UNIT - IV

Traffic Signals & Road signs.

Safety at Construction Site

Content :

Traffic Signals & Road signs:

- Traffic Signals,
- Factors affecting signal design,
- street lighting,
- Provisions for NMT Vehicles in India,
- Safety Provisions for Pedestrians & Cyclists,
- Road Signs and Pavement Markings.

Safety at Construction Site:

- Safety provisions for workers at construction site,
- Construction Zone markings, signs.

Traffic Signals

- The conflicts arising from movements of traffic in different directions is solved by time sharing principle
- A traffic control signal is a signal , which through its indications , directs the traffic to stop and permits it to proceed alternatively
- Advantages of traffic signals
  - It provides for an orderly traffic movement
  - It increases the capacity of the intersection
  - It will reduce the frequency of certain type of accidents (right angled)

Dis-advantages

- It may increase certain type of accidents (rear end collisions)
- larger stopped delays
- When improperly located/designed it promotes disrespect
- it may encourage drivers to prefer alternate routes (under designed roads)

Classification of Signals

- Traffic control signals

1. **Fixed time signal** (set to repeat fixed cycle of red-amber-green lights)

2. **Traffic actuated signal** (time cycle/green time distribution as per the demand of traffic flow)
   - Fully actuated signal (detectors installed to sense and assign right of way)
   - Semi-actuated signal (detectors installed only in minor streets)
   - Speed control signal
3. **Pedestrian signals**

Signal systems

- **Synchronized system/ Simultaneous system**
  - All signals along the given street always show same indication at the same time
  - The division of the cycle is the same at all signalized intersection systems and only one controller is used to operate a series of intersections
- **Alternative system**
  - The alternate signals or group of signals along a given road show opposite indications at the same time
  - The system is operated with a single controller. This permits vehicles to travel one block in half the cycle time

Signal systems

- **Simple progressive system**
  - The signals controlling a street given green indications according to a pre-determined schedule to permit continuous operation of groups of vehicles at a planned rate of speed, which may vary in different parts of the system
- **Flexible progressive system**
  - It is possible at each intersection to automatically vary cycle time and division
  - Possible to introduce flashing or shutdown during off-peak hours

Concept of Signal Design: Definitions

Cycle: A signal cycle is one complete rotation through all of the indications provided.

Cycle length: Cycle length is the time in seconds that it takes a signal to complete one full cycle of indications. It indicates the time interval between the starting of green for one approach till the next time the green starts.

Interval: It indicates the change from one stage to another. There are two types of intervals - change interval and clearance interval.

Concept of Signal Design: Definitions

Change interval is also called the yellow time indicates the interval between the green and red signal indications for an approach.

Clearance interval **is also called** ***all red*** is included after each yellow interval indicating a period during which all signal faces show red and is used for clearing off the vehicles in the intersection.

Clearance interval is optional in a signal design. It depends on the geometry of the intersection. If the intersection is small, then there is no need of clearance interval whereas for very large intersections, it may be provided

Timing of signals
Timing an isolated signal

It should be determined on the following lines according to the traffic requirements

- **Cycle time should normally be from 40 to 60 sec.** (best timing would be the shortest possible under the traffic conditions). Maximum cycle time should be 120 sec.
- Determine pedestrian crossing time of all approaches based upon pedestrian walking speed generally taken as 1 m/s. These values will be minimum green plus amber time for each phase
- Based on these minimum, compute green plus amber time in proportion to approach volumes per approach lane. **No phase should be less than 15 sec**.
- Adjust cycle time (sum of all phases) to next higher 5 sec. interval and re-compute phase values

- **Select amber periods based upon approach speeds**. Table below is recommended as a guide for selecting appropriate amber periods
- Compute percentage value for all phases (total being 100%). It is necessary to use % since controller settings are in % of signal cycle
- Computed timing should be installed in the controller and the operation of the intersection observed, especially during peak conditions
- Field correction of the timing may be necessary to provide smooth flow

- The prerequisite of any coordinated system is that all signals in the system must operate on the same cycle length. The division of the cycle may vary with the individual intersection but the total cycle length must remain constant
- Usually the **critical intersection is tuned according to the isolated signal timing system** and the resulting cycle length used throughout the system

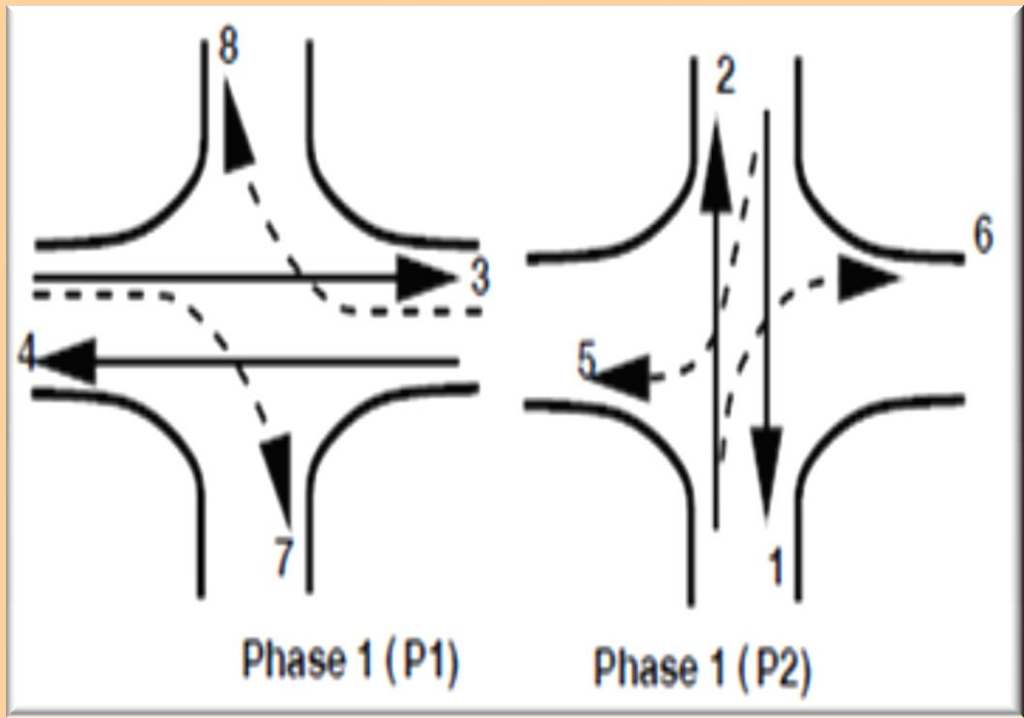
Approach speed (KMPH)	Amber period (seconds)
0-50	3
50-65	4
65-80	5
80 or more	5 (plus all red period)

Concept of signal design
Phase design

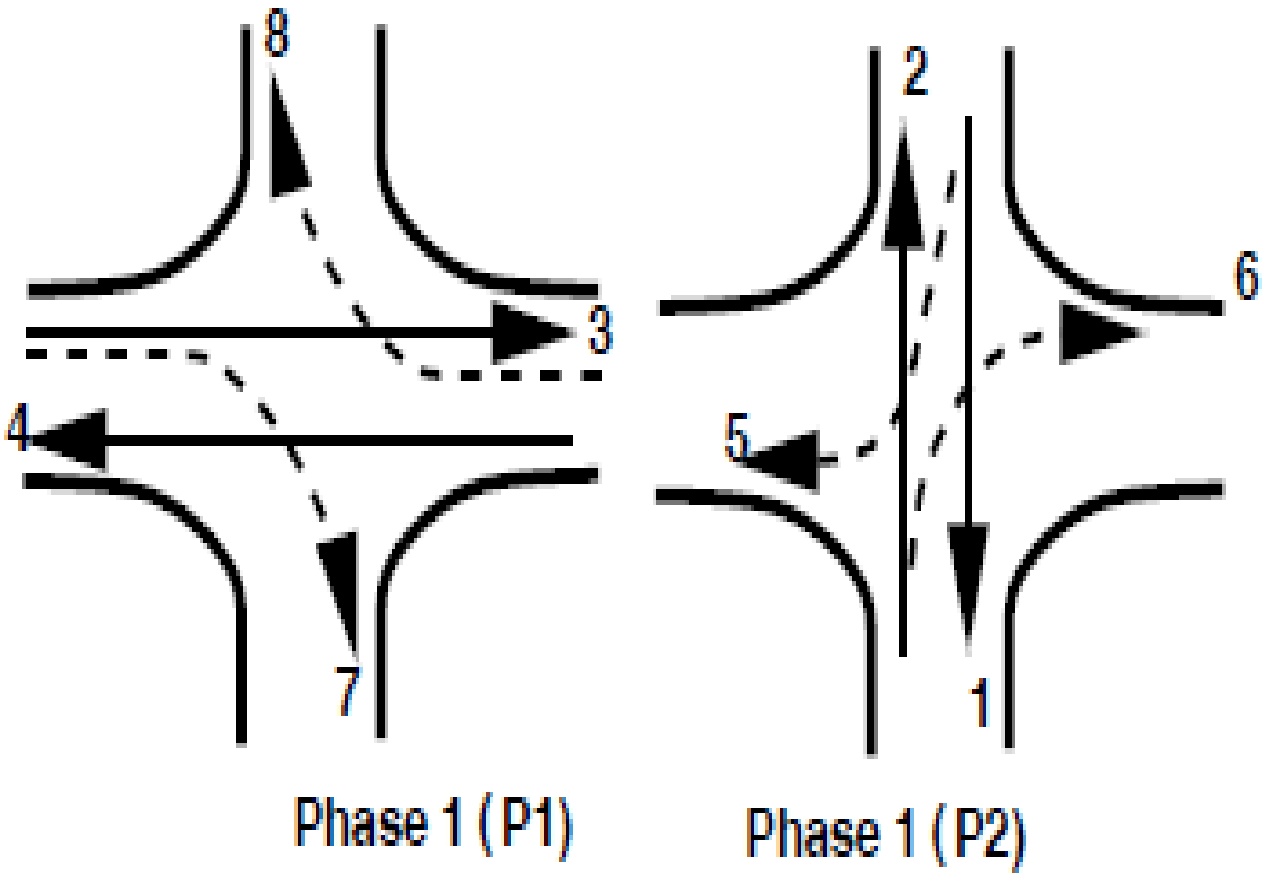
- **Two phase signals**

Two phase system is usually adopted if **through traffic is significant** compared to the turning movements. For example in figure, non-conflicting through traffic 3 and 4 are grouped in a single phase and non-conflicting through traffic 1 and 2 are grouped in the second phase. However, in the first phase flow 7 and 8 offer some conflicts and are called **permitted right turns**.

