

## Risk ASSESSMENT

This section discusses briefly the risks with the project and its Disaster Management Plan / Emergency Control Plan to eliminate/reduce/offset the intensity of the impact. To minimize the risk the NHAI has road safety manual to be followed while designing. They are as follows:

- Ministry's circular No. RWINH-35072/04/2004-SftR(R) dated 27.04.2010 regarding Road Safety - Engineering Measures.
- IRC:99-2018" Guidelines for Traffic Calming Measures in Urban and Rural Areas" .
- IRC:119-2015 "Guidelines for Traffic Safety Barriers"
- Ministry's circular No. RW/NH-29020/1/2015-PftM (RSCE) dated 07.09.2016 regarding Provision of Road Safety items.
- Ministry's circular No. RWINH-29011/1112015-PftM (RSCE)dated 04.07.2018 regarding Road Safety Audit.
- IRC:SP-88-2019" Road Safety Audit Manual".
- IRC:103-2012 "Guidelines for Pedestrian Facilities".
- IRC:67-2012 "Code of practice for Road Signs".
- Ministry's circular No. RW-NH-29011/01/2019-SftR(PftB) dated 26.08.2019 regarding Rectification of Accident Black Spot.

The Ministry of Road Highways and Transport (MoRTH) and Indian Road Congress (IRC) has issued various Code and Guidelines, time to time to implement various road safety measures so as to minimize the accidents on National Highways during construction and operation phase of the project. The hazard identification and risk assessment have been carried out for following stages for this project:

- During construction phase
- During operation phase

Risk assessment is a process that seeks to estimate the likelihood of occurrence of adverse effects as a result of major road mishaps, gas tanker explosions, fire hazards, floods, cyclones, earth quakes etc. at Highway projects. Fatality rate on Indian highways is very high mainly due to road accidents. The other adverse impacts due to gas tanker explosions, fire hazards, floods, cyclones, earth quakes etc. are nominal. Elimination of the risk (avoidance of accidents) is given prime importance and NHAI has introduced road safety provisions during the design of highway with the help of Road Safety Manual. Some of these are listed below:

- Safety barriers/delineators hard shoulders on main roads
- Traffic signs and pavement markings
- Underpasses and other grade separators at congested junctions
- Removal of junctions and direct access points on main roads



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- Improved median openings with stacking lanes
- Separate provisions and direct access point
- Service roads in towns and villages for segregating local and highways traffic.
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Contractor shall conduct third party Risk Assessment for all works to decide on priorities and to set objectives for eliminating hazards and reducing risks.

The next stage in the risk assessment is the control of the risk. When assessing the adequacy of existing controls or introducing new controls, a hierarchy of risk controls should be considered. The principles are:

- Avoiding risks.
- Evaluating the risks which cannot be avoided.
- Combating the risks at source.

Adapting the work to the individual, especially as regards the design of the workplace, the choice of work equipment and the choice of working and production methods, with a view, in particular, to alleviating monotonous work and work at a predetermined work rate and to reducing their effects on health.

### **7.1. ADAPTING SAFETY MEASURES**

Replacing the dangerous by the non-dangerous or the less dangerous. Developing a coherent overall prevention policy which covers technology, organization of work, working conditions, social relationships and the influence of factors relating to the working environment.

#### **7.1.1. Hazards during Construction Phase**

Potential hazards during the construction phase can be minimize by giving collective protective measures priority over individual protective measures and giving appropriate instruction to employees. In addition to the above the following principles shall also to be employed:

- Eliminating;
- Substitution;
- Applying engineering controls (e.g. isolation, insulation and ventilation); • Reduced or limited time exposure; • Good housekeeping; • Safe systems of work, Method Statement, permit to work,
- Training and information;
- Personal protective equipment;
- Welfare;
- Monitoring and supervision;
- Review



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### **7.1.2. Emergency Preparedness Plan**

A construction site can be a difficult and dangerous place to work. A good construction emergency action plan will help people take quick and effective action in the event of a disaster. It will help in easing the severity of the situation and limit the consequences.

A response plan establishes an organization's procedures and structures for response to emergencies. Emergency action plans provide strategies to combat specific situations, and assigns and responsibilities for implementation employees must follow during an emergency.

A few examples of emergencies that should be planned for at construction sites include:

- Chemical Spill
- Fire
- Floods
- Wind
- Explosions
- Electrocution
- Extended Power Loss
- Medical Injuries
- Poisoning
- Toxic Gas Releases
- Structural Failures
- Respiratory threat from silica

#### **7.1.2.1. Emergency Numbers**

One of the most important pieces of information an employer needs is a list of all internal personnel who work for the company. The list will include the duties they will handle in the case of potential workplace emergencies.

Names, areas of responsibility, and contact numbers of each individual should be included in the list. The list should also include the phone numbers of external support sources like:

#### **Emergency Contact Number**

- 100 – Police
- 101 – Fire
- 102 – Ambulance
- 103 – Traffic Police
- 1033 – Emergency Relief Centre on National Highways
- 104 – State level helpline for Health
- 104 – Hospital on Wheels
- 1066 – Anti -poison
- 1070 – Central Relief Commissioner for Natural Calamities
- 1070 – Relief Commissioners of Central/State/Union territory
- 1073 – Road Accident
- 1073 – Traffic Help Line



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- 1077 – Control room of District Collector/Magistrate
- 108 – Disaster management
- 1090 – Anti -terror Helpline/Alert All India
- 1091 – Women in Distress
- 1092 – Earth -quake Help line service
- 1096 – Natural disaster control room
- 1099 – Central Accident and Trauma Services
- 1099 – Catastrophe & Trauma service
- 112 – General emergency Department of Telecommunications (DoT)

#### **7.1.2.2. Chemical Spills**

Chemical spills are dangerous if they are not immediately contained. The designated emergency coordinator should be notified. The site should be secured. The spill should be cleaned only by trained personnel. Proper equipment should always be used for the cleaning process. If trained personnel are not available, use a professional chemical spill cleanup company.

#### **7.1.2.3. Weather**

Weather can affect the construction business in a big way. Floods, earthquakes, hurricanes, and tornadoes have the potential to affect your business. Good policies and procedures will help in dealing with severe weather.

#### **7.1.2.4. Fire**

Activate the alarm system and call for emergency assistance if there is a fire. Always notify the fire department before you start fighting the fire. If the blaze is small and not spreading, you should use proper equipment to fight the fire. Proper evacuation procedures should be followed.

#### **7.1.2.5. Structural Accident**

Bridges, towers, and scaffolding are common structures at construction sites. Accidents involving these structures can be serious and often life threatening. All structures should be listed, and the emergency action plans should be developed for each structure. Employees working around the structures should be familiar with all required procedures.

#### **7.1.2.6. Training the Employees**

All employees at the construction site should be trained, preparing them for any eventuality. The builders risk insurance premiums will also be less if the employees are trained in handling emergencies.

#### **7.1.2.7. Fire and Explosion Hazard**

At construction site and construction camps, stack yards etc suitable type of fire extinguishers shall be positioned at applicable areas including vehicles. To meet any emergency at work spot during any hot work, provision of enough number of fire extinguishers is ensured. Also First Aid boxes are kept at fixed locations to provide first aid in case of any injury.



