# Road Safety in Planning and Geometric Design

UNIT III

**COURSE INSTRUCTOR: S PRAVEEN** 

#### Points to be covered

- Vehicle and Human Characteristics
- Road design and Design Equipment's
  - Redesigning Junctions
  - Cross section Improvements
  - Reconstruction and Rehabilitation of Roads
  - Road Maintenance
  - Traffic Design
  - Vehicle Design and Protective devices
  - Post Accident Care

# Traffic System Components

- Road users-drivers, pedestrians, bicyclists, and
- passengers
- Vehicles- private and commercial
- Streets and highways
- Traffic control devices
  - The general environment

### Road Users

- Physiological—Measurable and Usually Quantifiable
- Psychological—Much more difficult to measure and quantify

#### Psychological:

- Desired speeds
  - Desired safety distances

#### Physiological:

- Perception-Reaction time
- Visual factors

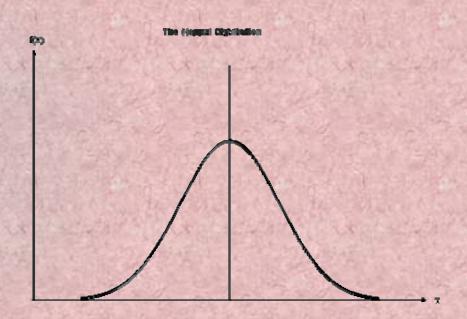
# Diversity (behaviors)

- Drivers and other road users have widely varying characteristics.
- Traffic controls could be easily designed if all drivers reacted to them in exactly the same way.
- Safety could be more easily achieved if all vehicles had uniform dimensions, weights, and operating characteristics.
  - The traffic engineer must deal with elderly drivers as well as 18-year-olds, aggressive drivers and timid drivers, and drivers subject to myriad distractions both inside and outside their vehicles

# Diversity (behaviors)

Most human characteristics follow the normal distribution. A normal distribution defines the proportions of the population expected to fall into these ranges. Because of variation, it is not practical to design a system for "average" characteristics. If a signal is timed, for example, to accommodate the average speed of crossing pedestrians, about half of all pedestrians would walk at a slower rate and be exposed to unacceptable risks.

Thus, most standards are geared to the "85th percentile" (or "15th percentile")



# Diversity (Vehicles)

Highways must be designed to accommodate motorcycles, the full range of automobiles, and a wide range of commercial vehicles, including double- and triple-back tractor-trailer combinations.

Thus, lane widths, for example, must accommodate the largest vehicles expected to use the facility.

# Uniformity for Diversity

- design of roadway systems and traffic controls is in the core of their professional practice.
- Roadways of a similar type and function should have a familiar "look" to drivers; traffic control devices should be as uniform as possible. Traffic engineers strive to provide information to drivers in uniform ways.

#### Drivers

- Visual Acuity factors
- Reaction Process

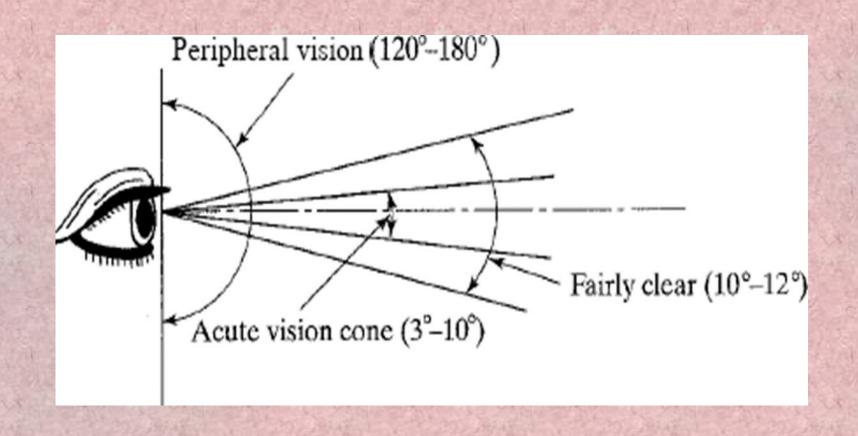
- Hearing
- Physical Strength

Personality and Psychology

# Visual Acuity factors

- The most important characteristic of drivers is their ability to see!
- Field of Vision
  - Color Blindness

# Field of Vision



#### Field of Vision

- Acute or clear vision cone-3° to 10° around the line of sight; legend can be read only within this narrow field of vision.
- Fairly clear vision cone-10° to 12° around the line of sight; color and shape can be identified in this field.
- Peripheral vision-This field may extend up to 90° to the right and left of the centerline of the pupil, and up to 60° above and 70° below the line of sight. Stationary objects are generally not seen in the peripheral vision field, but the movement of objects through this field is detected.