This phasing is possible only if the turning movements are relatively low. If the turning movements are significant ,then a four phase system is usually adopted



Concept of signal design
Phase design

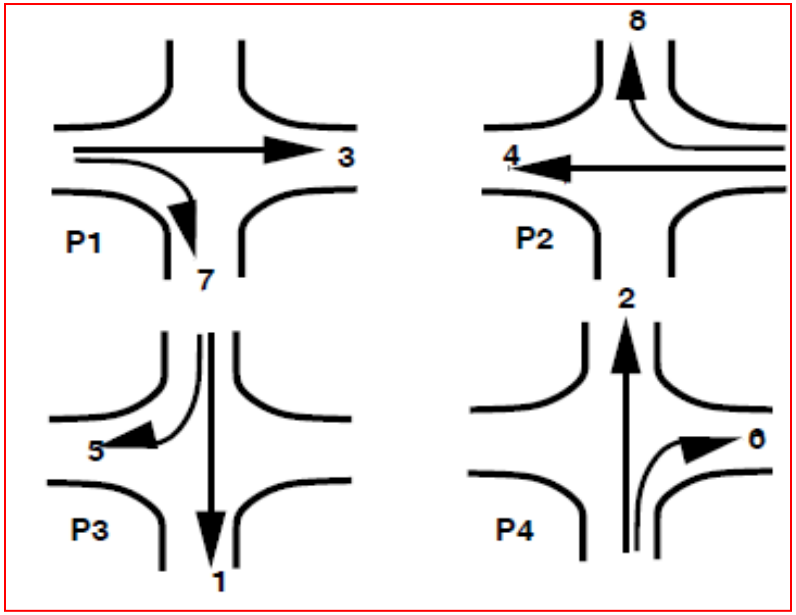


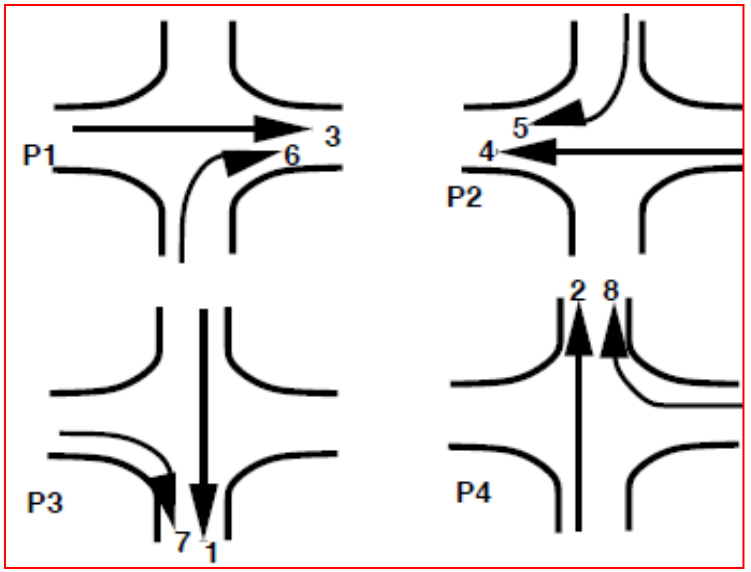
Four phase signals

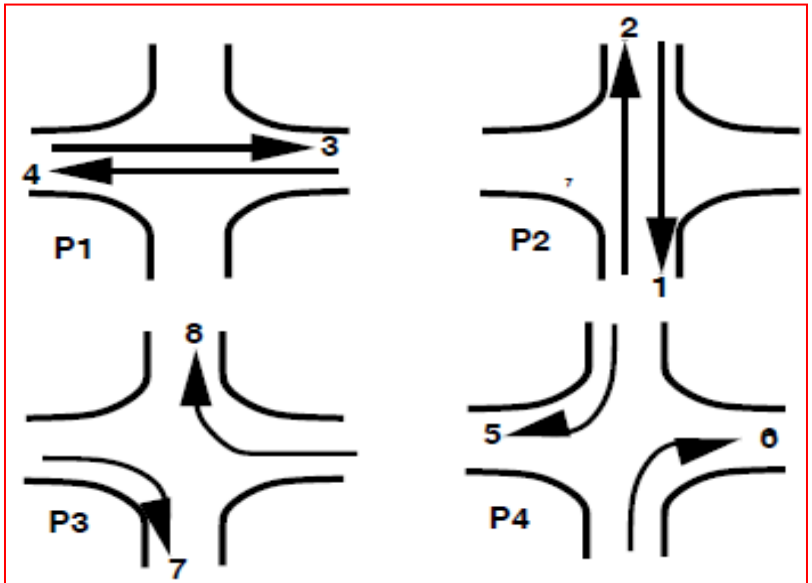
- There are at least three possible phasing options. For example, figure shows the most simple and trivial phase plan. where, flow from each approach is put into a single phase avoiding all conflicts. This type of phase plan is ideally suited in urban areas where the turning movements are comparable with through movements and when through traffic and turning traffic need to share same lane.

- This phase plan could be very inefficient when turning movements are relatively low

Four phase signals







Street lighting

Safe road treatment	Estimated Cost	Casualty Reduction
Speed Management	Medium	25-40%
Street Lighting	Medium	10-25%

- In order to have safer, comfortable, more convenient, efficient movement of vehicles and pedestrians at night time, street lighting or highway lighting is required along the road
- Lighting should be planned appropriately, it should allow night traffic operations with maximum possible safety, comfort and convenience
- It should be planned in such a way that the driver should be able to see more clearly and explore all the important details of the driving environment
- **Types of Street Lighting:**
  1.Single side light system
  2. Staggered light system:
  3.Central light system

Street lighting

- Glare effects can be minimized by reducing luminaire brightness and by increasing the background brightness in a driver’s field of view.
- Specific actions taken to achieve this in lighting design include using higher mounting heights, positioning lighting supports farther away from the highway, and restricting the light from the luminaire to obtain minimum interference with the visibility of the driver

- **Spacing of Lamps for Street Lighting:**
- It should have closer spacing of lights, so that the road has suitable brightness and visibility during the night.
- The spacing of light depends on the importance of highway or road.
- By performing experiments, the normal distance is recommended to be from 35 m to 55 m for better brightness and visibility during the night for all types of roads

Advantages and Disadvantages of Street lighting

Advantages of Street lighting:

- Due to proper street lighting, police can do better patrol during the night and their work becomes easier and more manageable.
- Increases the business in a city or town, areas during the night that would otherwise be completely uninhabited.
- Architects and town planners have considered lighting as a major source for the beautification of their projects.
- Due to good street lighting, the accident rate during the night reduces significantly.
- Illegal works on the streets and anti-social activities are definitely discouraged by better lighting techniques.
- It gives a pleasant atmosphere at night.

Disadvantages of Street Lighting:

- Sometimes street lighting is an expensive process.
- During installation, it can jam traffic.
- Also requires a good amount of electricity

Provisions for NMT Vehicles in India

- Non-motorised modes include walking, bicycle and cycle rickshaw.
- In many Indian cities, cycle rickshaw is an important non-motorised mode of intermediate para-transit (IPT).
- These modes are not dependent on fossil fuels, and have minimal emissions. Thereby, they are truly low carbon modes.
- Low-income households are dependent on these modes to access employment, education and other essential services.
- Use of non-motorised transport (NMT) has health benefits, however, with the rise in incomes and poor infrastructure, use of NMT has been declining.
- City authorities and state governments have not invested in upgrading NMT infrastructure, resulting in a degrading level of service and increasing risk to pedestrians and bicyclists.
- This has resulted in a declining use of NMT, with the increasing income levels throughout the years

Safety Provisions for Pedestrians & Cyclists

- By providing appropriate parking facilities for bicycles at or near bus stops, and safe bicycle paths, it is likely that more commuters will be added to the bus service, with an increase to the catchment area
- a complete network plan must be in place for promoting use of NMT that is also well integrated with the existing and proposed Public Transport system of the city
- Bicyclists require a complete network, which may consist of bicycle tracks (physically segregated from motorised traffic), bicycle lanes (painted segregation on lower speed roads), and mixed facilities where speeds can be kept below 30 km/hr by traffic-calming measures
- the width of the lane/track must be at least 2.5m. Socially safe, lively and well-lit routes are preferred for riding.

Safety Provisions for Pedestrians & Cyclists

- Routes across parks and leisure routes can further attract ridership of recreational bicyclists. Other facilities for cyclists can also be provided, especially in Indian cities that include bicycle repair shops, kiosks for drinking water and space for street vendors along the bicycle routes
- There is a requirement of traffic signals, advanced stop lines, and bicycle boxes.
- It is also important to carefully consider the position of the approaching bicycle lane at intersections.
- Additionally, at the intermediate points of conflict, such as access points to properties, speed ramps should be provided to control the speed of the approaching MV
- Rent and ride services can also be an important factor in encouraging the use of public transport and bicycles in the city

Objectives of the Road signs

- To provide **valuable information** to drivers and other road users to move safely on the road system of Indian cities.
- To ensure **safe movement** of vehicles on the outer regions of the cities which are prone to more no. of accidents cause of negligence of education in the road user related to the different signs provided on the highways.
- They represent **rules** that are in place to **keep you safe**, and help to communicate messages to drivers and pedestrians that can maintain order and reduce accidents.
- To ensure **enforcement** of the **traffic signs** as neglecting them could be dangerous for the road user.

