Studs for Lane Visibility: Enhances lane markings' visibility, especially at night or in low-light conditions.
- Lane and number marking with reflective thermoplastic painting in the truck yard for organize parking, ensure efficient space utilization, enable easy identification, and streamline truck movement to prevent congestion and accidents.

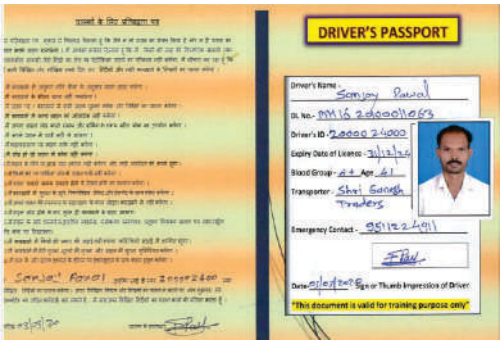




- A large LED screen installation in the truck yard, displaying the loading vehicle numbers for easy identification, allowing drivers to quickly locate their assigned vehicles.



- The Drivers management center is developed (DMC) and newly hired drivers undergo induction and defensive driving training. A "Driver Passport" is issued post-training.



- Flexible Posts installation for lane separation and maintain lane discipline while allowing flexibility to minimize damage in case of contact.



- A designated area Transport Facility Building available in truck yard for drivers to rest, register, and access necessary facilities for safety compliance.
- Public Address (PA) System used for real-time announcements and communication to manage vehicle movement and emergencies.
- Zebra markings are painted at pedestrian crossings to ensure safe movement across roads within the plant, enhancing visibility and reducing the risk of accidents.





- Implementing unmanned auto weighbridge system, automates the vehicle weighing process, reducing the need for manual handling and enhancing operational efficiency and safety.

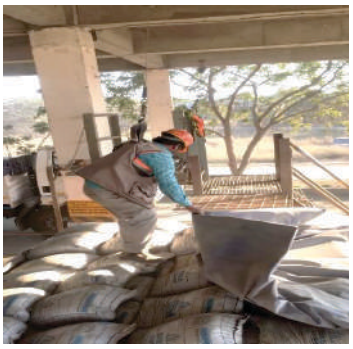


- Bulker lid opening and closing platforms are equipped with lifeline and fall arrester systems to ensure worker safety by preventing falls during operations.





- Tarpaulin Covering Platforms with Lifeline & Fall Arrester System are Provided to secure drivers while covering vehicles, preventing falls and related injuries.







- A high-visibility lighting arrangement installation on plant roads and truck yards to ensure adequate illumination during the night, enhancing safety and visibility for drivers, workers, and pedestrians.





4 Best Practice Steps Toward Safer Roads:

Ensuring road safety and vehicle compliance in cement truck handling and transportation is critical to maintaining operational efficiency and protecting lives. Below is a summary of the key measures implementation to enhance Road and Transportation safety

1. Digital Compliance Verification: A comprehensive 8-point checklist for RTO and vehicle fitness compliance is digitally verified through the plant's automated reader system. Vehicles are allowed entry only after successful verification.
2. Driver Alcohol Testing: All drivers undergo an alcohol test at the main entry gate before entering the plant premises.
3. Organized Parking: Drivers proceed to the truck yard and park their vehicles in the designated lanes as per the issued token numbers.
4. Single Entry and Exit Routes: Implemented a well-planned transportation flow with a single-entry and exit routes, and reduces the need for reversing, this streamlined design minimizes blind spots, enhances visibility, and improves traffic flow efficiency and Turnaround time (TAT) of the plant.
5. Reflective Road Studs: Reflective road studs are installed on roads to enhance visibility and guide drivers, particularly during nighttime and low-light conditions, improving overall road safety
6. Color-Coded Token System: To ensure systematic traffic flow and FIFO-based loading, color-coded tokens are issued to drivers for assigning specific parking slots in the truck yard:

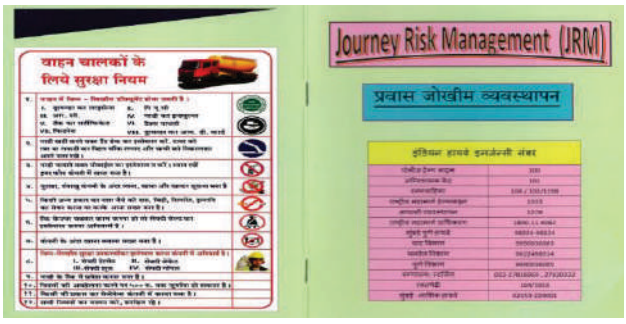


Blue : Light Commercial Vehicles (LCVs)
Red : Heavy Commercial Vehicles (HCVs)
Green : Bulkers

7. FIFO-Based Loading: Vehicle numbers are announced as per the FIFO sequence based on the loading and dispatch plan. Security verifies

token numbers before allowing vehicle entry into the loading section.

8. Controlled Loading Points: Truck loading points are designed with a single-entry and exit route, equipped with barricades to eliminate the need for vehicle reversing and signalling (Green/Red) system to avoid the collision between two vehicles.
9. Ignition Key Control: At the loading point, the ignition key is taken by the loading operator to prevent any unintended vehicle movement during loading. The key is returned to the driver after loading.
10. Safe Tarpaulin Covering: A dedicated platform with fall arrest lifelines is provided for drivers to safely cover the tarpaulin after loading. Loaded covered truck are only allowed for plant exit to sustain the pollution board compliance.
11. Bulk Loading Stations: Two bulk loading stations are equipped with lid-opening and closing systems that include fall arresters to eliminate fall hazards.
12. Speed Limit Compliance: A speed limit of 20 km/h is enforced within the plant premises, with random speed checks conducted to ensure compliance.
13. Dedicated Routes for pedestrians and vehicles: Separate routes are developed for pedestrians, bulkers, and trucks are implemented to enhance road safety. By clearly segregating pathways, pedestrians are safeguarded from vehicle movement, while trucks and bulkers can operate within defined routes, reducing the likelihood of collisions. Additionally, clear signage, lane markings, and physical barriers implementation.
14. Road Safety Awareness: Safety message boards are displayed across the plant to promote road safety awareness.
15. Driver Training and Certification: Newly hired drivers undergo induction and defensive driving training. A "Driver Passport" is issued post-training.
16. Journey Risk Management (JRM): High-volume and high-risk routes are identified, and JRM is conducted. Ideal routes, considering available emergency facilities, are shared with drivers and transporters.