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#### **7.1.2.8. Road Accident**

Risk and Hazard Due To External Traffic Are As Follows

- Construction workers hit by external vehicles while working.
- Injury to Pedestrians:
- Due to fall in excavated trenches.
- Hit by construction equipment / vehicle.
- As they use carriageway due to blockage / absence of footpath.
- Collision due to improper traffic management.
- Between external vehicle and construction equipment / vehicle.
- Between external vehicles.
- External vehicle with other stationery objects in the side of the road

Objectives & Guidelines

- Warn the road user clearly and sufficiently in advance.
- Provide safe and clearly marked lanes for guiding users.
- Provide safe and clearly marked buffer and work zones.
- Provide adequate measures that control driver behaviour through construction zones

#### **7.1.2.9. Traffic Control Plan**

This plan gives the detailed guideline for traffic management in most of the common situations at our Projects. Traffic Control Plan for a specific road sections should be prepared based on this general guideline and applying the following variables, which may vary from project to project. The variables are:

- Average Vehicular Traffic Density in peak and non-peak hours.
- Maximum width of lane required for construction during various activities.
- Number and types of junctions in the road.
- Availability of standard footpath and its location and dimensions.
- Change in the lane width if any and its location.
- Regulatory and advisory speed limits etc.

#### **7.1.2.10. TRAFFIC CONTROL DEVICES**

Traffic control devices used to regulate the traffic in Road Construction Zones include,

- Road Signs
- Delineators
- Barricades
- Cones
- Pylons
- Pavement markings
- Flashing lights



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#### 7.1.2.11. Traffic Management at work place

The contractor will abide by the Guidelines on Safety in Road Construction Zones; IRC:SP:55-2014; issued by Indian Road Congress. As per the IRC Work zone accidents are caused by several factors such as frequently changing environment that occurs during road work whereby the driver is often surprised, insufficient warning signs for normal and construction traffic, lack of audible warning to workers and, inadequate provisions of safety devices to protect workers.

At most work zones, normal traffic is never more than 15 meters away from construction activities. Major contributing factors to work zone accidents are not paying sufficient attention, going too fast for the prevailing conditions, failure to yield the right-of-way and, following too close. An ideal way to reduce work zone accidents is to create a working area that does not influence the normal traffic flow by segregating and shielding the site.

#### 7.1.2.12. Work Zone Area

A work zone is an area where road user operating conditions are changed because of construction and maintenance activities. The construction and maintenance activities would involve movement of workers and construction equipment requiring dedicated space for performing the activities and moving materials for the activities. The presence of regular traffic and works traffic makes the work zone a potential zone of conflict resulting in disruption to normal traffic and hazards.

A work zone should be earmarked by the presence of signs, channelizing devices, barriers, pavement markings, and/or work vehicles. It extends from the first warning sign or high-intensity rotating flashing or oscillating or strobe lights installed on roadside or a vehicle-mounted sign posted to indicate the work zone, and continues to delineate the channelized vehicle paths till up to the end road work sign.

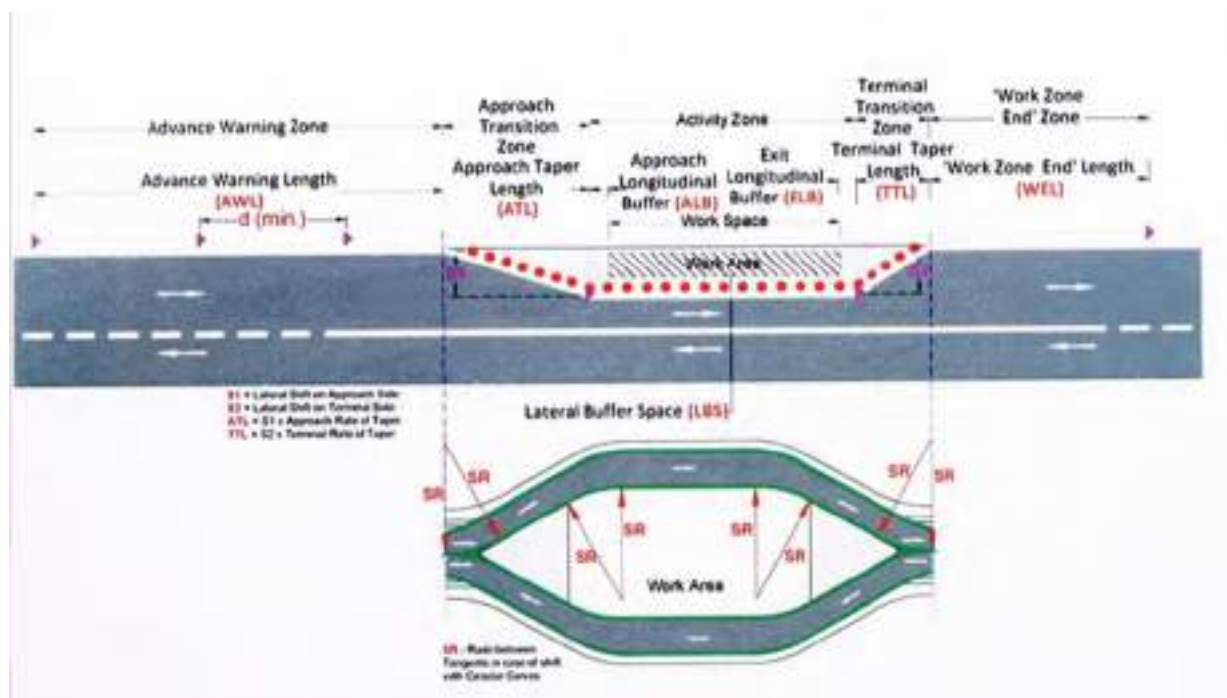


Figure: Traffic Control Zone at Construction Site



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#### 7.1.2.13. Working Space

The space around the works area that will require storing tools, excavated material and other equipment. It is also the space to allow workmen, movement and operation of plant, (e.g. swing of jibs, excavator arms) to move around to do the job. Materials and equipment must not be placed in the zone either. Workmen will only need to enter the zone to maintain cones and another road sign.



Figure: Road Signage in construction Zone

#### 7.1.2.14. Traffic Signals

The Contractor should follow IRC SP 67-2012; Code of Practice for Road Signs for operation phase of the project. The purpose of road signs is to promote road safety and efficiency by



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providing for the 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. The road signages are highlighted in figure below.