Classification of Road Signs (RCI)

1. **Mandatory/Regulatory signs**
   i. ‘ Stop ‘ and ‘Give Way’ signs
   ii. ‘ Prohibitory’ signs
   iii. ‘No Parking’ and ‘No Stopping’ sign
   iv. ‘Speed **Limit’** and ‘Vehicle Control’ signs;
   v. ‘Restriction Ends’ sign ; **and**
   vi. ‘Compulsory Direction Control’ and other signs.
2. **Cautionary/Warning signs**
3. **Guide/ Informatory signs**
   i. Direction and Place Identification Signs
   ii. Facility Information Signs
   iii. Other Useful Information Signs;
   iv. Parking Signs; and
   v. Flood Gauge.

Mandatory/Regulatory Signs

- These signs are used to inform road users of certain laws and regulations to provide safety and free flow to traffic. These include all signs which give notice of special obligations, **prohibitions or restrictions** with which the road user must comply. **The violation of these signs is a legal offense.**

Some of the regulatory signs

- Certain speed limit
- No entry
- No parking
- Prohibit of use of horns
- U turn prohibited
- Left turn or right turn prohibited etc.

Stop and give way signs

Speed limit and vehicle control signs

SPEED LIMIT

WIDTH LIMIT

HEIGHT LIMIT

LOAD LIMIT

Prohibitory Signs

NO ENTRY

ONE WAY SIGN

VEHICLES PROHIBITED IN BOTH DIRECTION

U-TURN PROHIBITED

RIGHT/LEFT TURN PROHIBITED

PARKING PROHIBITED

OVER TAKING PROHIBITED

HORN PROHIBITED

Regulatory Signs (Prohibitory)


NO RIGHT TURN


NO LEFT TURN


NO U-TURN

MAXIMUM SPEED 50 KM


NO ENTRY


NO STOPPING

NO PARKING


NO OVERTAKING


NO OVERTAKING BY GOODS VEHICLES


NO ENTRY FOR ALL VEHICLES


NO ENTRY FOR GOODS VEHICLES

NO ENTRY FOR GOODS VEHICLES LONGER TH..


NO ENTRY FOR TRAILERS


NO ENTRY FOR VEHICLES WITH D...


NO ENTRY FOR BUSES


NO ENTRY FOR MOTORCYCLES

Cautionary/Warning Signs

- These signs are used to warn road users of the existence of certain hazardous conditions either on or adjacent to the roadway, so that motorists are cautious and take the desired action.

1. Right Hand/Left Hand Curve
2. Right/Left Hairpin Bend
3. Right/Left Reverse Bend
4. Steep Ascent/Descent
5. Narrow Bridge
6. Narrow Road Ahead
7. Road Widens Ahead
8. Gap in Median
9. Slippery Road
10. Loose Gravel
11. Cycle Crossing
12. Pedestrian Crossing
13. School
14. Cattle
15. Men at Work
16. Falling Rocks
17. Ferry
18. Cross Roads
19. Side Road
20. T—Intersection
21. Y—Intersection
22. Staggered Intersection
23. Major Road Ahead
24. Roundabout
25. Dangerous Dip
26. Hump or Rough Road
27. Barrier Ahead
28. Unguarded Railway Crossing
29. Guarded Railway Crossing


RIGHT HAND CURVE
LEFT HAND CURVE
RIGHT HAIR PIN BEND
LEFT HAND PIN BEND
RIGHT REVERSE BEND
LEFT REVERSE BEND
STEEP ASCENT
STEEP DESCENT
NARROW ROAD AHEAD
ROAD WIDENS AHEAD
NARROW BRIDGE
SLIPPERY ROAD
LOOSE GRAVEL
PEDESTRIAN CROSSING
SCHOOL AHEAD
MAN AT WORK
CROSS ROAD
GAP IN MEDIAN
SIDE ROAD RIGHT
SIDE ROAD LEFT
Y - INTER SECTION
Y - INTER SECTION
Y - INTER SECTION
T - INTER SECTION
STAGGERED INTERSECTION
STAGGERED INTERSECTION
MAJOR ROAD AHEAD
MAJOR ROAD AHEAD
ROUND ABOUT
BANDA ROUS DIP

TRAFFIC SIGNS

Enter your sub headline here

Double bend

Merging traffic

Right bend

Roadway narrows

Slippery road

Deer crossing

Roadwork ahead

Location of Cautionary/Warning Signs

- The warning signs should normally be located at the following distances in advance of the hazard warned against:

(a) *Non-urban Locations*

	Plain or rolling terrain	*Hilly terrain*
(i) National Highways and State Highways ..	120 m	60 m
(ii) Major District Roads	90 m	50 m
(iii) Other District Roads	60 m	40 m
(iv) Village Roads	40 m	30 m

These distances may be increased on steep downhill gradients to account for increased speed.

(b) *Urban Locations*

In urban locations, the warning signs should be located at about 50 metre away from the points of hazard. Distance may be increased or decreased to suit site conditions.

Guide / Informatory signs

- These signs are used to **guide road users** along routes, **inform** them about destination and distance, identify points of geographical and historical interest, and provide other information that will make the road travel easier, safe and pleasant.

  i. Direction and Place Identification Signs
  ii. Facility Information Signs
  iii. Other Useful Information Signs;
  iv. Parking Signs; and
  v. Flood Gauge.

The common guide signs.

- End of speed limit;
- Flood marks;
- Location of petrol pump, hospital, etc;
- Names of streets and highways;
- Parking places;
- Public telephones; etc.

Facility information signs

Public Telephone

Petrol Pump

Hospital

First - aid Post

Resting Place

** 

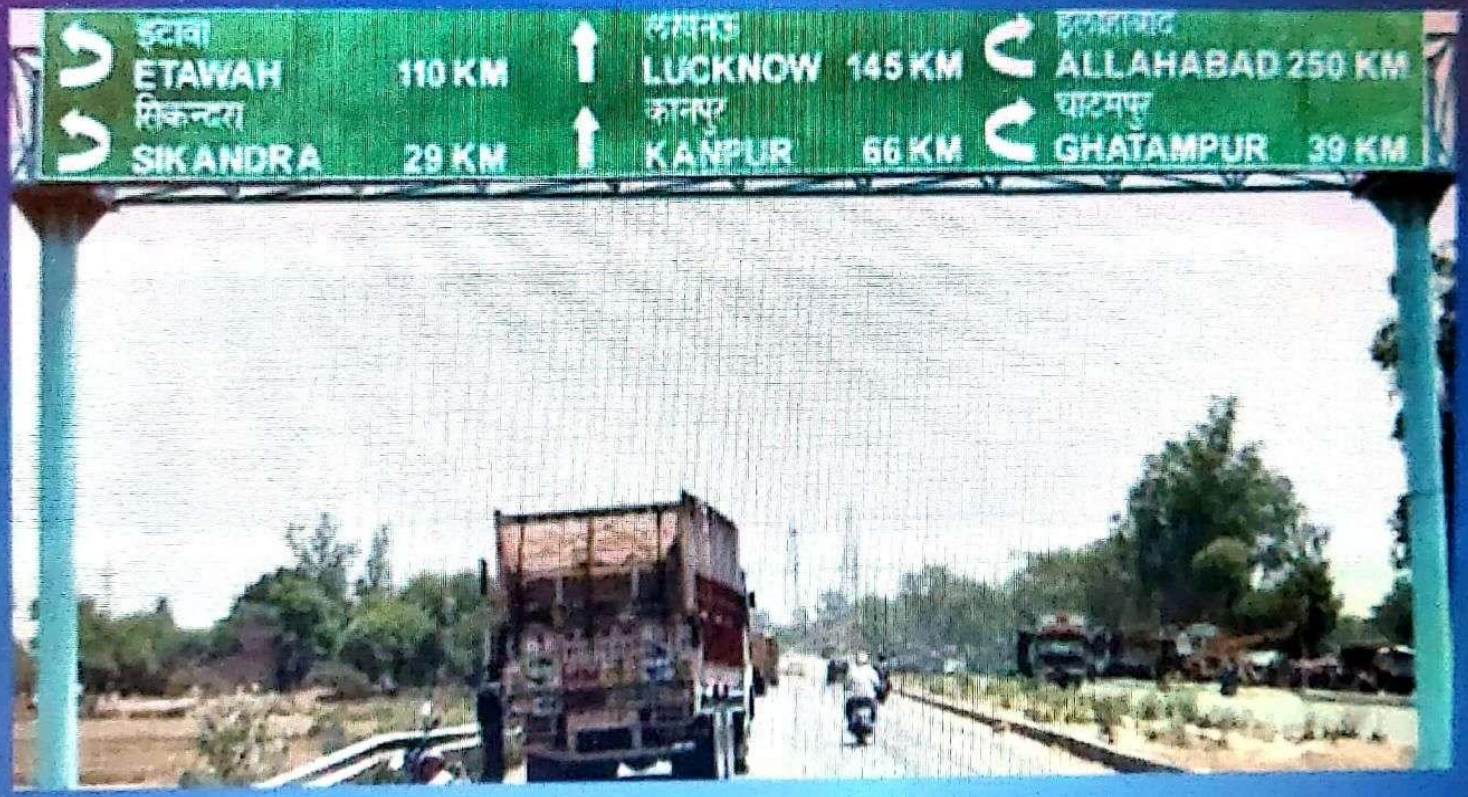
No Through Road

Eating Place

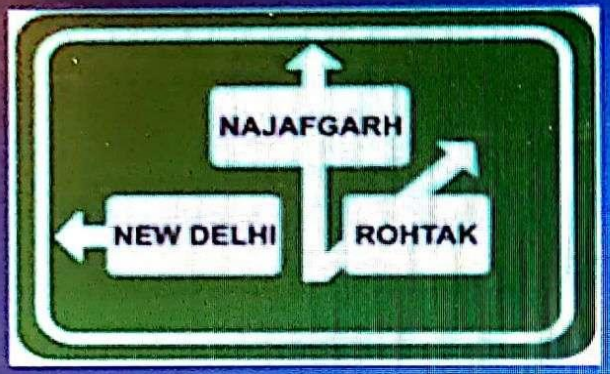
Light Refreshment

** ***no through road; this sign is used at the entrance to a road from where there is no exit***

Direction and place identification signs



Map Type Advanced Direction Sign



Advance direction and Reassurance Sign

Road Marking

- **Lines**, **patterns, words** set into applied or attached to the carriageway or kerbs or objects within or adjacent to carriageway

Role of Road Markers.