#### Field of Vision

- Objects or other vehicles located in the fairly clear and peripheral vision fields may draw the driver's attention to an important event occurring in that field, such as the approach of a vehicle on an intersection street or driveway or a child running into the street after a ball. Once noticed, the driver may turn his/her head to examine the details of the situation.
- Traffic Signs: Location, Height, Shapes, Colors
- The peripheral vision field narrows, as speed increases, to as little as 100° at 20 mi/h and to 40° at 60 mi/h.

#### Visual Deficits

- Some of the more common problems involve cataracts, glaucoma, peripheral vision deficits, ocular muscle imbalance, depth perception deficits, and color blindness.
- Unfortunately, one of the most common forms of color blindness involves the inability to discern the difference between red and green.
  - The location of colors on signal heads has long been standardized, with red on the top and green on the bottom of vertical signal heads. On horizontal heads, red is on the left and green on the right.

## Perception-Reaction Time

- The second critical driver characteristic is perception-reaction time (PRT).
  - **Detection**. In this phase, an object or condition of concern enters the driver's field of vision, and the driver becomes consciously aware that something requiring a response is present.
  - *Identification*. In this phase, the driver acquires sufficient information concerning the object or condition to allow the consideration of an appropriate response.
  - Decision. Once identification of the object or condition is sufficiently completed, the driver must analyze the information and make a decision about how to respond.
  - Response. After a decision has been reached, the response is now physically implemented by the driver.

#### PRT or PIEV

- Perception of cue or stimulus
- Interpretation
- Evaluation of appropriate response (i.e., decision)
- Volition or physical response (i.e., reaction)

# Factors Affecting PRT

- Age
- Fatigue
- Complexity of Reactions
- Presence of Drugs or Alcohol
- AASHTO Recommendations:
  - For braking reactions on Highways:
  - Perception and Reaction Time: 2.5 seconds (90th percentile)
  - For reaction time to traffic signal
  - Perception and Reaction Time: 1.0 Second (85th percentile)

#### Reaction Distance

- The most critical impact of perception-reaction time is the distance the vehicle travels while the driver goes through the process.
- The reaction distance is simply the PRT multiplied by the initial speed of the vehicle.

$$d = 0.278 \, S.t$$

d = reaction distance, m

t = reaction time, s

S = initial speed of vehicle, km/h

#### Reaction Distance

• The importance of this factor is illustrated in the following sample problem: A driver rounds a curve at a speed of 60 mi/h and sees a truck overturned on the roadway ahead. How far will the driver's vehicle travel before the driver's foot reaches the brake? Applying the AASHTO standard of 2.5 s for braking reactions:

$$d_r = 1.47 * 60 * 2.5 = 220.5 \text{ ft}$$

• The vehicle will travel 220.5 ft (approximately 11-12 car lengths) before the driver even engages the brake. The implication of this is frightening. If the overturned truck is closer to the vehicle than 220.5 ft when noticed by the driver, not only will the driver hit the truck, he or she will do so at full speed-60 mi/h. Deceleration begins only when the brake is engaged-after the perception-reaction process has been completed.

#### Pedestrian Characteristics

- One of the most critical safety problems in any highway and street system involves the interactions of vehicles and pedestrians.
- Walking Speeds
  - 1 to 1.2 m/s for 85%
- Gap Acceptance
  - □ 38 m
- Pedestrian Comprehension of Controls

# Vehicle Categories

- AASHTO Four main categories :
  - Passenger curs-all passenger cars, SUVs, minivans,
     vans, and pickup trucks.
  - Buses-intercity motor coaches, transit buses, school buses, and articulated buses
  - Trucks-single-unit trucks, tractor-trailer, and tractorsemi-trailer combination vehicles
  - Recreational vehicles-motor homes, cars with various types of trailers (boat, campers, motorcycles, etc.)