17. Quarterly Vehicle Fitness Inspections: Vehicle fitness inspections are conducted quarterly. "Fit for Drive" stickers in different color for each quarter (Q1: Green, Q2: Orange, Q3: Pink, Q4: Blue) are affixed to vehicle windshields to track compliance.



5 Reward and Recognition for Drivers

The "Best Saarthi of the Month Award" recognizes drivers who consistently demonstrate exceptional performance and adherence to safety protocols. This practice is being continued since plant inception Aug-2015 on monthly basis in which total 03 number of drivers being awarded.





The selection criteria are detailed below:

1. Recognition for efficiency and dedication in completing the maximum number of trips within the designated period.
2. Emphasis on the consistent use of personal protective equipment (PPE) to ensure compliance with safety norms.
3. Evaluation of the driver's knowledge and proactive implementation of safety measures both inside and outside the plant premises.
4. Adherence to defined speed limits inside and outside the plant, contributing to safe driving practices.
5. Ensuring vehicle fitness and compliance by

maintaining and presenting all required documents without lapses.

6. Assessment of professional and behaviour with security personnel, logistics teams, and loading operators within the plant.

6 Awareness Campaigns

Road Safety Week Celebration: Activities and initiatives during the celebration aim to educate drivers, workers, and the community about best safety practices to prevent accidents and promote safe behaviour on roads.



Awareness is created among **school children** by organizing road **safety poster competitions**, encouraging them to learn and express important safety messages creatively



A **road safety rally** is organized to promote public awareness, engaging the community in spreading critical messages about safe driving practices, traffic rules, and accident prevention.

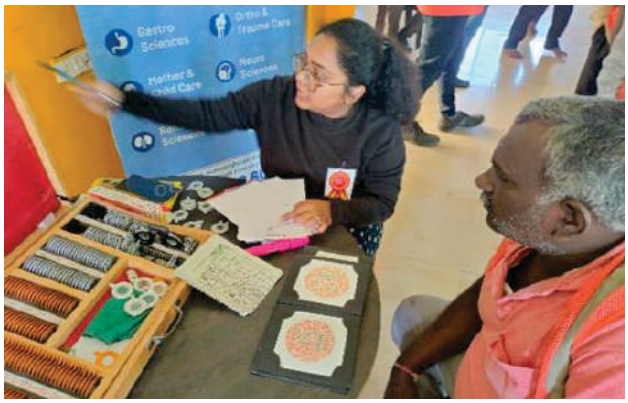


A **school children's rally** is conducted to raise local public awareness about road safety, with students carrying banners and slogans to promote safe driving and responsible road behaviour.



7 Health and Wellbeing Campaign for Drivers

A free **Eye check-up camp** is organized for drivers to address vision-related challenges, promoting better eyesight and enhancing road safety through early detection and corrective measures.



Nasha Mukti & HIV awareness programs are conducted in collaboration with NGOs to raise awareness among drivers about the harmful consequences. These initiatives focus on educating drivers about health risks and the long-term impact of substance abuse.



A **Driver Welfare Scheme** Awareness Camp is organized to facilitate the enrolment of drivers in various government insurance and pension schemes, including **Pradhan Mantri Suraksha Bima Yojana, Pradhan Mantri Jeevan Jyoti Bima Yojana, Atal Pension Yojana, and Ayushman Bharat Bima** for health coverage. This initiative aims to provide financial security, health benefits, and social welfare support to drivers and their families.



Weekly yoga sessions are arranged for drivers to promote their physical and mental health, reduce stress, improve flexibility, and enhance overall well-being, contributing to safer and more focused driving practices.



Physiotherapy camps are organized for drivers to address musculoskeletal issues by reducing fatigue and physical discomfort. During these camps, drivers receive professional guidance on posture correction, and exercises for pain management and physiotherapy kits are distributed to support their long-term well-being.



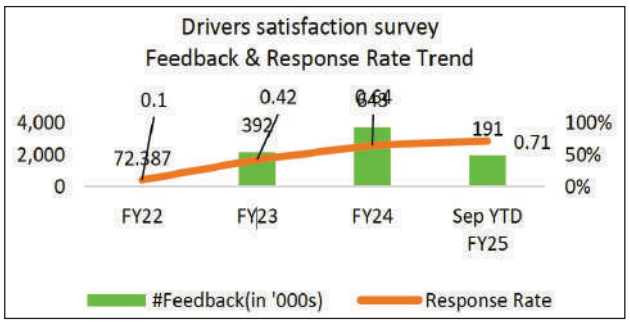
Daily sessions of energetic music and dance are organized for drivers to help reduce stress, boost morale, and promote mental relaxation, contributing to improved focus and safer driving practices.



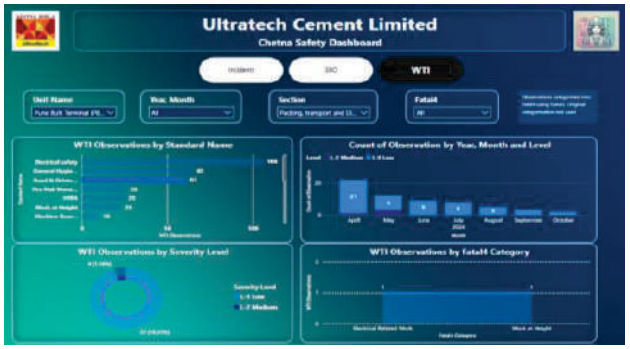
Books Library is set up in the truck yard rest room for drivers, providing access to books, magazines, and newspapers to promote relaxation, learning, during their rest periods.

Daily alcohol checks are conducted for drivers, and those found to be alcohol-free are Daily alcohol checks are conducted for drivers, and those consistently found with zero alcohol levels during regular checks are **Rewarded with a token of appreciation**. This initiative promotes a culture of responsible behaviour and encourages safe driving practices.