To guide and control traffic on the highway

To serve as psychological barrier

To delineate traffic path and its lateral clearance from traffic hazards

To aid pedustrians and cyclists for movement into safe locations

Road Marking Colors

Colour	Uses
White	All carriageway markings except those intended for parking restrictions.
Yellow	i) Markings intended for parking restrictions ii) Continuous centre and barrier line markings.
Alternate bands of white and black	Curb object markings.

Paint Material

- Ordinary road marking paint (Cold)
- Hot applied thermoplastic compound
- Reflectorized paint

Road Marker Classification

Carriageway markings

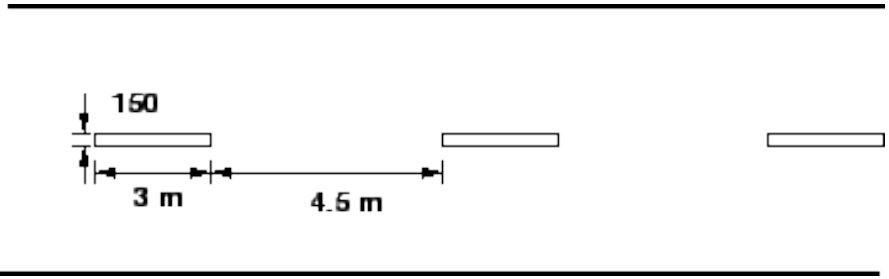
- **Longitudinal markings**: center line, traffic lanes, no passing zones, warning lines, edge lines, bus lane, cycle lane
- **Markings on intersections**: stop lines, give way lines, pedestrian crossings, cyclist crossings, direction arrows, protected right turn lanes, marking on rotaries
- **Markings on hazardous locations**: carriageway width transition, obstruction approaches, road-rail level crossings, check barriers
- **Markings for parking:** parking space limits, parking restrictions, bus stops
- **Word messages**: stop, slow, bus, school, exit only

Road Marker Classification

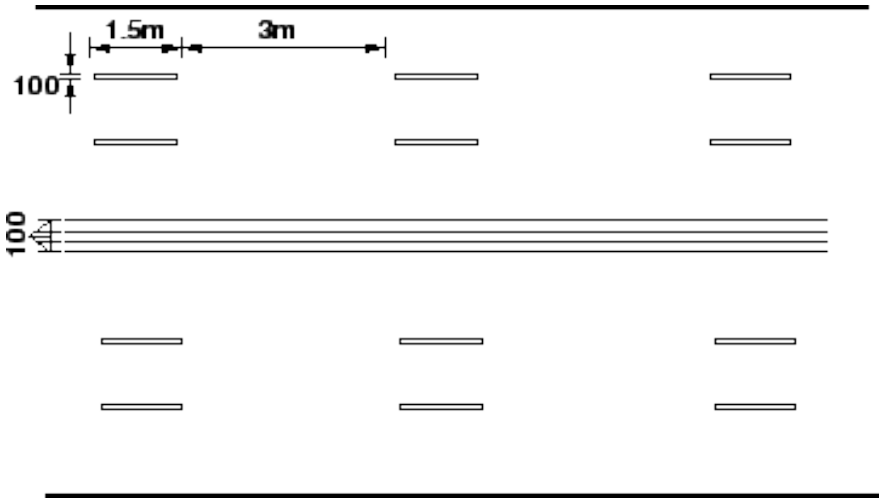
Object markings

- Objects within the carriageway
- Objects adjacent to carriageway
- Marking on kerbs