# Vehicle Characteristics

- Braking and deceleration
- Acceleration
- Low-speed turning characteristics
- High-speed turning characteristics

- Size
- Weight

# **Turning Movements**

- Low-speed turning characteristics
  - $\le 16 \text{ km/h}$
  - The turning radius can be attained from graphs. (e.g. Fig 2.4)
- High-speed turning characteristics

$$R = \frac{S^2}{127.14 (0.01e + f)} \Rightarrow S = \sqrt{127.14 R (0.01e + f)}$$

# **Turning Movements**

Coefficient of side friction in wet pavements

Speed km/h	48	64	80	97	113
F	0.16	0.15	0.14	0.12	0.1

# Braking Characteristic

Braking Distance

$$d_b = \frac{S_i^2 - S_f^2}{254.28 (F \pm \%G)}$$

d<sub>b</sub>: Braking Distance m

S<sub>i</sub>: Initial Speed m/s

S<sub>f</sub>: Final Speed m/s

a: Deceleration rate m/s<sup>2</sup>

 $F = a/g (g=9.81 \text{ m/s}^2)$ 

G: Grade %

# **Total Stopping Distance**

$$d = d_r + d_b = 0.278 \, S.t + \frac{S_i^2 - S_f^2}{254.28 (F \pm \%G)}$$

- Safe Stopping Sight Distance
- Decision Sight Distance
- Change (Yellow) and Clearance (All Red) Intervals for a Traffic Signal

# Safe Stopping Sight Distance

• One of the most fundamental principles of highway design is that the driver must be able to see far enough to avoid a potential hazard or collision. Thus, on all roadway sections, the driver must have a sight distance that is at least equivalent to the total stopping distance required at the design speed.

# Decision Sight Distance

- there are some sections that should provide greater sight distance to allow drivers to react to potentially more complex situations than a simple stop.
- AASHTO recommends that decision sight distance be provided at interchanges or intersection locations where unusual or unexpected maneuvers are required; changes in cross-section such as lane drops and additions, toll plazas, and intense-demand areas where there is substantial "visual noise" from competing information (e.g., control devices, advertising, roadway elements).

# Decision Sight Distance

$$d = 0.278 (t_r + t_m) S_i$$

d = Decision Sight Distance, m

 $t_r$  = reaction time for appropriate avoidance maneuver, s

 $t_m$  = maneuver time, s

 $S_i$  = initial speed of vehicle, km/h

# Decision Sight Distance

Design Speed (mi/h)	Assumed Maneuver Time (s)	Decision Sight Distance for Avoidance Maneuver (ft)						
		A (Equation 2-9)	B (Equation 2-9)	C (Equation 2-10)	D (Equation 2-10)	E (Equation 2-10)		
Reaction	on Time (s)	3	9.1	11.2	12.9	14.5		
30	4.5	219	488	692	767	838		
40	4.5	330	688	923	1023	1117		
50	4.0	460	908	1117	1242	1360		
60	4.0	609	. 1147	1341	1491	1632		
70	3.5	778	1406	1513	1688	1852		
80	3.5	966	1683	1729	1929	2117		