Drivers' Satisfaction Survey is a valuable tool to understand and improve driver performance, address their needs, and meet their expectations. This initiative focuses on gathering feedback from drivers to identify key areas impacting their job satisfaction, work environment, and overall engagement



Road & Transportation Safety Audits: To ensure continuous improvement and effective management of road and transportation safety, internal and external safety audits shall be conducted periodically. These audits are designed to comprehensively review the performance of the transportation safety.



Inclusiveness: Drivers are actively included in all plant functions and initiatives such as **award celebrations, Mandir Pooja, Vishwakarma Pooja, Mahaprasad, mass communication meetings, Republic Day and Independence Day celebrations, Birthday celebrations, Mega cleaning and monthly safety campaigns**. This involvement making them feel valued as an integral part of the plant community and society.









8 Amenities for Truck Drivers:

Truck drivers spend a certain amount of time for loading and unloading material at the plant, recognising the need to provide decent amenities during waiting times, provide clean rest rooms, sleeping arrangements, mobile charging points, a sanitisation facility, and a canteen facility with food. implemented Truck Yard Management and Maintenance Guidelines, laying down the following as the minimum basic requirements at their truck yards.

Minimum basic requirements at the truck yard

1. Driver rest rooms: A concreted driver rest room with adequate space, beds for resting, proper illumination, television and ceiling fan, reading facility (Newspaper, books etc.).
2. Clean toilets/washrooms: A hygienically maintained clean toilet/washroom facility.
3. Safe drinking water: Adequate number of water coolers with safe drinking water.
4. Driver's canteen: A driver's canteen serving hygienic food for all the drivers.

* * *

Road Safety Signage and Signs

SANDEEP SAMISHETTY, Manager (Safety), Rashtriya Ispat Nigam Ltd.,Vizag Steel Plant, Visakhapatnam, A.P. E-mail: sandeep.cbit@gmail.com

1 Introduction

Driving a motor vehicle is not a right. Rather, it is a privilege and this privilege comes with many responsibilities. In order to enjoy the privilege of driving, it is important that you should know what laws, rules and regulations exist for safe driving and must follow them at all times. As the driver of a vehicle, your aim should be to make driving a safe and enjoyable experience for yourself, for the passengers in your vehicle, as well as for other drivers sharing the road. Driving is a complex task and complicated situations can arise at any point of time. How you react to such situations depends upon your training, alertness and your attitude while driving.

Lack of knowledge and perpetual disobedience of traffic rules have made our roads extremely unsafe. It does not come as a surprise that most of the drivers of motor vehicles, pedestrians, cyclists and even the traffic police personnel managing and controlling traffic on the roads are not fully aware of the traffic rules and driving regulations. Lack of awareness of the basic concepts of safe or defensive driving coupled with poor enforcement of rules of the road have resulted in chaotic driving conditions on Indian roads. More than 1,50,000 persons die in accidents on Indian roads every year.

The situation on the road safety front will not improve unless the prospective drivers are imparted proper training. One of the most important steps to bring some discipline on the roads and prevent accidents is to offer quality driver training and implement an effective licensing system.

2 The Essence and Origin of Road Signs:

The Road Signs we see around us date long back in history. The earliest road signs were milestones, giving distance or direction. The Romans erected stone columns throughout their empire giving the distance to Rome. In the Middle Ages, multidirectional signs at intersections became common, giving directions to cities and towns. Since roads do not see borders and boundaries and road safety being a universal concern, it was decided to have a common language for road signs. It was recognized that international uniformity of road signs, signals and symbols is necessary to facilitate transboundary international road traffic and road safety. With advent of motorized traffic and its increasing pressure on road, many countries have adopted pictorial signs and standardized their signs to facilitate international travel, where language differences would create barriers, and in general to help enhance traffic safety through appropriate caution, regulation and informatory signs. Most of these pictorial signs use symbols in place of words and have international recognition and acceptance. These signs were primarily evolved in Europe, and have been adopted by most countries to varying extents.

The UNECE has since 1947 made road safety one of its major concerns, in particular through the Working Party on Road Traffic Safety known as WP .1. UNECE pioneered road safety activities in the United Nations system with the establishment of an Ad Hoc Working Group on the prevention of road accidents in 1950 known as Working Party 1 (WP .1.). Under its auspices several international legal instruments have been drawn up. These legal instruments in general and the Conventions in particular are important points of reference for the international harmonization of regulations governing traffic, signs and signals and driving behaviour

A treaty was signed on 19th Sept 1949 under Convention on Protocol on Road Signs and Signals in Geneva under the aegis of United Nations Economic Commission of Europe. This came into force on 20th December 1953 and was registered on the same day. India is also a party to the treaty. Contracting parties were desirous of developing and harmonising, to the greatest possible extent, the road signs and markings in their respective countries.

Subsequently during a Convention on Road Signs and Signals held on 8th November 1968 in Vienna, amendments were incorporated and Road Safety was comprehensively deliberated upon. It was imperative upon contracting parties to have uniformity of usage of signs.

In addition to these legal instruments, WP .1 has issued two Consolidated Resolutions, on road traffic (R.E.1) and on road signs and signals (R.E.2), to reinforce the 1968 Conventions and the European Agreements supplementing them. While these Resolutions do not have the binding force of the Conventions, they go into more detail and furnish a catalogue of measures and practices that States are called on to implement on a voluntary basis.

Today, WP.1 remains the only permanent body in the United Nations system that focuses on improving road safety. Its primary function is to serve as guardian of the United Nations legal instruments aimed at harmonizing traffic rules.

In India, Motor Vehicle Act 1988 has laid down the uniform Road Signs in its Schedule I which comprehensively explains the shape and sizes of these road signs. One may find differences in this book from the said Schedule I of the MVA which is under review to bring it in conformity with the above mentioned international conventions. The signs and signages as depicted in this book are in conformity

with the international conventions mentioned above.