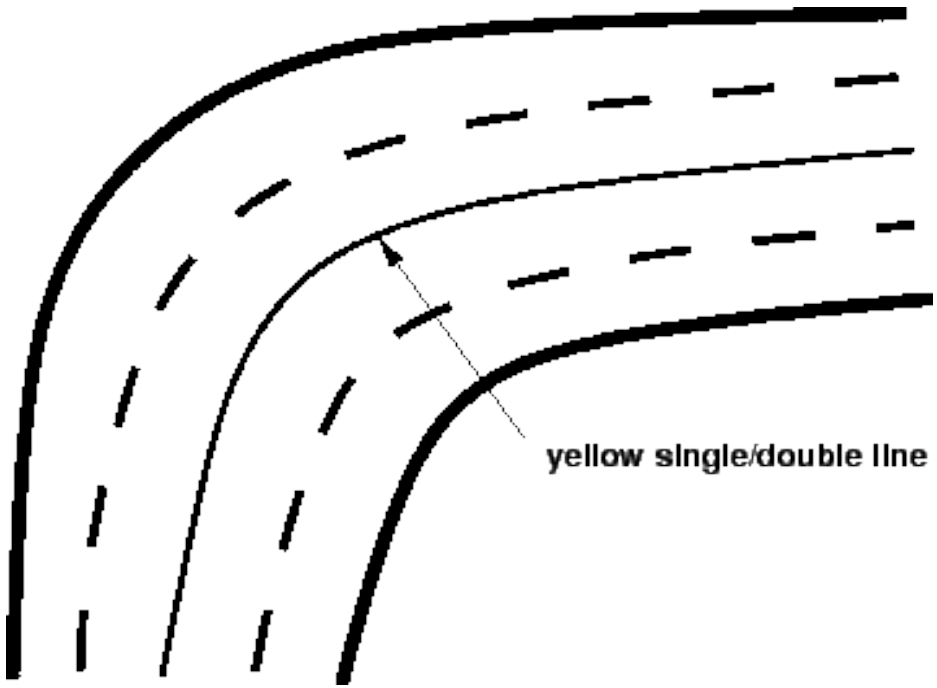
Carriageway Longitudinal markings



Centre line marking for a two-lane road



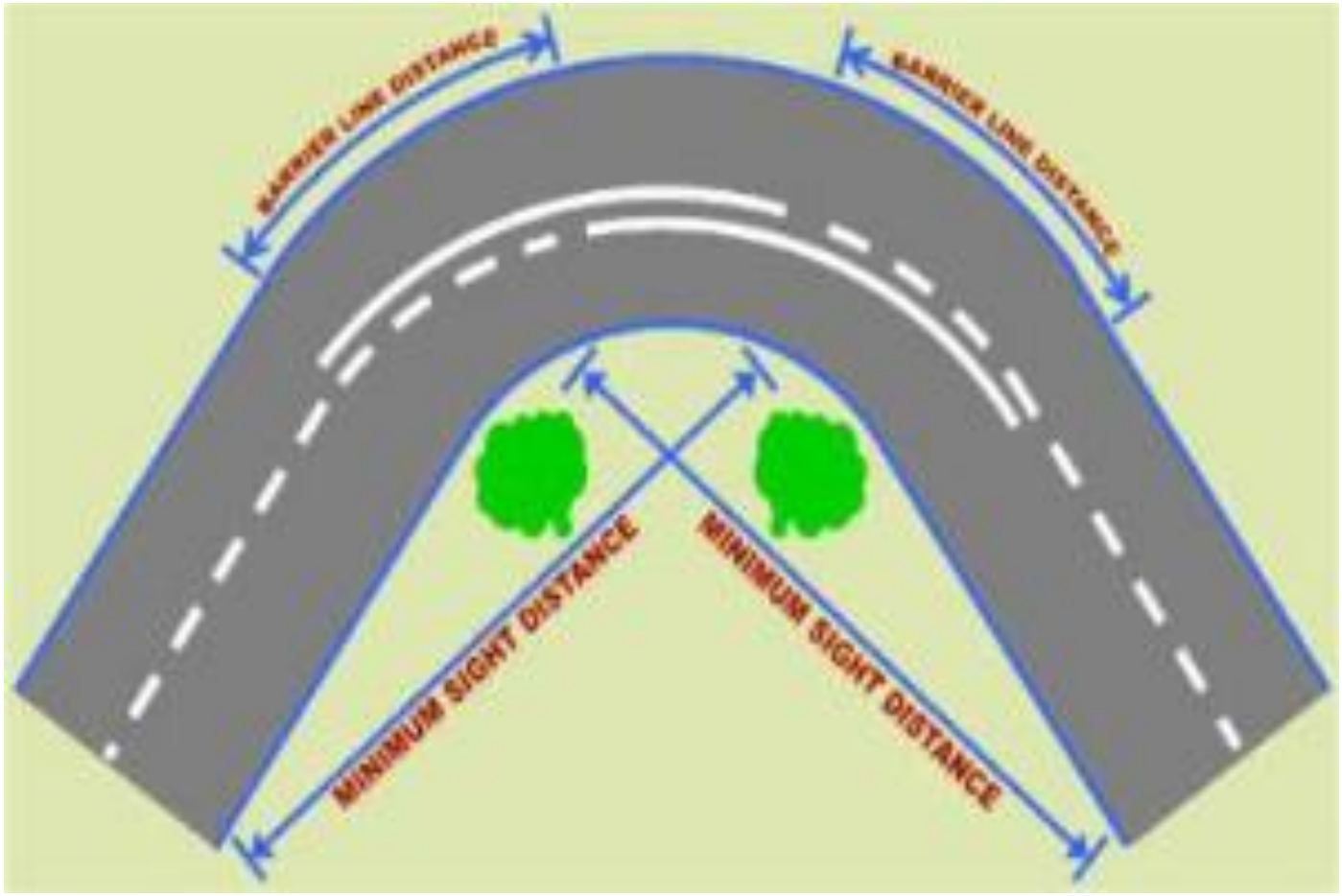
Double solid line for a two-lane road



Barrier line marking for a four lane road

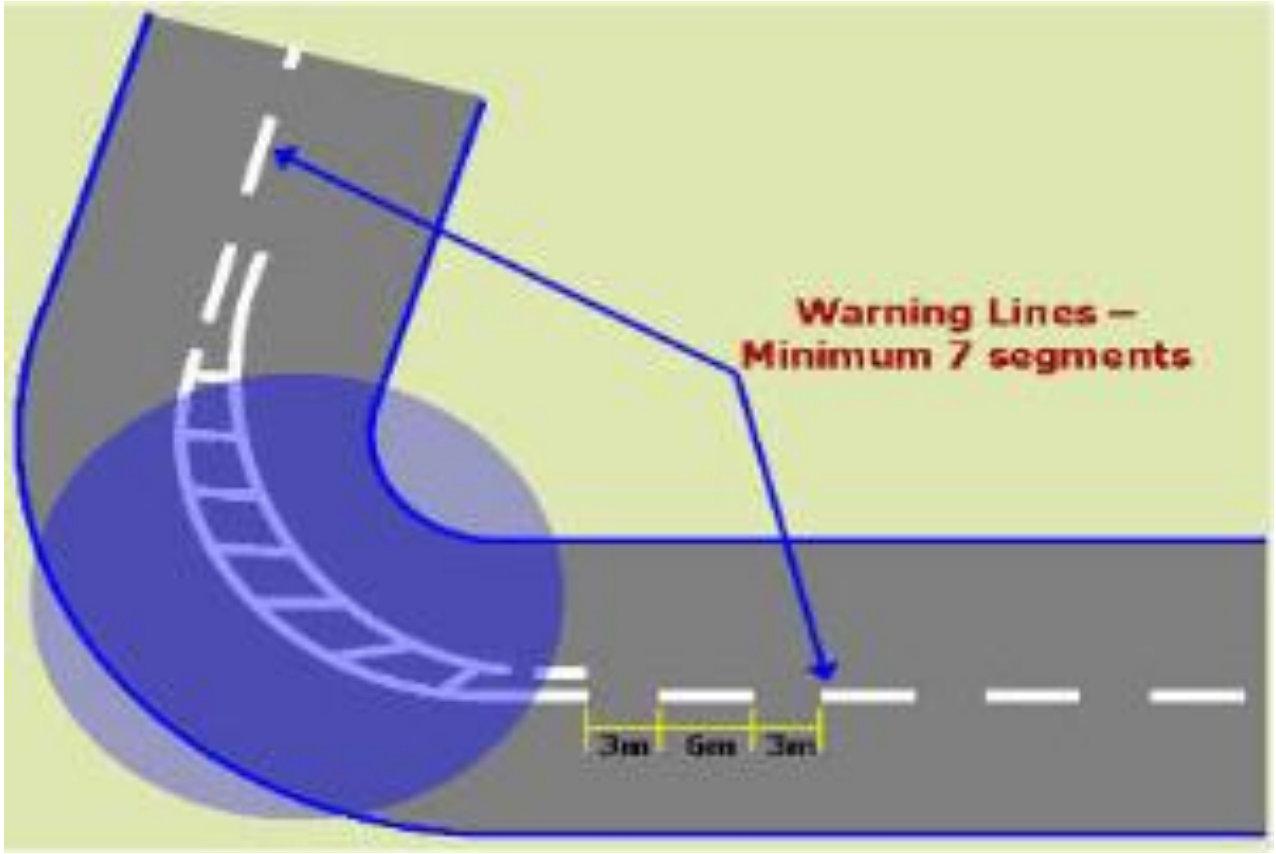
Speed Reduction Markings

Carriageway Longitudinal markings



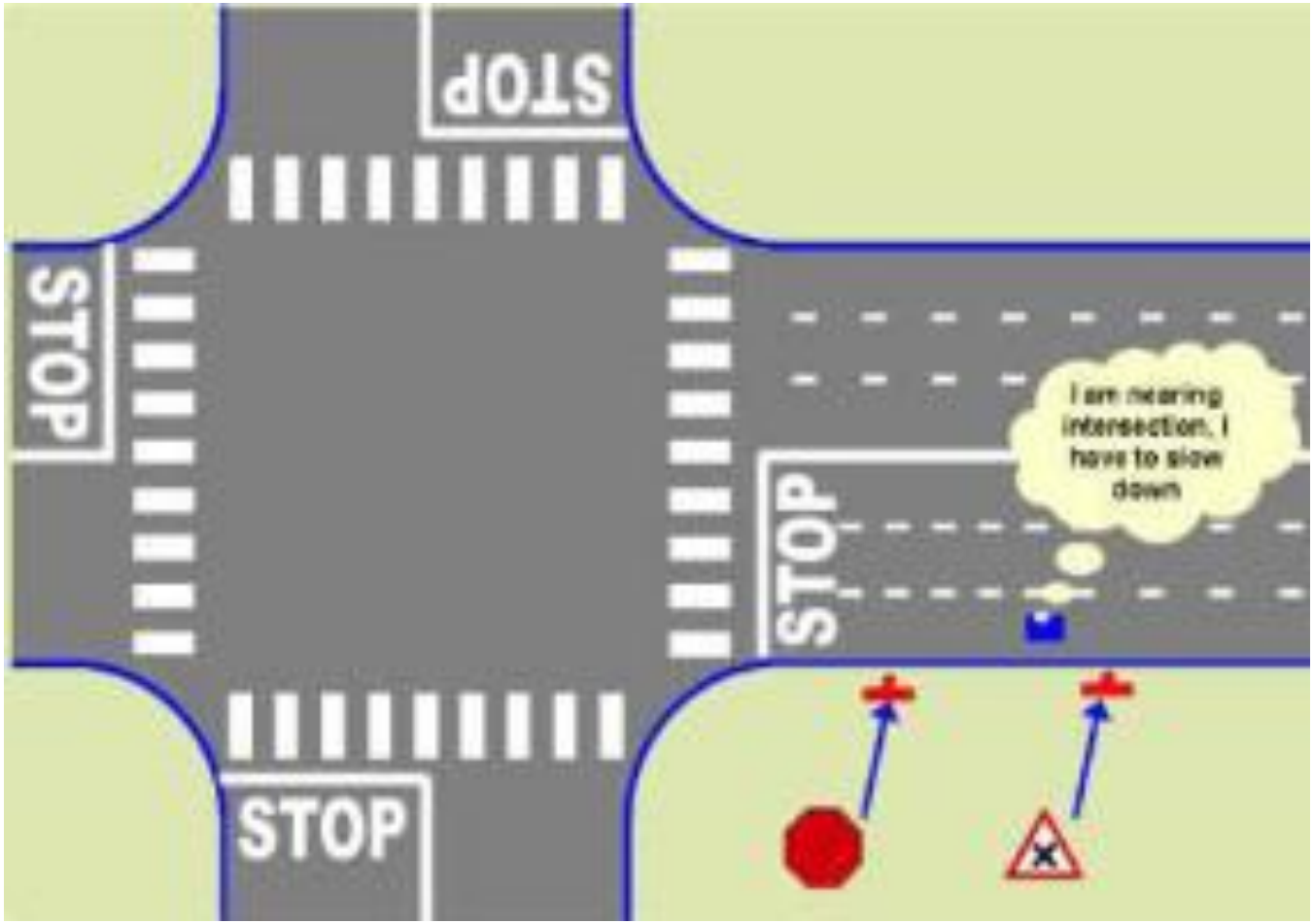
No overtaking zone marking at horizontal curves