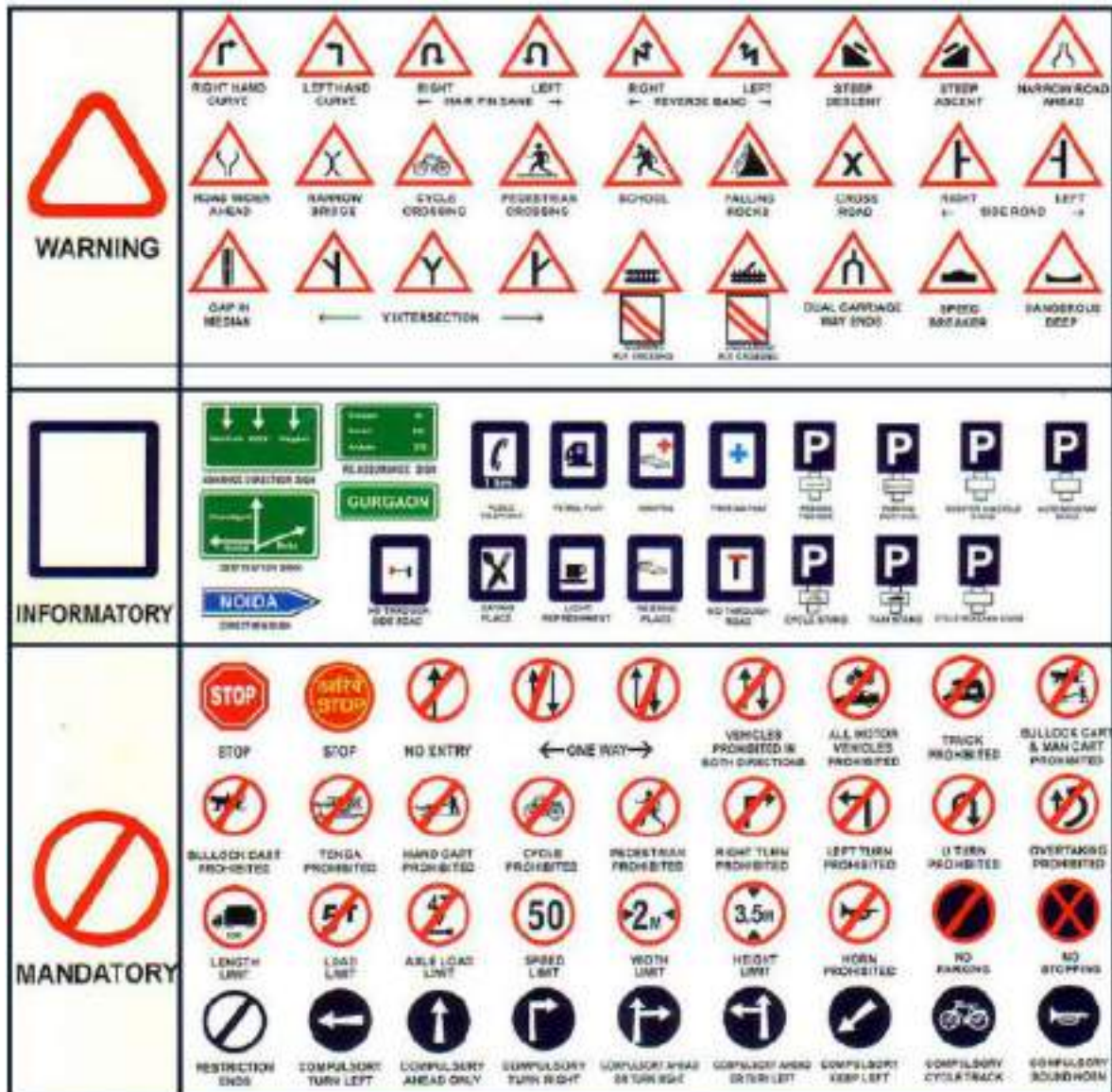


Figure: Road Signages

#### 7.1.2.15. Road Safety Audit

The road safety audits are tools to check the safety aspects of new/ existing roads and traffic management plan, which also include modifications if required in the existing roads for safety of travelers. The India Roads Congress **IRC SP:88-2015 “Manual on Road Safety Audit” and Manual on Road Safety Audit (First Revision) IRC SP:88-2019, need to be followed for safety of roads during Planning, (DPR) Design stage, Construction, Pre-opening and Existing Roads.** The road safety Audit stages for the roads are discussed in



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**Table Error! No text of specified style in document.-1: Suggested Stage for Road Safety Audits**

| <b>Audit</b>          | <b>Expressways</b>                     | <b>National Highway</b> | <b>State Highways</b> | <b>Major District Roads</b> | <b>Urban Arterial, Sub Arterial and Collector Roads</b> | <b>Local Streets, Rural Roads</b> |
|-----------------------|----------------------------------------|-------------------------|-----------------------|-----------------------------|---------------------------------------------------------|-----------------------------------|
| <b>Planning</b>       | ✓                                      | <b>Optional</b>         | <b>Optional</b>       | <b>Optional</b>             | <b>Optional</b>                                         | <b>N/A</b>                        |
| <b>DPR</b>            | ✓                                      | ✓                       | ✓                     | ✓                           | ✓                                                       | ✓                                 |
| <b>Construction</b>   | ✓                                      | ✓                       | ✓                     | Optional                    | Optional                                                | Optional                          |
| <b>Pre-opening</b>    | ✓                                      | ✓                       | ✓                     | Optional                    | ✓                                                       | Optional                          |
| <b>Existing Roads</b> | According to Local policy and resource |                         |                       |                             |                                                         |                                   |

**Source: IRC SP:88-2019 (Manual on Road Safety Audit (First Revision))**

**Objective of Road Safety Audit:** The main objective of road safety audit is to minimize the risk of crashes occurrence on an existing roads/ a new road project.

- To ensure high levels of safety on road projects
- Reduce whole-life costs of projects
- Minimize accidents risk on the adjoining road network
- Promote the safety of all road users
- Promote road safety engineering

#### **Safety concerns and Audits Findings on Existing Roads:**

- Sight Distance
- Intersection & Interchanges
- Geometric Issues: Cross Sections
- Roadside Hazards
- Drainage
- Signs, Pavement Markings & Delineating
- Vulnerable Roads Users (Pedestrian, Bicyclist, two & three wheelers and animals Drawn carts)
- Access to property and developments
- Lighting and Night time issues
- Bus stop & Bus Bays
- General Road safety considerations

#### **➤ Vulnerable Roads Users:**

The safety audit should uniqueness of mix traffic, i.e Pedestrians, bicycles, motorcycle, rickshaws, and animals drawn carts mix with cars, trucks, buses and countless other vehicles at all times of day and night.



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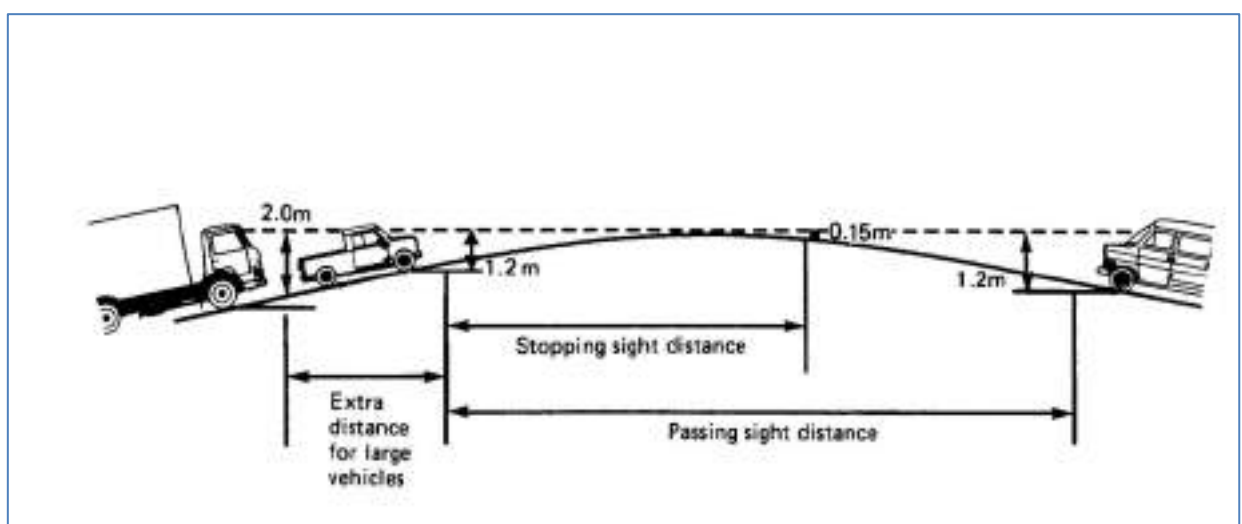
During safety audit, safety enhancement measures can be audit. The auditor should carry out audit considering him/her as vulnerable road users.