3 Road Safety Signage and Signs: A Key Element of Traffic Safety

Road safety signage and signs are fundamental components of any transportation system, providing essential information to drivers, pedestrians, and cyclists. These signs are designed to enhance safety, reduce accidents, and ensure the smooth flow of traffic. Road safety signs serve multiple purposes: they regulate traffic behavior, warn of potential hazards, guide vehicles through road networks, and inform users of necessary actions to take in specific situations.

The importance of road safety signs lies in their ability to prevent accidents by giving clear, concise, and timely information. These signs are typically categorized into three main types: **regulatory signs, warning signs, and informational signs**.

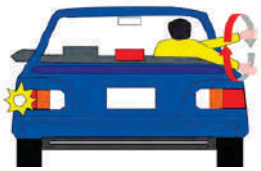
Proper road safety signage is vital in minimizing confusion, reducing the likelihood of accidents, and ensuring the safety of all road users. Clear and visible signage, with well-thought-out placement and regular maintenance, helps keep roads organized, predictable, and secure. In addition to their practical functions, effective signage helps in the creation of a safety-conscious driving culture, where both individuals and communities prioritize road safety.

4 Road Signs

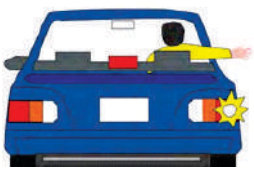
Signals play an important role during smooth movement of traffic. Road signals are to be followed systematically, otherwise it may cause accidents

A) Arm Signals:

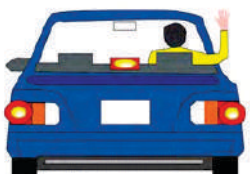
Arm signals are needed when a vehicle's indicators are not used, or when necessary to reinforce direction indicator signals and stop lights



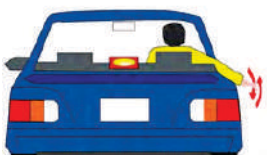
a) Intending to move to the left or turn left



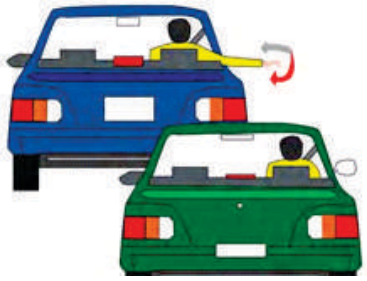
b) Intending to move out to the right or turn right



c) Intending to stop



d) Intending to slowdown



e) Indicating the car following you to overtake

B) Traffic/Road Signs:

Article 5 of Chapter II of the Convention on Road Signs and Signals held on 8th November 1968 lays down the classes of Road Signs, which were broadly categorized into:

i) Regulatory signs (Circle symbols)

ii) Danger warning signs (Triangle Symbols)

iii) Informative signs (Rectangular symbols)

There are three basic types of traffic sign: signs that give orders, signs that warn and signs that give information. Each type has a different shape. Circles give orders, Triangles warn and Rectangles inform. Article 6 of Chapter II primarily spells the modalities for erection of road signs. It has provided that signs shall be so placed that the drivers for whom they are intended can recognize them easily and in time. The location and the manner of placing these signs have been described at length. Road Signs are placed beside or above the highways or streets. If the positioning of the signs is not supported by any visual considerations, these may become destructive rather than effective means of guiding the motorists. Pictorial signs are used as symbols in place of words to allow comprehension independent of the language of the region and are usually a result of international standards.



(A) Circles



(B) Triangles



(C) Rectangles



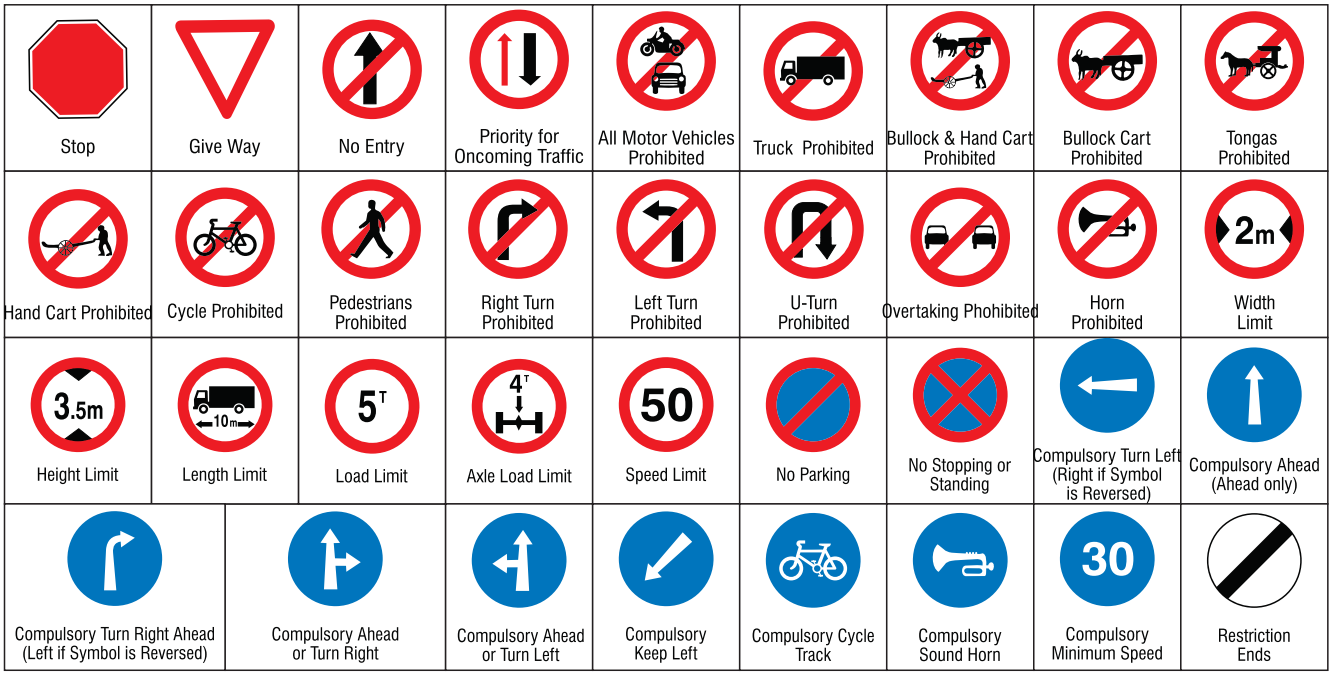
A further guide to the function of a sign is its colour. Blue circles give a mandatory instruction, such as "Compulsory Turn Left" etc. Blue rectangles are used for information signs. All triangular signs are red.