Carriageway Longitudinal markings



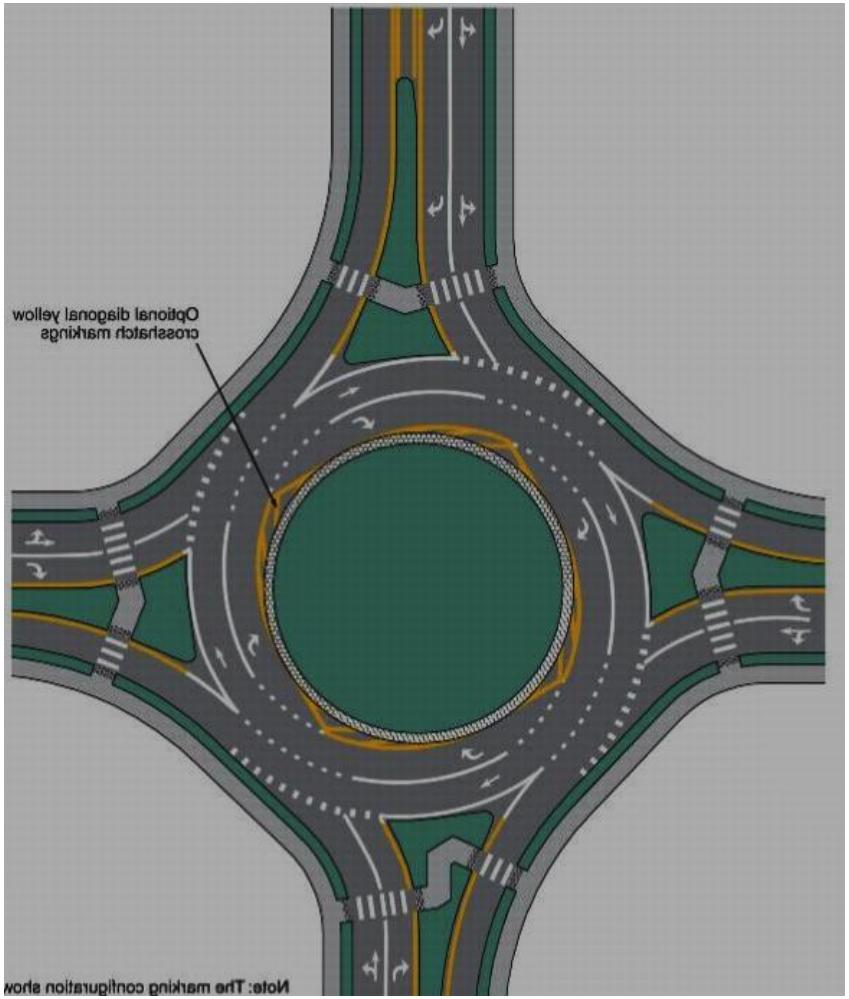
MARKINGS AT A SHARP CURVE

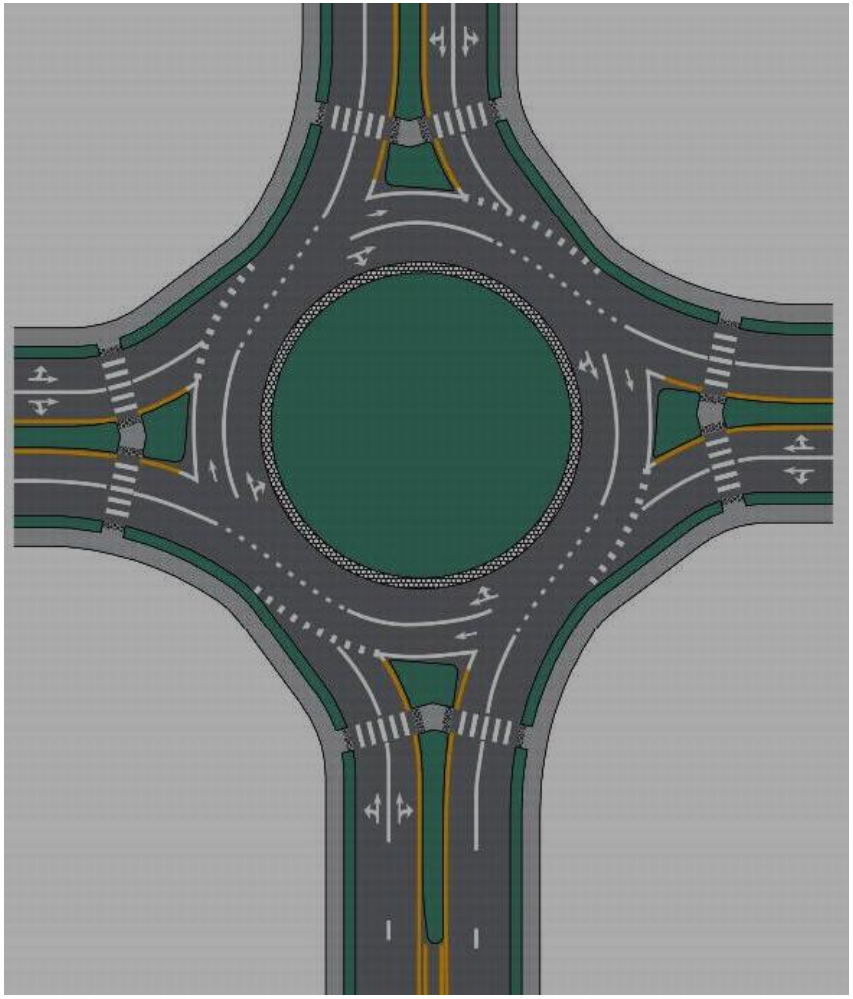
Markings on intersections

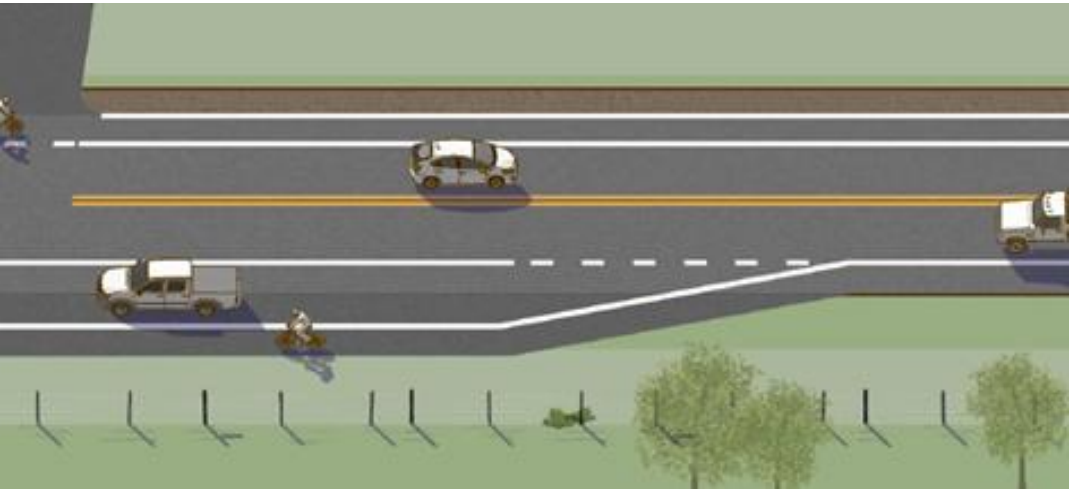


ROAD MARKINGS ACT AS PSYCHOLOGICAL BARRIER TO THE ROAD USER

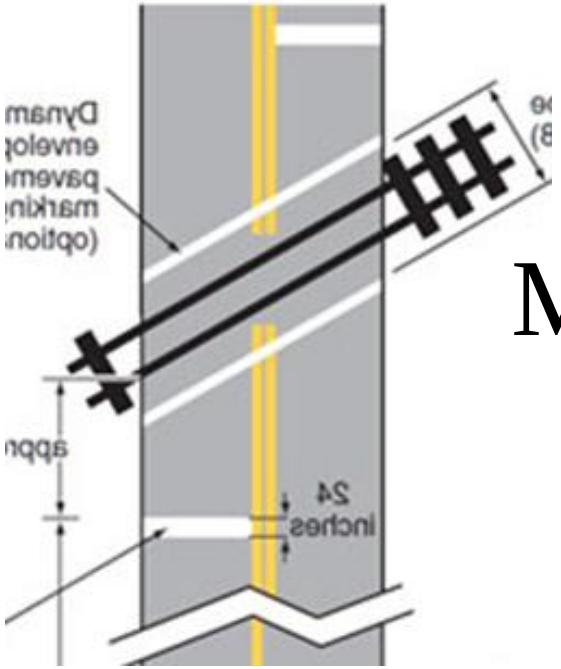
Markings on intersections



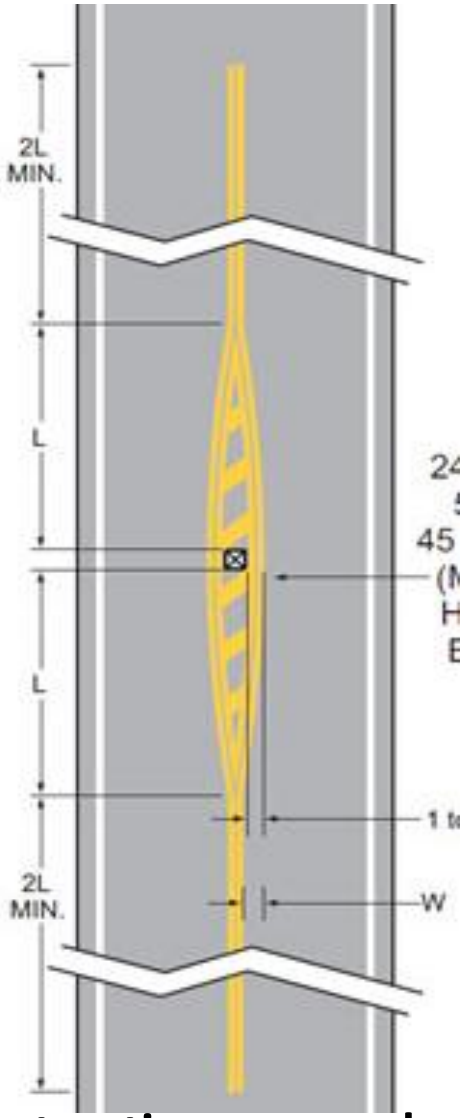




carriageway width transition



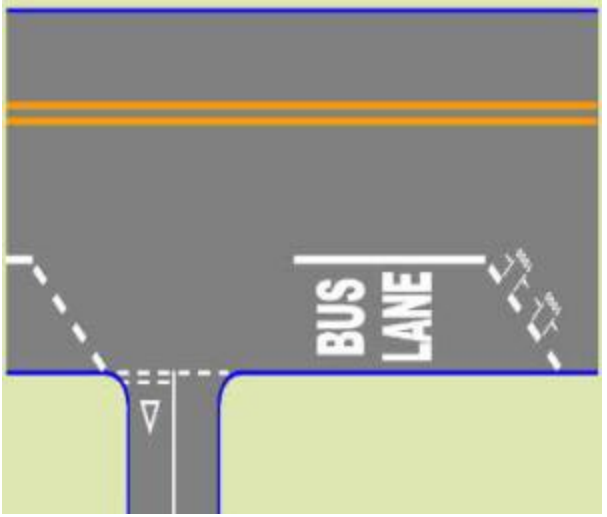
Markings on hazardous locations

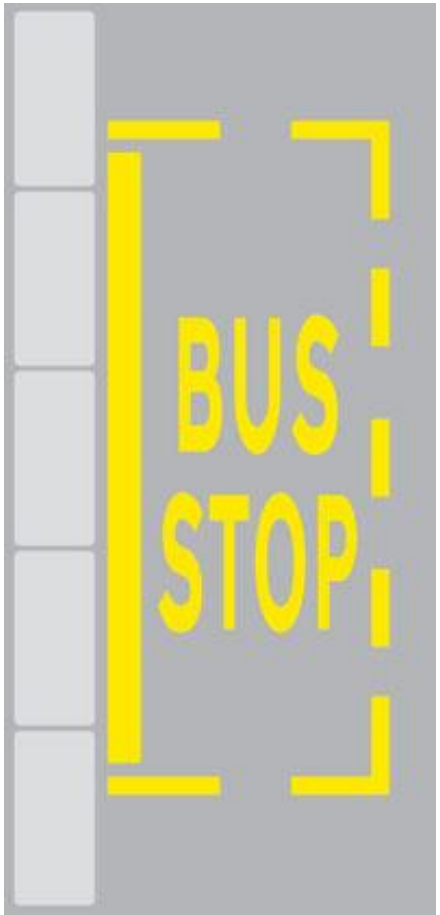


Obstruction approaches

Markings for parking

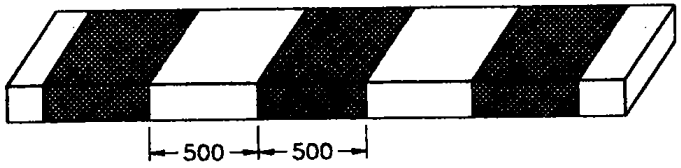
Word messages

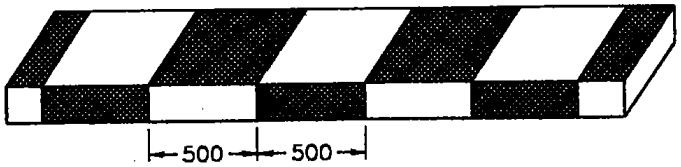




Object markings

- Objects within the carriageway
- Objects adjacent to carriageway
- Marking on road kerbs





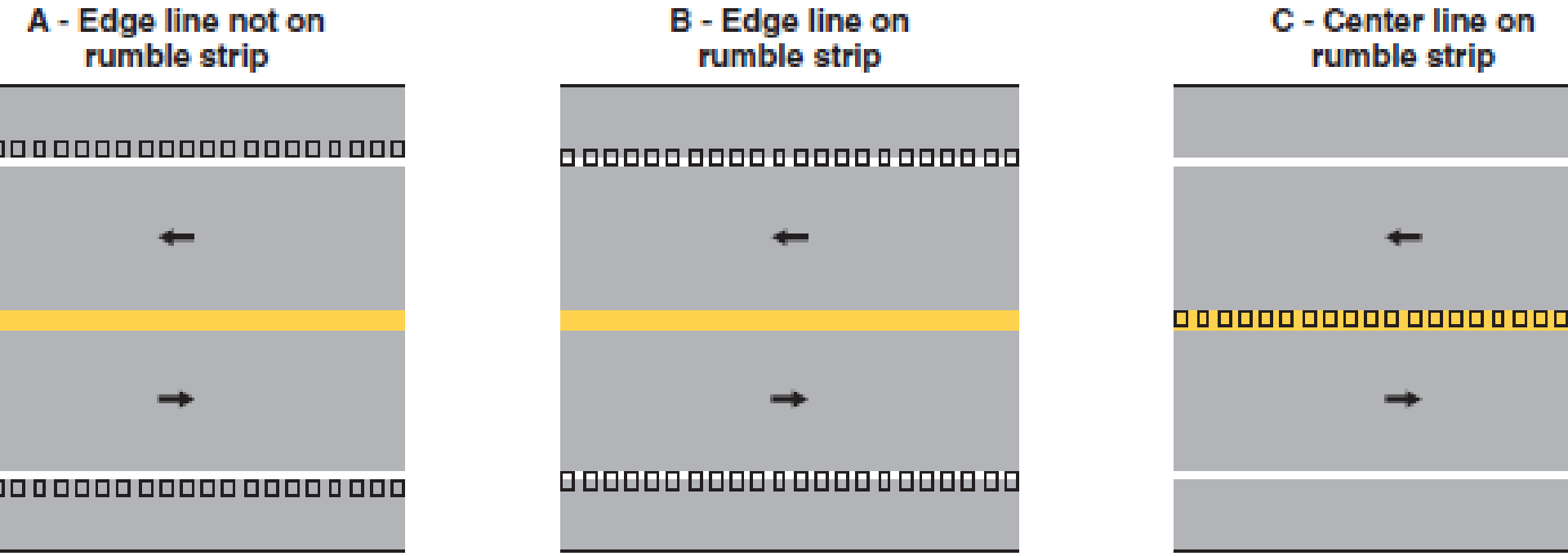
Road humps (Speed breakers)

Transverse rumble strips

Transverse rumble strips consist of intermittent narrow, transverse areas of rough-textured or slightly raised or depressed road surface that extend across the travel lanes to alert drivers to unusual vehicular traffic conditions.
Through noise and vibration, they attract the attention of road users to features such as unexpected changes in alignment and conditions requiring a reduction in speed or a stop.

Rumble strips

- To reduce run-off-road (ROR) crashes, rumble strips are typically placed longitudinal to the roadway surface on the shoulder or edge of pavement to alert drivers that they are leaving the roadway.



Safety at Construction Site

Most essential safety practices a contractor should be following.

- Personal Protective Equipment (PPE)
- Follow Environmental Guidelines
- Keep the Work Area Clean
- Ladder Safety
- No Crowding inside the Site Perimeter
- Lifting Precautions
- Proper Site Training
- Safety Programs and Culture
- Risk Management System

Basic Safety Precautions at Construction Site