Figure: Mix Traffic on Busy Roads

#### ➤ Sight Distance:

Safe stopping sight distance is measured between two points, one 1.2 m above the carriageway standing for in driver's eye and the other 0.15 m height representing the object. The sight distance is discussed in figure below.





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### ➤ **Horizontal Alignment**

Minimum Radius of curve should be provided as per design speed. If not possible speed limit sign should be installed and measures to ensure its adherence be employed. Transition curves at ends should be consistent with design speed/speed limit. Super elevation should be as per design speed/ speed limit.

### ➤ **Vertical Alignment**

The Safety measures for vertical alignment need to be assess during safety audits are:

- Provide adequate sight distances
- Broken-back curves should be avoided
- Frequent changes in vertical profile should be avoided
- On long grades, steepest grade should be placed at the bottom and lighter grade near top.
- Sag curves associated with underpasses, curve lengths must be chosen to ensure the necessary vertical clearances and to maintain adequate sight distances into the underpass.

### ➤ **Typical Cross Section**

For typical cross-section the safe measures need to be look in during road safety audits are as follows:

- Properly maintained cross-sectional profiles assist safety.
- Side slope gradients for embankments and drains should be as flat as possible.
- Open channel drains should be covered or separated from the carriageway.
- Incorporation of properly maintained shoulder allows room for parking, in emergency use and segregation of pedestrians.
- Provision of the number of lanes primarily dependent on the projected traffic volume.
- **Shoulders**

The safe practices required for shoulders are as follows:

- Shoulder should support vehicles under all weather conditions.
- Hard shoulders, should be differentiated from carriageway
- Edge line markings help to discourage traffic from using the shoulder
- Shoulder cross slopes should be so designed as to avoid draining onto the carriageway.

### ➤ **Median Barrier**

Median Barrier are designed to segregate and prevent certain opposing pedestrian and vehicle movements. Some of the problems of median barrier are:

- Inadequate pedestrian crossing provisions will encourage pedestrians to climb over the barriers and ignore their purpose.
- Median barriers without gaps for emergency vehicles can cause delays and congestion if vehicles break down.
- Poor design and maintenance such as unprotected ends or damaged and stolen sections.
- Clear and effective signing along with enforcement is necessary to ensure that drivers drive on the correct side of the barrier.



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### ➤ **Median Gaps**

The safety practices for median gaps are as follows:

- Their number should be kept to the minimum.
- Openings for right turns through bullet nosed shape should be adopted.
- Openings for U-turns, semi-circular openings are more appropriate for the vehicle paths.
- Median openings in urban areas: should be spaced at 500m on the more important arterial roads.
- Median openings for four lane divided carriageways and expressways should be located near all terminal junctions.

### ➤ **Service roads**

Safety issues adopted for service roads are as follows:

- Service roads may be continuous or intermittent, they may be on one or both sides, and they may have one-way or two-way traffic.
- Service roads provided are invisible due to encroachments observed on these service roads.
- Absence of adequate truck parking facilities on highways/City Zonal Road leads vehicles to parked on service roads, thus negating the benefits of service roads to the vulnerable road users.
- Absence of service roads increases pedestrianvehicular conflicts and road safety is threatened.

### ➤ **Unregulated access**

The main concern for unregulated access is the side road traffic from towns/villages joining the high speed corridor is highly unsafe. If they are not controlled before entering into the main road, each access point could become a blackspot.

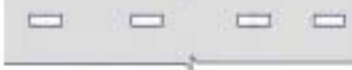
The road safety auditor should take care of the followings during audits:

- The speed of the side road traffic should be curtailed before it enters the main road with a provision of road hump of 3.7m chord length in the side road. The hump should be provided for all side roads, where it joins NH directly without through a service road.
- Hump shall be placed around 12m to 15m away from the edge line of the main road so that a vehicle approaching the main road shall mount the hump and then wait to see an opportunity to enter into main stream. Similarly, vehicles exiting from main road can fully leave (full length of vehicle) from traffic way of main carriageway and then mount the hump in order to avoid any possible rear end collision.
- Install hump warning signs in advance and informatory sign at the location of hump. All signs should be installed at the side road only. Also, properly mark the hump as per IRC.
- Mark Stop marking and Install stop sign at 2-4m away from stop marking to establish the control.