There are a few exceptions to the shape and colour rules, to give certain signs greater prominence. Examples are the "STOP" and "GIVE WAY".

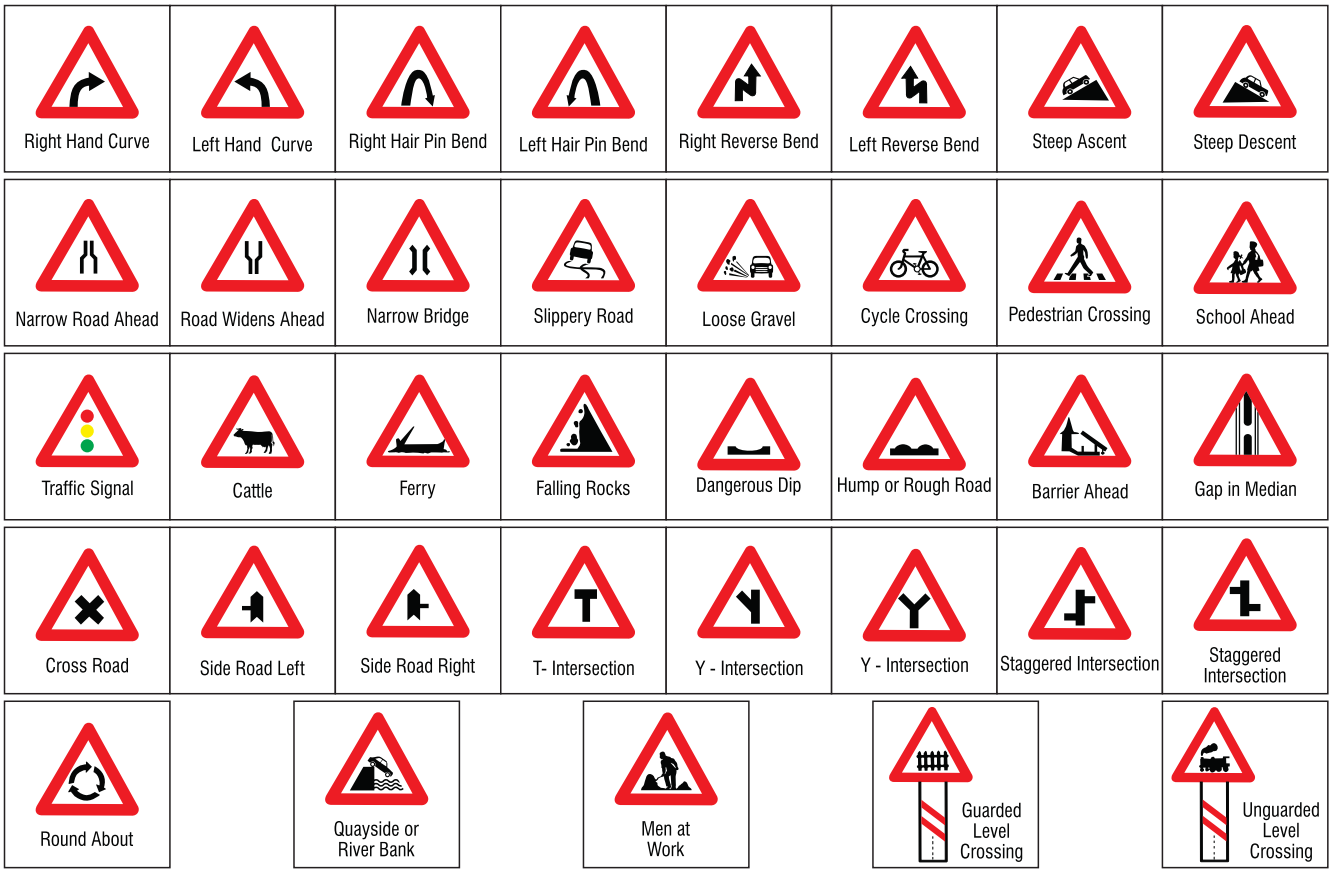
i) Regulatory /Mandatory Signs:

These signs are obligatory on the traffic which uses a specific are of road. These signs indicate what must one do, rather than must not do. Mandatory Road signs are generally round in shape with red border. Some of them are blue in colour. 'Stop' and 'Give Way' are octagon and triangular, respectively, in shape. Violation of these signs attract heavy fines and punishments. Importantly, violation of these could lead to major crashes also.