In any construction project for basic safety precautions to be implemented are:

- Guard rails to be installed at open scaffold areas, all openings in the building floor, in the excavated areas, at mobile elevated platforms.
- Yellow stickers with safety notes to be pasted where necessary
- All the working platforms should be stable, properly braced, should not be overloaded and safe for the working personnel
- All the working areas and passageways should be free from waste or debris or any of obstruction like stored material
- The site should be clean all the times and the material should be stored safely
- There should be proper arrangement of collection and disposal of waste materials
- First aid should be available at all times on site for cuts burns or any mishaps
- Fire extinguishers to be placed on site on proper locations in case of any fire
- That should be proper lighting arrangements on the site especially when the work is carried out during the night stand

Safety at Construction Site

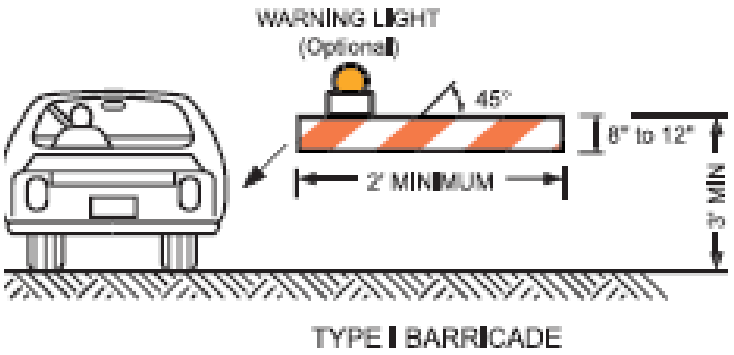
work zone traffic control

- Highway, road, street, bridge, tunnel, utility, and other **workers for the highway infrastructure** are exposed to hazards from outside and inside the **work zone**. Falls, electrical, struck-by, and caught between are the common hazards found in this type of work
- The following are four types of traffic control devices used in work zone traffic control:
- Signs
- Channelizing Devices
- Lighting Devices
- Pavement Markings

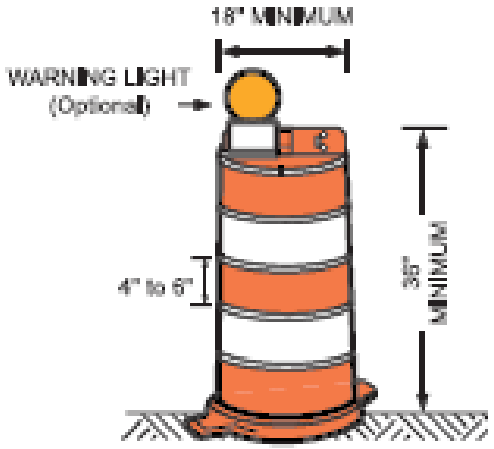
Construction Zone markings, signs.

- Signs used in work zone traffic control are classified as **regulatory, guide, or warning**.
- Regulatory signs impose legal restrictions and may not be used unless authorized by the public agency having jurisdiction.
- Guide signs commonly show destinations, directions, and distances.
- Warning signs give notice of conditions that are potentially hazardous to traffic

Construction Zone markings, signs.