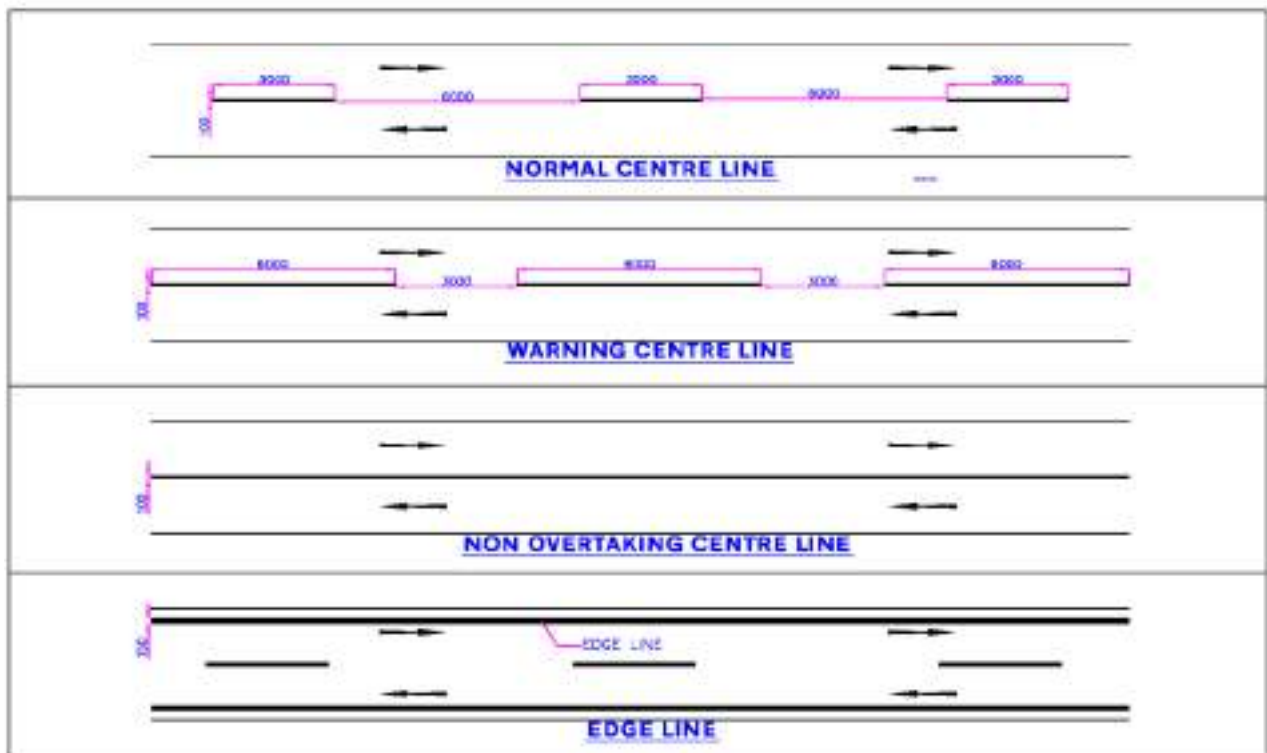


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### ➤ Pavement Marking

| Type of line                          | Figure                                                                                                                   | Description                                                                                                                                                                                                                       |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Broken line                           | <br>SINGLE BROKEN LINE                  | Broken lines are permissive in character and may be crossed with discretion, if traffic permits                                                                                                                                   |
| Solid lines                           | <br>SINGLE SOLID LINE                   | Solid lines are restrictive in character and indicate that crossing is not permitted except for entry or exit from a side road.                                                                                                   |
| Double solid lines                    | <br>PAIR OF SOLID LINES                 | Double solid lines indicate maximum restrictions and are not to be crossed except in emergent usage                                                                                                                               |
| Combination of broken and solid lines | <br>COMBINATION OF BROKEN & SOLID LINES | In a combination of broken and solid lines, a solid line may be crossed, with discretion, if the broken line is nearer to the direction of travel. Vehicle from the opposite directions are not permitted to cross the solid line |

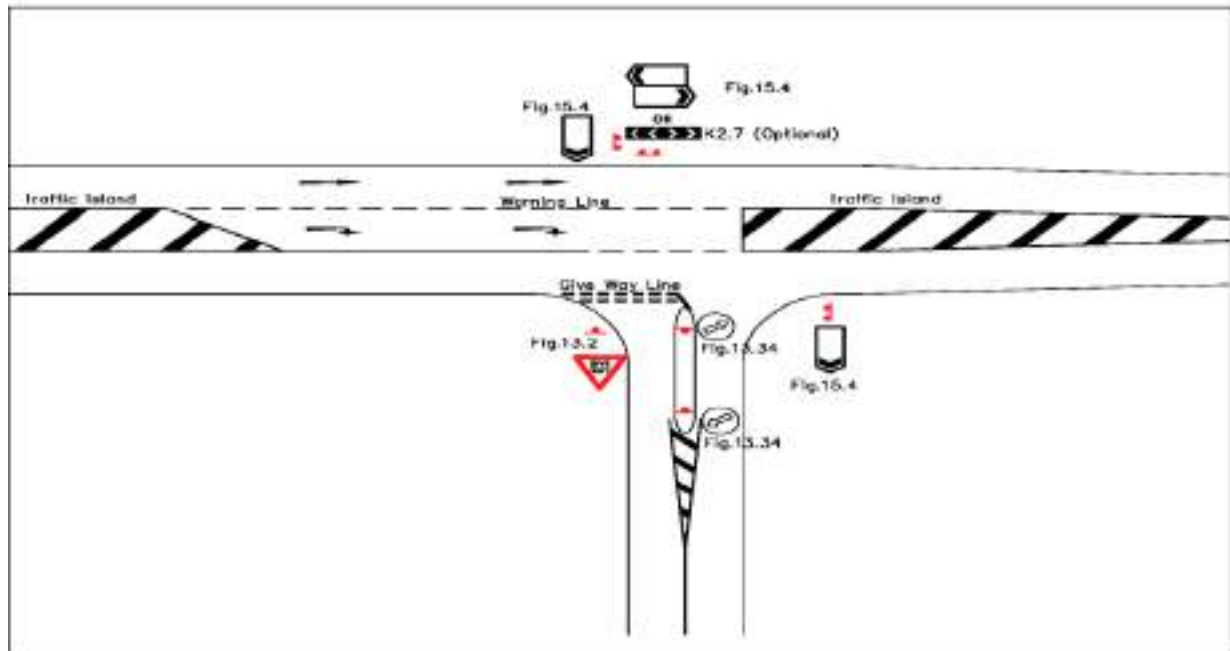
## Line Markings





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## Typical Junction Markings



## Safety Fencing and Chevron Signs





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### ➤ Lay-byes & Bus Stops

The safety issues which were lacking at most of Lay-byes & Bus stops are:

- Buses stopping at road junction's forces pedestrians to cross the road where there is turning traffic and it also leads to reduction in road width at the junction causing congestion and unsafe overtaking maneuvers.
- Taxis and para-transit vehicles often stop indiscriminately along major roads to pick up or discharge passengers
- Vehicles stopping at a lay-bye or bus stop constitute a temporary obstruction which may obstruct visibility of an important features.
- The slower speeds of vehicles entering and leaving a laybyes could cause a hazard to faster moving through traffic.

## Lay-byes & Bus Stops



**Well-maintained Bus Stop**



**Segregated Bus Lay-byes**

### **7.1.2.15.1. ROAD SAFETY AUDIT DURING - CONSTRUCTION PHASE**

- To prevent construction and utility worker fatalities and serious injuries at work zone and construction sites.
- To educate exposed workers about work zone workplace safety and health issues
- To strengthen public knowledge on work zone hazards
- **Work Zone Safety Audit**
  - To improve the safety of road users and workers at road work zones.
  - To guide highway authority and concessionaire for effective implementation of work zone safety practices as per national standards and best international practices.



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- To review the methods which are currently adopted by the contractor.
- To make appropriate recommendations on the safety measures to be used at different work zone area at the given site.

## MoRTH & IRC Signage Stand as Code of Practice at Construction Zone

### MORTH & IRC Signage Standards

- Code of Practice for Road Signs ( IRC 67:2012 )
- Code of Practice for Road Marking ( IRC 35 – 2015)
- Guidelines on Traffic Management in Work Zone ( IRC 55: 2014)
- MORTH 2013 – Specifications for Roads and Bridge work
- Guidelines for road signage under PMGSY



### MORTH & IRC Signage Standards

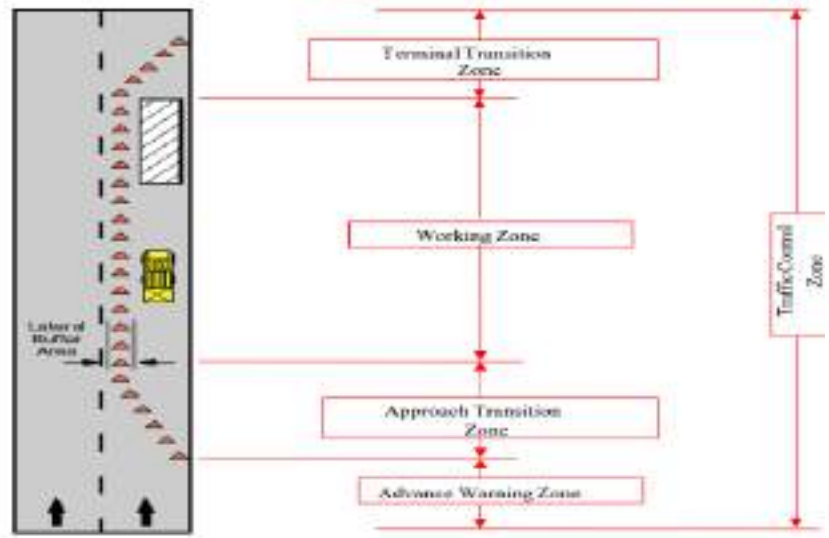




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## Work Zone Safety Practices during Audit Findings

- Advance Warning Area
- Transition Area
- Buffer Space
- Activity (work) Area
- Termination Area



**Transition Area:** Redirecting traffic from a normal traffic flow to a new flow.



## Activity Area:

The area where work takes place which may also include a “lateral” buffer space.