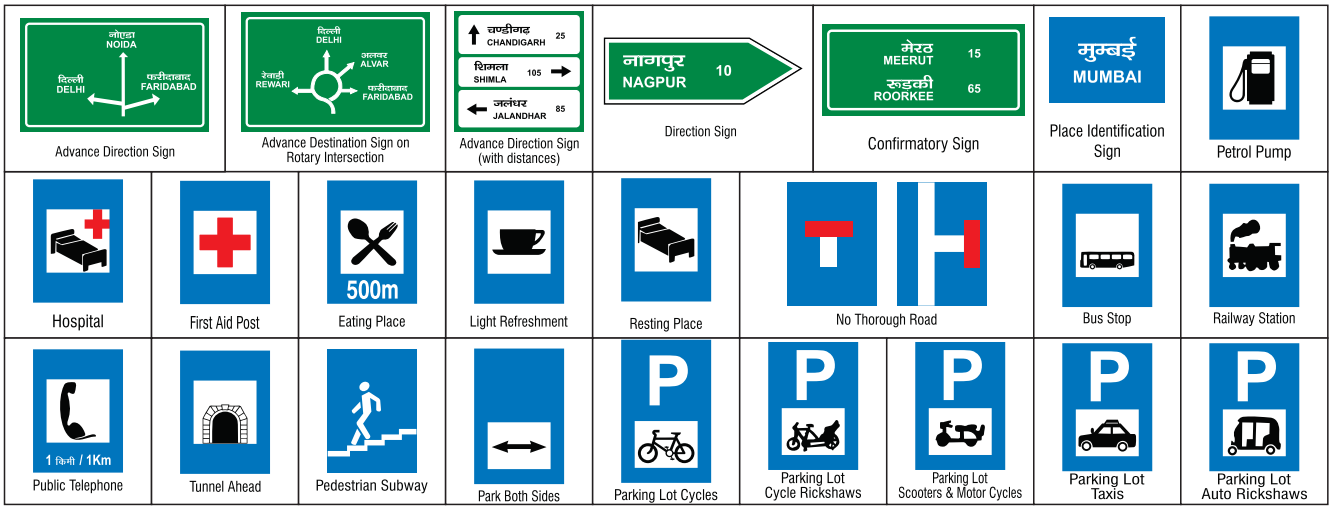
ii) Cautionary Road Signs

These signs are meant to caution the driver about the hazards/situation lying ahead on the road. The driver should obey these for his safety. Though violation of these Road sign do not attract any legal action, they are very important for the fact that avoiding them could result in major crashes. Cautionary signs are triangular in shape with red border.



iii) Informatory Signs

These signs are meant to provide information on direction, destination, roadside facilities, etc. to the road user. Following informative road signs helps a driver in saving time, reaching destination without wandering around. These signs are generally facilitators to the driver and signs are normally blue in colour. The sign may have direction arrow and also the distance of facility from the sign.



C) Road Markings:

A well-designed road should "speak" to the drivers and guide them. This reduces both the decision-making time and the likelihood of a crash. However, as a driver, you should know the language that the road is speaking. Road markings bridge this gap.

Each road marking has a specific purpose: **Your safety**. This will be clear through some examples:

1. Solid white lines are used along sharp curves to indicate drivers to slow down. A speeding vehicle might leave the lane at curves.
2. Solid lines are also used to mark the road edge. This is done to prevent vehicles from going off-road.
3. Wide roads with multiple lanes on both sides and no physical dividers have double solid lines. This is because wide roads usually encourage drivers to drive at a higher speed. And any vehicle that crosses onto the opposite side at high speed is going to increase the likelihood of a crash. The double white lines indicate that crossing to the other side is strictly prohibited.
4. Intersections create a scenario for multiple conflicts between vehicles and pedestrians. Road markings such as STOP signs or Pedestrian (Zebra) Crossings are specifically designed to warn drivers of impending danger.
5. Glowing road markings provide directions and improve safety at night.

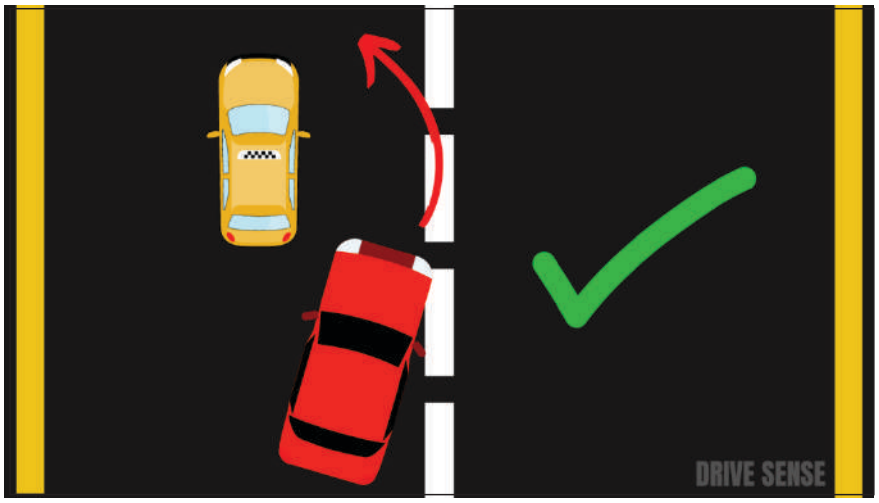
Different type of road marking in India

i) Broken White/Yellow Line

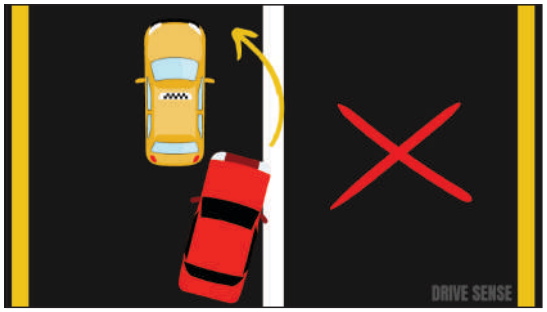
Broken lines are generally used as lane separators. A broken line on the road indicates that:

1. You are permitted to change lanes on a multi-lane road.
2. You can cross over the line to overtake on an undivided road.
3. You can take a U-turn.

The broken white line is the most liberal marking. However, this does not mean you can drive however you want. Always be aware of your surroundings. Leave your lane only when it is safe to do so.



ii) Solid/Continuous White or Yellow Lines



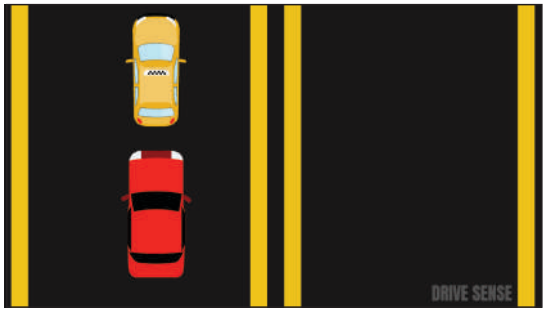
The solid line is much stricter than the broken white line. When you see a solid white line, you need to know that:

1. You are not allowed to change lanes.
2. You are allowed to overtake as long as you are not crossing the line.
3. You are not allowed to take a U-turn.
4. You are allowed to take a left/right turn to exit the road.

You can cross a solid line only to avoid an emergency such as a crash. Solid lines are found at locations where changing lanes or overtaking is risky, such as narrow roads with heavy traffic or sharp curves.