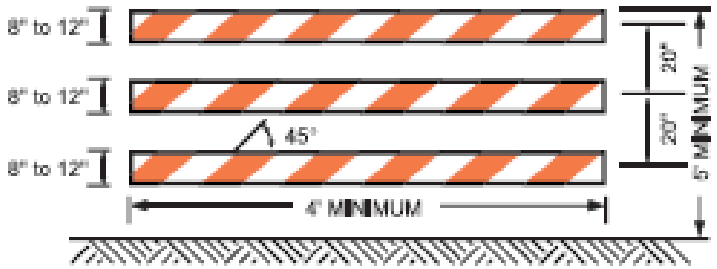
TYPE I BARRICADE



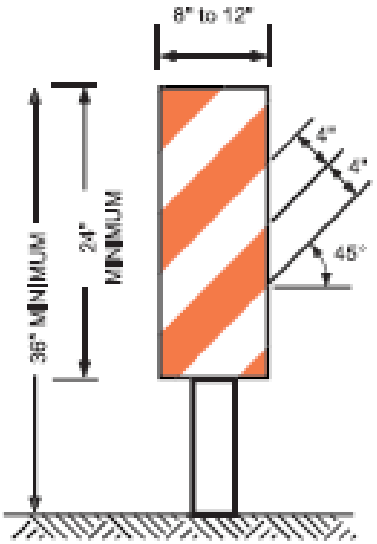
DRUM

Channelizing Devices

TYPE II BARRICADE

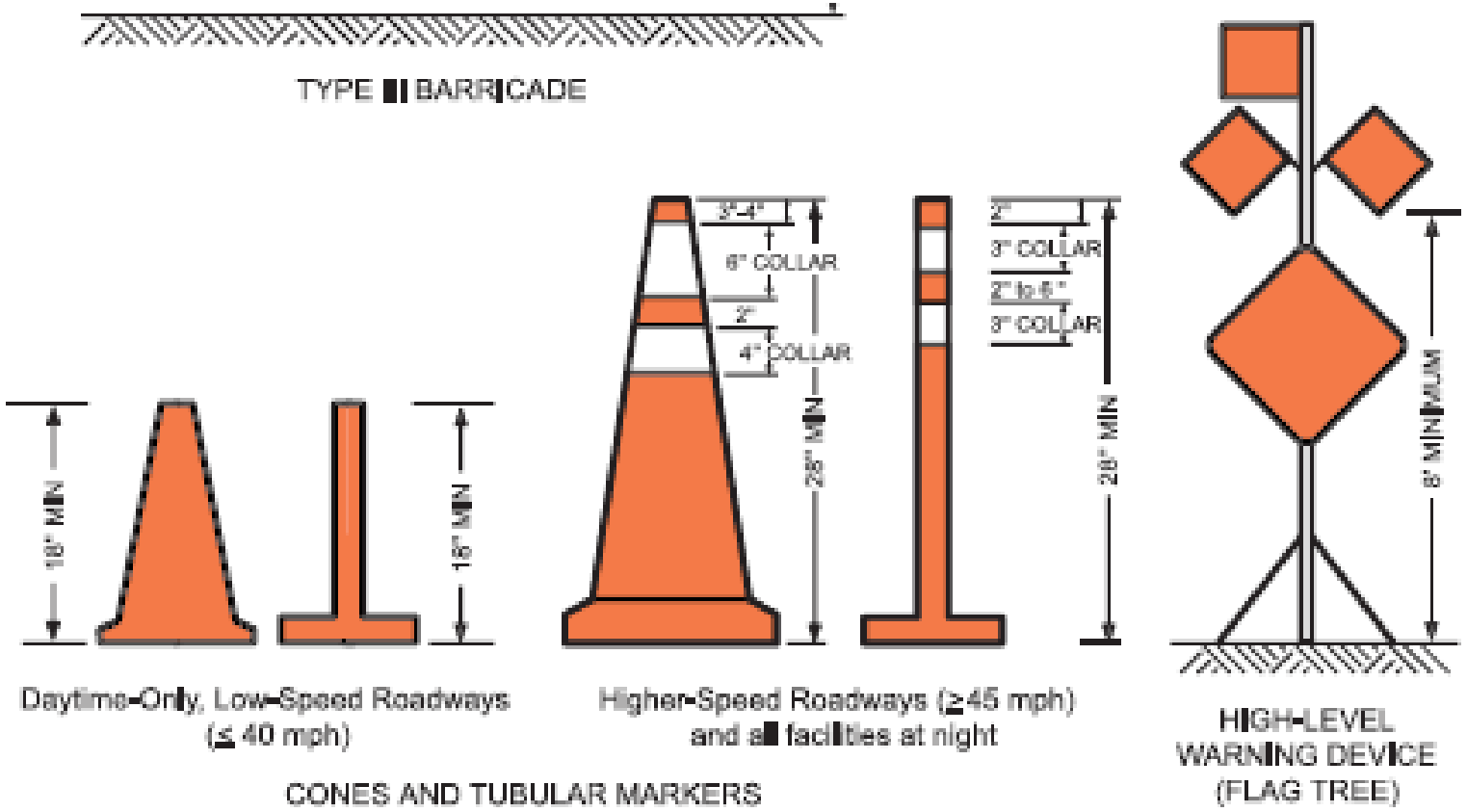


TYPE III BARRICADE



VERTICAL PANEL

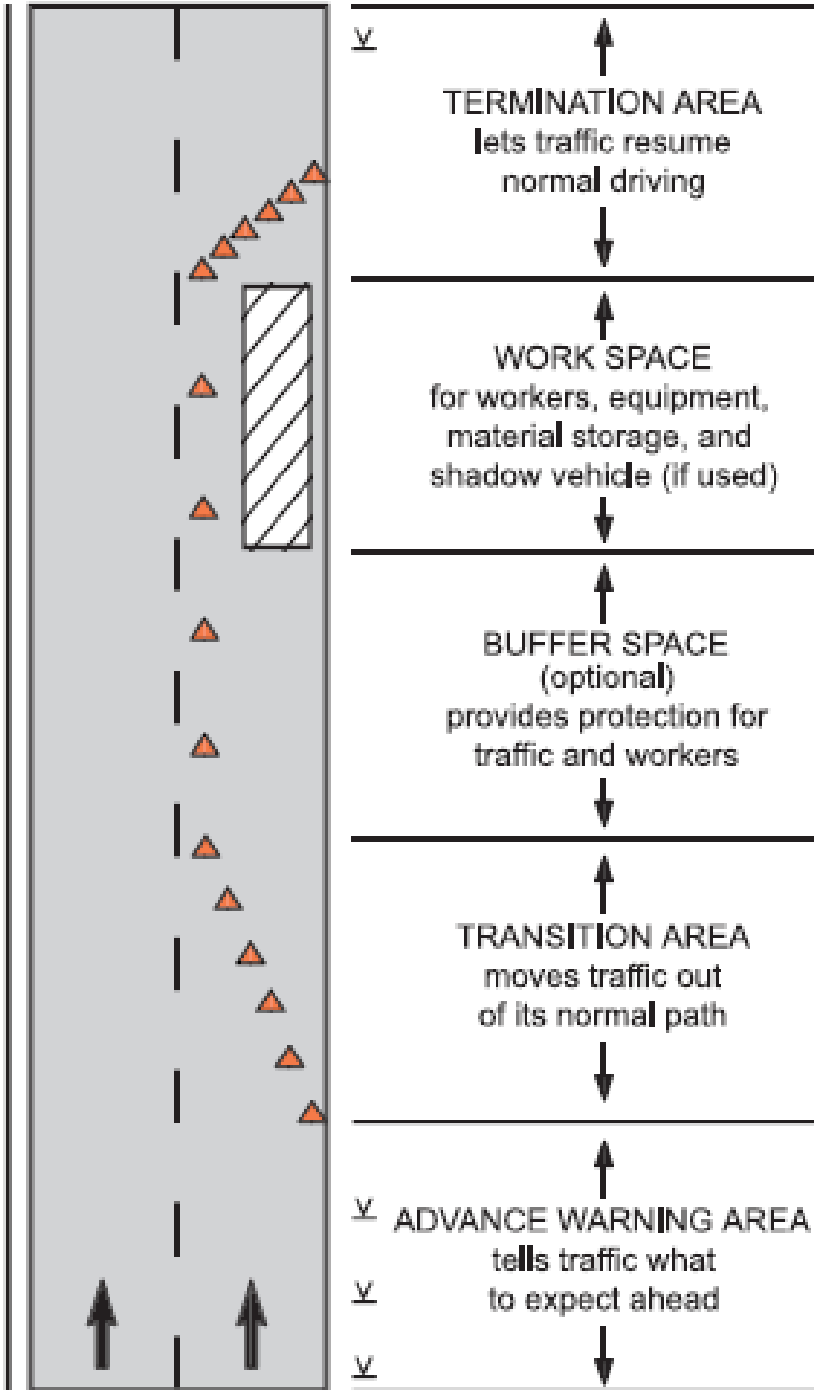
Construction Zone markings, signs



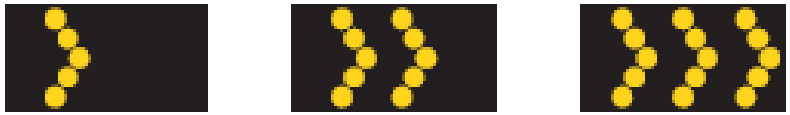
CONES AND TUBULAR MARKERS

Five Parts of a Traffic Control Zone

1. **Advance warning area**
2. **Transition area**
3. **Buffer space (optional)**
4. **Work space**
5. **Termination area**



Advance Warning Arrow Display

Operating Mode	Panel Display (Type C panel illustrated)
I. At least one of the three following modes shall be provided:	(Right arrow shown; left is similar)
Flashing Arrow	 Move/Merge Right
Sequential Arrow	 Move/Merge Right
Sequential Chevron	 Move/Merge Right
II. The following mode shall be provided: Flashing Double Arrow	 Move/Merge Right or Left
II. The following mode shall be provided: Flashing Caution	 Caution or  Caution

- END