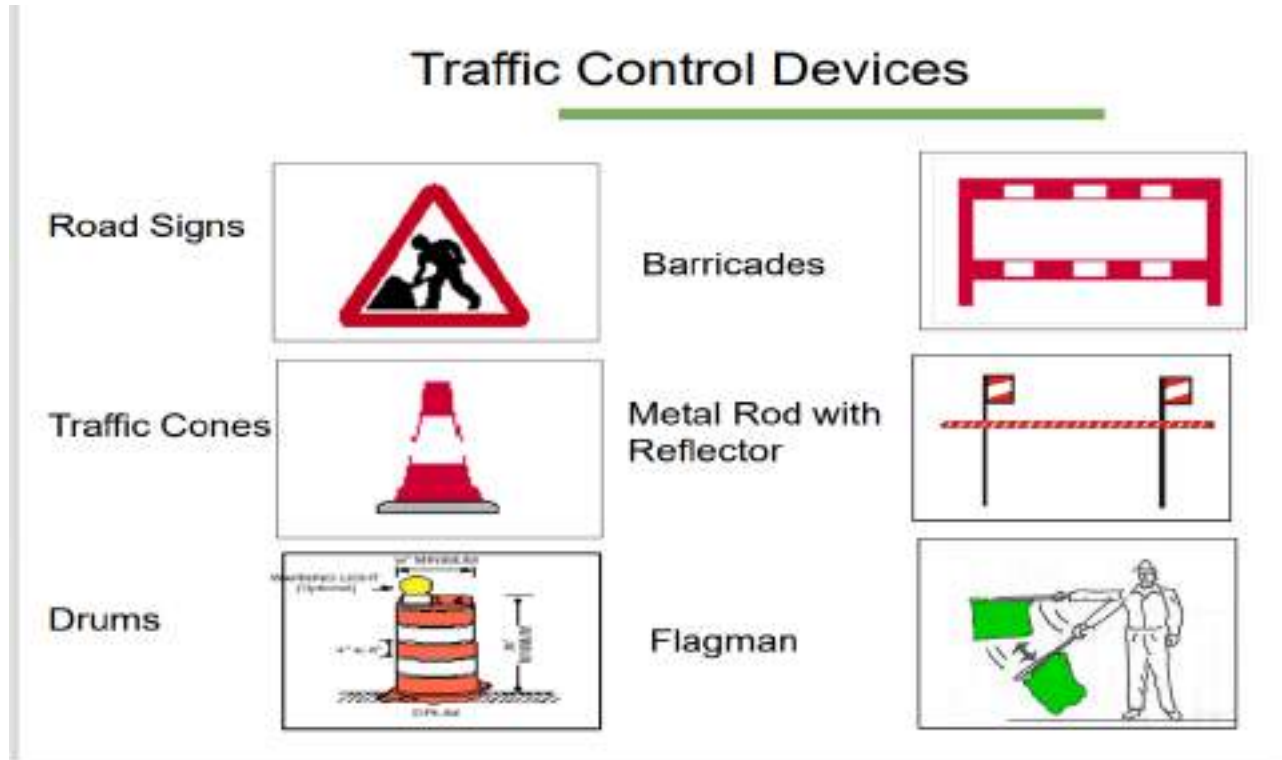




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#### ▪ Traffic Control Device at Construction site

The Road Safety Audit should look into traffic control device at active construction sites. Few of the devices which should be noted are as follows:



#### Main Signs Used for Work Zones (Regulatory)





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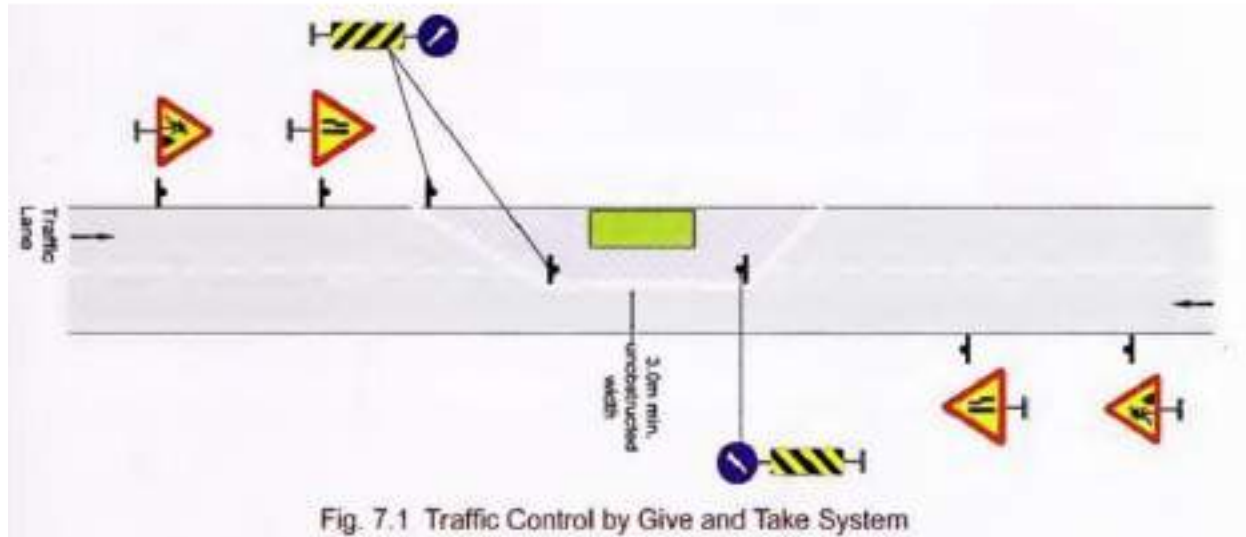
## Main Signs Used for Work Zones (Information)



## Use of Traffic Signs During Construction



## Traffic Control by give and take system (7.1.1- IRC :SP:55-2014)



## Traffic Control by Stop/Go Boards (7.1.3- IRC :SP:55-2014)





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#### ▪ **Temporary Diversion at Construction Zone**

- RSA should see that the construction area should have smooth horizontal and vertical profile with smooth vertical and horizontal curves.
- Should not get overtopped by flood or drainage discharges under any conditions
- Should have adequate capacity to cater to the expected traffic.
- Should be dust free and should ensure clear visibility at all times of day and night and
- Barricading should be provided to prevent construction material falling onto the diversion.



#### ▪ **Safety for Vulnerable Road Users**

- Provision of adequate pedestrian safety
- No danger from falling objects or sharp edges and that they will not fall over or bump into anything
- Pedestrian Barriers & Pedestrian Crossings
- To mark out temporary footway and to protect pedestrians from traffic, excavations, plant or materials.
- Avoid confusing pedestrians.
  - Works on Footways
    - Alternative safe route for pedestrians must be provided.
    - Pedestrian access to property must be provided
    - Pedestrians should not be diverted onto an unguarded carriageway
    - Guard and sign the approach on a temporary footway.