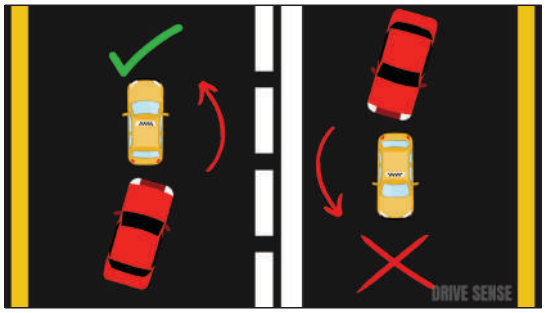
Solid lines are also used as "Edge lines" to mark the outer edge of the drivable section of the road.

iii) Double Solid Lines



The strictest of all road markings. A double yellow marking means that you cannot cross the lane line, no matter the scenario. Consider these lines as the "Laxman Rekha" of road markings. You will find these markings on wide roads (multiple lanes) with no physical divider

iii) Combination of Broken and Solid Lines



Combine the broken and solid lines and you get this type of road marking. Driving rules depend on which type of line borders your side of the road:

1. If your side of the road has a broken line, you follow the rules for the standard broken lines i.e. you can overtake, take a u-turn, etc.
2. If your side of the road has a solid line, you simply cannot cross the line. You cannot overtake, cannot take a turn, etc.

Combination lines are used only in specific scenarios.

5 Code of Practice for Road Signs

i) Purpose of Road Signs

The purpose of Road Signs is to promote road safety and efficiency by providing for t he orderly movement of all road users on all roads in both urban and non-urban areas. Road Signs notify road users of regulations and provide warning and guidance needed for safe, uniform and efficient operation.

To be effective, a road sign should meet five basic requirements:

a) Fulfill a need;
b) Command attention;
c) Convey a clear, simple meaning;
d) Command compliance and
e) Give adequate time for proper response.

Design, placement, operation, maintenance, and uniformity are aspects that should be carefully considered in order to maximize the ability of a road sign to meet these five basic requirements.

ii) Shape

The shape of the sign board should be octagonal circular, triangular or rectangular depending on the nature of sign. It is observed that at many places stop signs, other mandatory and cautionary sign are printed on rectangular boards. This is incorrect

iii) Placement and Operation of Road Signs

Placement of road signs should be within the roar user's view so that adequate visibility is provided to aid in conveying the proper meaning, the road sign should be appropriately positioned with respect to the location, object, or situation to which it applies. The location and legibility of the road sign should be such as to provide adequate response time to road users.

Road Signs or their supports shall not bear any advertising or other message that is not related to traffic

control. However, tourist-oriented directional signs and signs relating to specific wayside services and amenities, when used should not be considered advertising.

Road signs should be placed and operated in a uniform and consistent manner. Road signs which are not necessary or no longer required should be removed. The fact that a sign is in good physical condition should not be a basis for deferring the removal or change, if it is so warranted.

iv) Uniformity of Road Signs

Uniformity of signs simplifies the task of the road user because it helps in recognition and understanding, thereby reducing perception / reaction time.

v) Siting of Signs

The Road signs are the means of communication to the road users, especially drivers. Therefore, the signs shall be so placed that the drivers can recognize them easily and in time. Normally the signs shall be placed on the left-hand side of the road. For two lane roads, normally the signs may be placed on the left side of the carriageway. For multilane divided roads the signs may be placed on left side of each carriageway. In case of hill roads, the signs shall generally be installed on the valley side of the road.

vi) Orientation of Signs

The signs shall normally be placed at right angles to the line of travel of the approaching traffic. Signs relating to parking, however, should be fixed at an angle (approximately) 15 degrees to the carriageway so as to give better visibility. On horizontal curves, the sign should not be fixed normal to the carriageway but the angle of placement should be determined with regard to the course of the approaching traffic. Sign faces are normally vertical, but on gradients it may be desirable to tilt a sign forward or backward from the vertical to make it normal to the line of sight and improve the viewing angle.

vii) Sizes of Signs

As a general rule, there shall be three sizes (small, normal and large) of signs for mandatory/regulatory and cautionary/warning signs. The normal size shall be used for main roads and the small size shall be used for less important roads. For Urban roads and Expressways, reference may please be made to IRC: 67-2012. General dimensions of different categories of signs IRC 67-2012 document may be referred.

viii) Visibility of Signs

In order to make signs more visible and legible at night, in particular cautionary / warning signs and regulatory signs other than those regulating parking and stopping in lighted streets of built-up areas shall be lighted or provided with reflective material including luminous paints or reflective devices and sheeting Care should, however, be taken that this does not result in road users becoming dazzled.

ix) Sizes of Letters

Letter size should be chosen with due regard to the speed, classification and location of the road, so that the sign is of adequate size for legibility but without being too large or obtrusive.

x) Definition Plates / Supplementary Plates

The definition plate shall have white background of retro-reflective and black letters and black border 20 mm wide. Numerals shall be inscribed in international form of Indian numerals and word messages shall be in English and/or other languages as necessary. To contain the size of the sign, the number of languages on the signs shall normally be limited to two. Refer IRC: 67-2012.

xi) Combination of Signs

The more the number of signs which drivers are presented with simultaneously, the greater the difficulty they are likely to have in assimilating the information. Generally, therefore, not more than two signs should be erected on anyone post when intended to be read from an approaching vehicle. This also applies to signs mounted at the same location on separate posts. Where a sign requires a supplementary plate, the combination of sign and plat e may be regarded as one sign. STOP or GIVE WAY signs or signs indicating the start of a speed limit (terminal signs) should not be mounted on the same post as a warning sign.

References

- *Motor Vehicles Act, 1988*
- *Central Motor vehicles Rules, 1989*
- *Motor Vehicles (Driving) Regulations, 2017*
- *Roadsafetyguy.com*
- *Book on Road Safety signage and signs by Ministry of Road Transport and Highways, GOI*
- *IRC: 67-2012*

* * *

Asia pacific occupational Safety & Health Organization (APOSHO)

Hosted by:

National Safety Council, India

APOSHO – 39

Safety, Health & Environment

Safer & Healthier World through Innovations and Collaborations

26th – 29th November 2025

YASHOBHOOMI (India International Convention Centre)

Dwarka, New Delhi, India

INVITATION

Dear APOSHO Members,



I am pleased to inform you that the host for the APOSHO-39 is the National Safety Council of India (NSCI). It will be held from 26th to 29th November 2025 in New Delhi, India. As the Chairman of APOSHO-39, NSCI has made significant preparations in advance. The Organizing Committee of APOSHO-39 has chosen the theme for the Conference as **"Safety, Health & Environment – Safer & Healthier World through Innovations and Collaborations"**.