A: Stop on a rural road

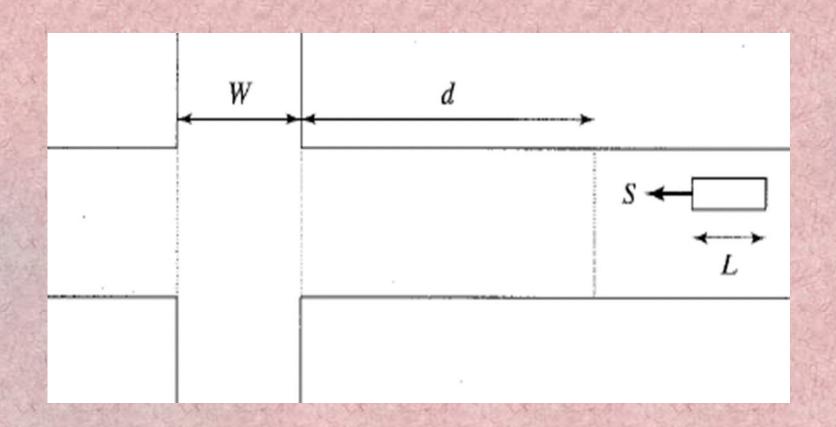
B: Stop on an urban road

C: Speed/path/direction change on a rural road

D: Speed/path/direction change on a suburban road

E: Speed/path/direction change on an urban road

# Change (Yellow) and Clea<del>rance (All Red)</del> Intervals for a Traffic Signal



# Reading

• *Traffic Engineering*, Roess, Prassas, McShane, [1] pp. 17-37

# Road Design

- Geometric roadway design can be broken into three main parts: alignment, profile, and cross-section. Combined, they provide a three-dimensional layout for a roadway.
- Horizontal Alignment
- Vertical Alignment
- The **alignment** is the route of the road, defined as a series of horizontal tangents and curves.
  - The **profile** is the vertical aspect of the road, including crest and sag curves, and the straight grade lines connecting them.
- The **cross section** shows the position and number of vehicle and bicycle lanes and sidewalks, along with their cross slope or banking. Cross sections also show drainage features, pavement structure and other items outside the category of geometric design.

# Horizontal Alignment

- Geometric design of highways
- Definition of alignment
- Types of alignment
- Horizontal Alignment
- Vertical Alignment

#### Importance of Geometric design

- It deals with the dimensions and layout of visible features of the highway such as alignment, sight distance and intersections
- Highway geometric design designed to provide optimum efficiency in traffic operations with maximum safety at reasonable cost
- The geometric design should be initially prepared considering the future growth in the traffic

#### Important points to consider:

- Width of pavement
- Formation and land
- ☐ The surface characteristics and cross slope of pavement
- ☐ The sight distance or clear distance important for design of horizontal and vertical curves
- The change in road directions is made possible by including horizontal curves
- Super- elevation is provided by raising the outer edge of the pavement to counteract the centrifugal force developed on a vehicle traversing a horizontal curve.
- Extra pavement is also provided on horizontal curves

- In order to introduce the centrifugal force and the super elevation gradually, transition curves are introduced between the straight and circular curves.
- The gradients and vertical curves are introduced in the vertical alignment of the highway

### Points influencing Highway geometrics:

- Design traffic volume
- Level of service
- Super-elevation, alignment and grades
- Lane width
- Cross section
- Slight distance
- Number of lanes
- Design speed
- Vertical and horizontal clearance

### **Design Speed**

- This refers to the highest speed at which vehicles can travel on the road safely, when the weather is favorable and the density of traffic is low, while ensuring that the safe speed is only determined by the road's geometric features.
- Minimum design elements are established with the design speed. These elements include super-elevation, the alignment and the grades. Other elements include width, clearance and side slope ratio.

### **Level of Service**

Level of service refers to the qualitative measure of functional conditions within traffic stream. This is commonly described as freedom to maneuver, travel time, speed, comfort, safety, convenience and interruptions. This criterion differs for multi-lane highways, and it is defined in density.

#### **Design Traffic Volume**

The traffic volume is the average density of traffic that will run on a road in an hour of every day. With the help of these volumes, service flow rate and other calculations that will help determine how the road should be constructed.

#### **Roadway Context**

The context of the road or highway is critical when developing a road construction project. This factor will determine fundamental design decisions like the cross-section determination, detailed design elements and street fixtures to name a few.

In order for a project to be successful, it is important for the highway design to consider its surroundings and respect it. A design that is context sensitive will start with analyzing the contextual elements like the community and environment that surrounds the area. Once the designer clearly understands the surroundings of a potential highway and its users, the rest is much easier to design and plan.

#### **Sight Distance**

This refers to the length of the road ahead that can been seen by the user of the roadway. Most of the time, specific distances applies to cyclists and motor vehicles, stopping sight distance, decision sight distance, and passing sight distance are usually taken into consideration.