**Works on Footway with Temporary Footway in Carriageway**



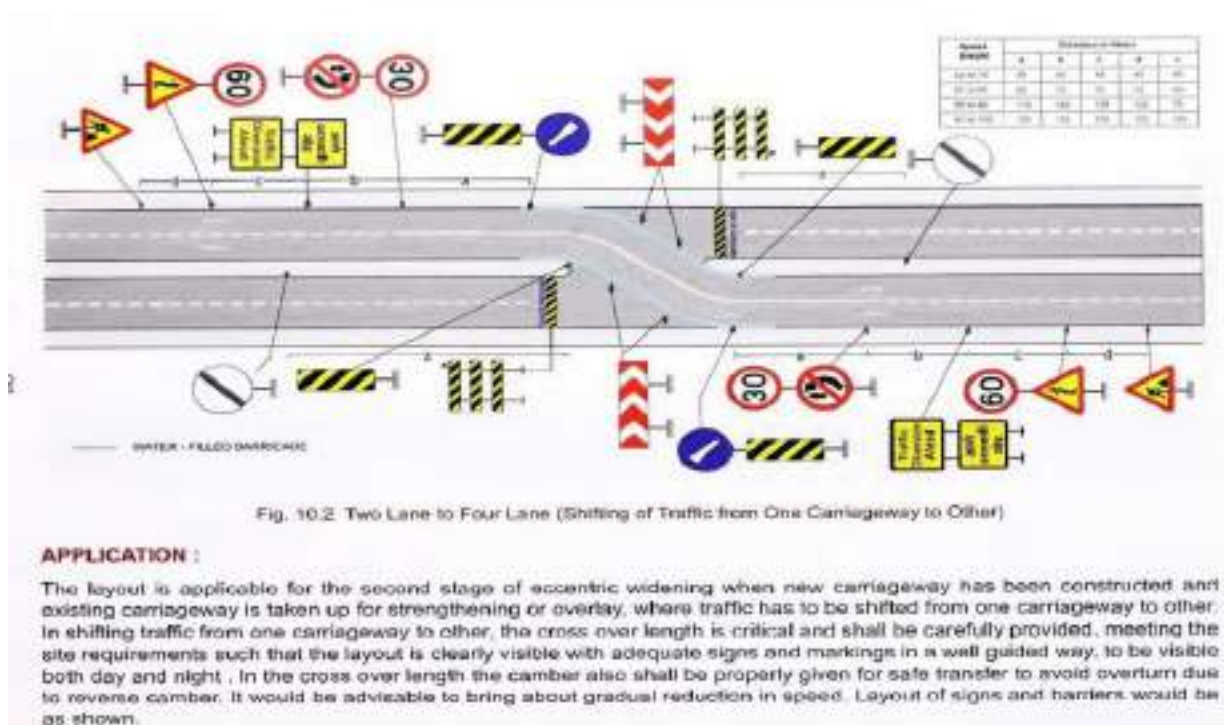
Development of Ludhiana-Bathinda Greenfield Highway, starting from Delhi-Katra Expressway near Ludhiana (village Ballawal) and terminating at Amritsar-Bhatinda Greenfield highway at Bhatinda near Rampura Phul

#### ▪ Safety of Workmen

- Workmen must be trained in use of tools and plant
- Safety Jackets, Gum Boots, Goggles, Gloves, Face Shields, Eye, Ear & Nose protectors etc. must be given to workers related to work.
- First-aid training be provided to all workmen and enough safety kits should be available at the site
- Workers required on site during night hours must be provided with fluorescent yellow jackets with reflective tapes.



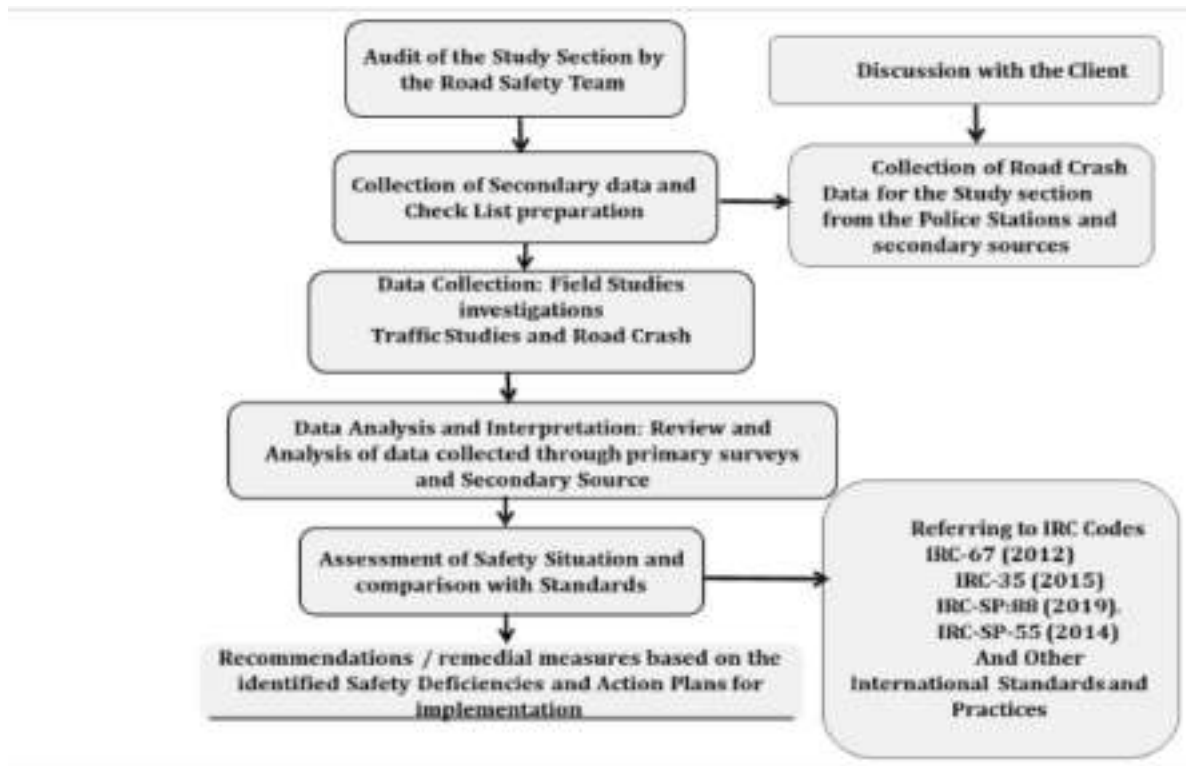
## Two lane to Four lane





#### 7.1.2.15.2. Road Safety Audit for Operational/ Existing Roads

The road safety Audit on existing roads gives the exact features implemented for passenger's safety. They provide details of all the safety features and implementation of IRC Codes of conducts. The audit methodology is used for both the Operational/ Maintenance of the existing roads. It represents present conditions of the roads after completion of construction. Any Hazardous conditions like which has arose during operation phase like encroachments, ribbon development or deterioration of road conditions as well as Traffic conditions.



The Road Safety Audit included the following

- Crash Protection Measures: Damage of Crash Guards Post.
- Absence of Object Hazard Markers
- Obscured, worn – off and missing road markings
- Obscured and damaged traffic signs
- Absence of Acceleration and Deceleration lanes at driveways to roadside facilities such as petrol pumps
- Delineation: improper Delineation at Horizontal Curves
- Non-Standard Traffic Signs: Regulatory, Cautionary, informatory
- Heavy plantation on the median portion
- Pedestrian facilities
- Trees very close to main Carriage way
- Painting faded out on Kerb, Crash Barrier, Parapets walls



*Development of Ludhiana-Bathinda Greenfield Highway, starting from Delhi-Katra Expressway near Ludhiana (village Ballowal) and terminating at Amritsar-Bhatinda Greenfield highway at Bhatinda near Rampura Phul*

- Presence of unauthorized sign boards
  - Damage/ missing of road studs on pedestrian crossings, TBM, Median & Carriageway edge lane markings, chevron markings.
  - Encroachment & Unauthorized parking
  - Damage of Kerb, cash barrier, islands, median kerb.
- **Design Features on Operational/ Existing Roads**
- Design: shapes, colour, size, composition, lighting or retro-reflection should command attention and convey a simple meaning.
  - The sight should have: High visibility by day and night: Treating similar situation in a similar way and using consistent fashion for similar signs.
  - High legibility (adequately sized letters or symbols and a short legend for quick comprehension.
  - Uniformity in design include shape, colour, dimensions, legends, borders, and illumination or retro-reflectivity.