This theme truly reflects the spirit of APOSHO, as it aligns with the aim of every member of the APOSHO family to create safer and healthier working environments across the globe.

This conference is very significant as in 2025, APOSHO will celebrate its 40th Birthday, an impressive milestone. Therefore, it is extremely fitting that it should be hosted by one of our 6 inaugural members.

Please mark your calendars for this significant event. I encourage you to show your eagerness and commitment by registering early. I look forward to seeing you all at APOSHO-39 in New Delhi, India in 2025.

Yours faithfully
Bernie Doyle
Secretary General,
APOSHO

Dear APOSHO Members, NSCI Members, OSH Practitioners and other Associates,



The National Safety Council (NSC) of India is pleased to announce that the 39th Asia Pacific Occupational Safety and Health Organisation (APOSHO) Conference, along with APOSHO Committee Meetings and the AGM, will be held in New Delhi from 26th to 29th November, 2025. The venue for APOSHO-39 will be the India International Convention Centre, YASHOBHOOMI, Dwarka, New Delhi

We are gratified to share that the NSC India has successfully organized the 11th and 31st APOSHO Conferences in 1995 and 2016, respectively. We extend our heartfelt thanks to the members of the APOSHO Main Committee for granting us this opportunity once again.

To highlight the importance of innovative and collaborative efforts in enhancing workforce safety worldwide, we have chosen the theme for the Conference as **"Safety, Health & Environment – Safer & Healthier World through Innovations and Collaboration ".**

As the Director General of NSC India, I am delighted to invite you to take full advantage of this important international event and to delegate a significant number of representatives from your organization. I, especially, look forward to welcoming our international guests and offering them our renowned Indian hospitality.

Yours faithfully,
Dr Lalit R. Gabhane
Director General,
National Safety Council, India

ABOUT APOSHO

The Asia-Pacific Occupational Safety and Health Organization (APOSHO) is an international body composed of non-profit professional organizations devoted to the prevention of occupational accidents and diseases.

The National Safety Council of India (NSCI) is a founding member of the APOSHO. It was set up in 1985 by Safety Councils of six countries of Asia including NSC India with the objective of promoting mutual understanding and co-operation and contributing to enhancement of OHS through exchange of information & views among the communities in the Asia Pacific region. Presently, APOSHO has 36 organisations from 20 countries as its members and meets once every year.

The Annual Meetings & Conference of APOSHO are held annually in different APOSHO member countries by rotation.

IMPORTANT DATES

Early Bird Registration
On or before 31st July 2025

Abstract Submission
By 15th April 2025

Final Paper Submission
By 15th June 2025







APOSHO PROGRAMME

Committee Meetings	26th November 2025 (APOSHO Members only)
Conference & HSE Exhibition	27th & 28th November 2025 (All Delegates)
AGM	29th November 2025 (APOSHO Members only)

CALL FOR PAPERS

We invite experts from industries, research institutions connected with field of Safety, Health and Environment, enforcement agencies, professional bodies and trade unions, government officials and other stakeholders to submit their abstracts on the following thematic areas before 15th April 2025.

THEMATIC AREAS :

- Regulation Readiness in a Changing World of Work
- Vision Zero – Strategy and Practices
- Leadership and Safety Culture
- Emerging Trends in Safety, Health & Environment in EV Vehicles, Renewal Energy, Agriculture Sector, etc.)
- New OSH Tools and Techniques for Managing Risks
- Construction Safety – Challenges & Opportunities
- Logistics, Transportation and Road Safety
- Disaster Management
- Sustainability, Carbon Neutrality
- Measuring Safety and Health Performance
- Safety Risks and Challenges in Business Process Outsourcing
- Well being and Mental Health
- Safety Strategies for an Informal Workforce (service delivery like Zomato, Amazon, Transport workers)
- OSH for Micro, Small and Medium-Sized Enterprises
- Health and Safety in a Digital Future (Work from Home, Remote Work, etc.)
- Operational Safety in High-Risk Industries – Challenges and Solutions (Oil Refinery, Fertilizer, Steel Industry)
- Significance of OHS in ESG Framework
- Engaging Technology in Managing Critical Risks and Controls

For more details, please visit website **https://aposho39.org**

DELEGATE FEES

Delegate Category	Fees for Early Bird (on or before 31st July 2025)	Fees from 1st August 2025 to 30th September 2025	Fees after 1st October 2025
Overseas Delegates			
APOSHO Members	USD 400	USD 450	USD 500
International	USD 450	USD 500	USD 550
Accompanying Persons	USD 200	USD 250	USD 300
Indian Delegates			
NSC Members	Rs. 20,000/-+GST	Rs. 22,000/-+GST	Rs. 24,000/-+GST
NSC Non-members	Rs. 22,000/-+GST	Rs. 24,000/-+GST	Rs. 26,000/-+GST
Trade Union	Rs. 10,000/-+GST	Rs. 11,000/-+GST	Rs. 12,000/-+GST

A Special Discount of 5% for more than 5 Delegates and 10% for more than 10 Delegates, along with full advance payment will be offered.

For registration Visit at https://aposho39.org

Contact

APOSHO 39 Conference Secretariat, National Safety Council
Plot No.98A, Sector 15, Institutional Area, CBD Belapur, Navi Mumbai, Maharashtra – 400 614, India.
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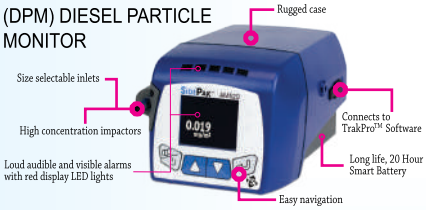


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