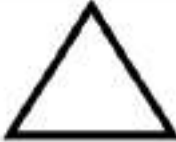
#### Color Codes with Appropriate meanings





Development of Ludhiana-Bathinda Greenfield Highway, starting from Delhi-Katra Expressway near Ludhiana (village Ballawal) and terminating at Amritsar-Bhatinda Greenfield highway at Bhatinda near Rampura Phul

## Proper Classification of Road Signs

| Type of signs                     | Shape                                                                             | Example                                                                            | Remarks                                                         |
|-----------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| <b>Mandatory/Regulatory Signs</b> |  |  | Blue Circles give a positive instruction (what must be done)    |
|                                   |                                                                                   |  | Red circles give a negative instruction (what must not be done) |
| <b>Cautionary/Warning Signs</b>   |  |  | Triangular signs warn                                           |
| <b>Informatory Signs</b>          |  |  | Rectangular signs give information and directions               |

### ▪ Traffic Signs Classifications

#### Mandatory/ Regulatory Signs:

Normally placed at or near the location where the regulation:

- Exists (Stop, yield)
- Begins (wrong way, do not pass)
- Additional signs where a regulation continues over an extended section of highway (Speed limits)



#### Cautionary/ Warnings signs:

- In advance of the hazard
- As a function of approaching traffic speed



#### Informatory/ Guide signs:

- In advance of an intersection or junction
- At the point where they apply (street names, kilometer posts)



## Mandatory/ Regulatory Signs



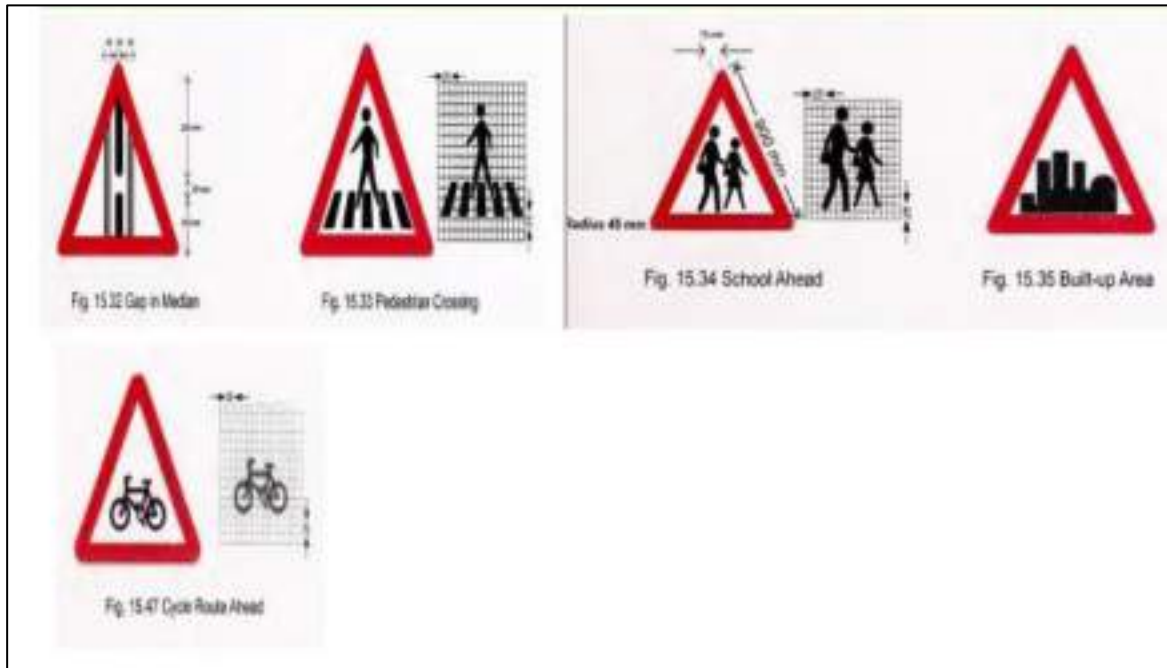
## Cautionary/ Warnings Signs



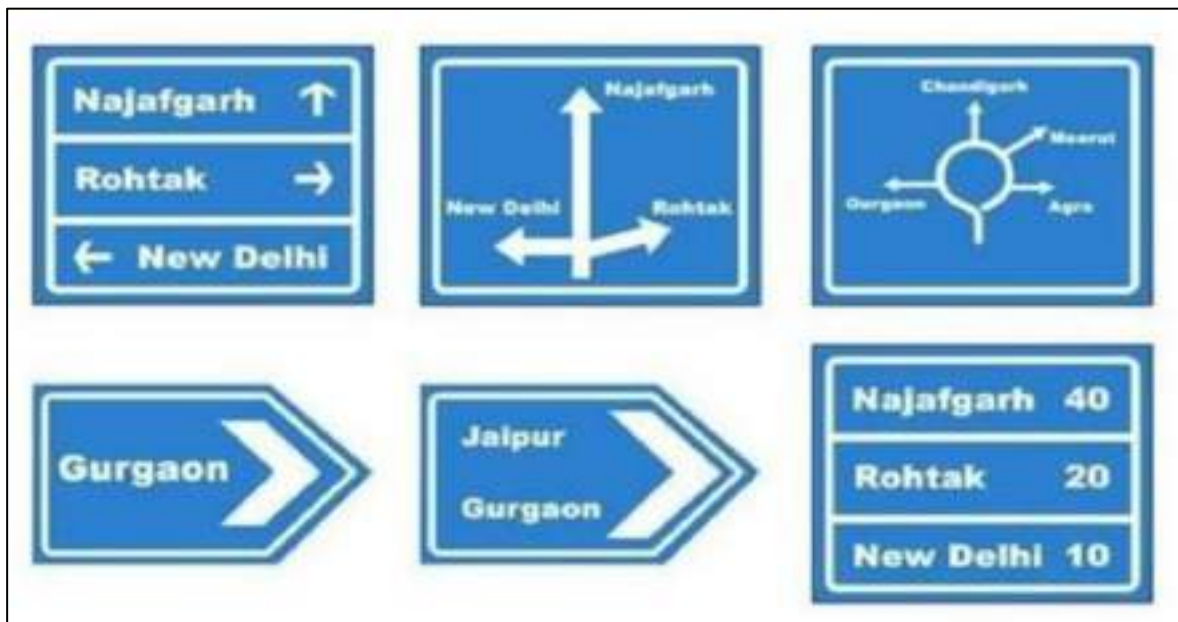


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### Cautionary/ Warning Signs



### Information Signs





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### **Pavement Marking**

- Yellow Line – Two Way Traffic
- White line – One way Traffic
- Solid Line – No Passing
- Broken Line – Pass with Caution