#### Safety

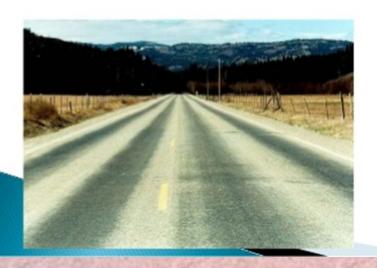
The safety that all transportation facilities provide is the primary consideration when it comes to geometric road design. While constructing roads, certain projects are specifically made to tackle existing safety hazards. It is important that all projects do eventually result in facilities that are extremely safe for its users.

Conducting corridor safety audits and crash record analysis are a great way to discover any hidden safety hazards. It is important for designers to pick project design elements according to their expected characteristics while operating and according to historic performance when it comes to safety. All highways are

tested before they become functional.

### **Influent Factors**

- Vehicle speed
- Surface texture (macro-texture)
- Surface condition
- Tire characteristics
- Weather
- Road geometry
- Aggregates (micro-texture)







### The elements of Road Design

- Angle of Crossing
- Speed Breakers
- Kerbs
- Pedestrian Crossings
- **Grade Separator**

#### Angle of Crossing

The angle at which the two roads cross each other should not be an acute angle. They should be such aligned so that they meet at right angles to each other.

#### Speed Breakers

The speed breakers should be laid at specific distances in specific areas. Speed breakers should never be constructed on highways. They could lead to road accidents.

#### Kerbs

Kerbs are to installed wherever necessary usually on a shopping street so as to connect the main road to the footpath for the access of the elderly and handicapped.

- Pedestrian Crossings
- Pedestrian Crossings should be marked in Black and White (Zebra Crossings) for convenience.
  - Grade Separator
  - Signages should be mounted from place to place displaying the limit of speed of vehicles for that particular area. This system is called grading.

### Road Construction Equipment

#### Rollers

- Static
- Vibratory,
  - Grid/sheep's foot roller
  - Pneumatic tire roller

#### Pavers

- Mechanical pavers
- Sensor Pavers
- Slip form Pavers
- Kerb making machines
- Road marking machines

### ... Continued

Aggregate Crushers

Mixing plants

Aggregate mixing plants

Bituminous plants

Concrete batching plants

Grader

Loader

### Speed Breakers

Speed breakers are designed to one - try to get the drivers to reduce their speed at critical junctions. This could mean pedestrian areas crosswalks, toll collection booths, security gates etc. Also referred to as speed breakers, we offer them in two materials - Rubber Speed Bump and Hexacore Polybump. We are one of the largest speed bumps supplier in India. Our Polymer base Speed bump with Hexacore design has become the go-to standard for malls, institutions and toll booths. PN Safety Industries is your ideal partner as speed breaker manufacturer in India.

Hexacore Polybump Speed Breaker

Rubber Speed Bump





### Safety Cone

- Height 750 mm
- Base 385 mm x 385 mm appx.
- Base Shape Square Flexible Rubber Base Black Colour
- Body Material HDPE Plastic Confirm to as per ASTM Standard
- Colour Red, Orange, Yellow
- Band Reflective 4 inch strip / 2inch strip
  - Weight 2.5kg appx.



### Spring Post

#### Specifications:

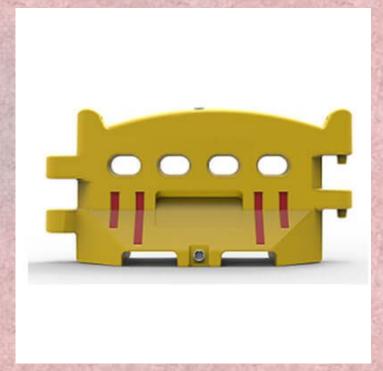
- Frame Material PVC or Rubber
- Flexibility Yes
- Color Silver, Orange
  - Upper diameter 80 mm
  - Length 750mm



### Safety Barricades

#### Features:

- Easy installation
- Available in different customized specifications
- Used while working in progress at toll plaza, check post and allied areas





Major Roads in the city are being redesigned to employ a holistic approach to street design which incorporates primary mobility elements — like footpaths, cycle tracks and carriageways — as well as secondary elements such as trees, bus stops, street furniture and organized vending spaces, in an integrated manner. Streets will be designed based on a scientific assessment of the needs and behavior of street users, as observed in the surveys part of the study.

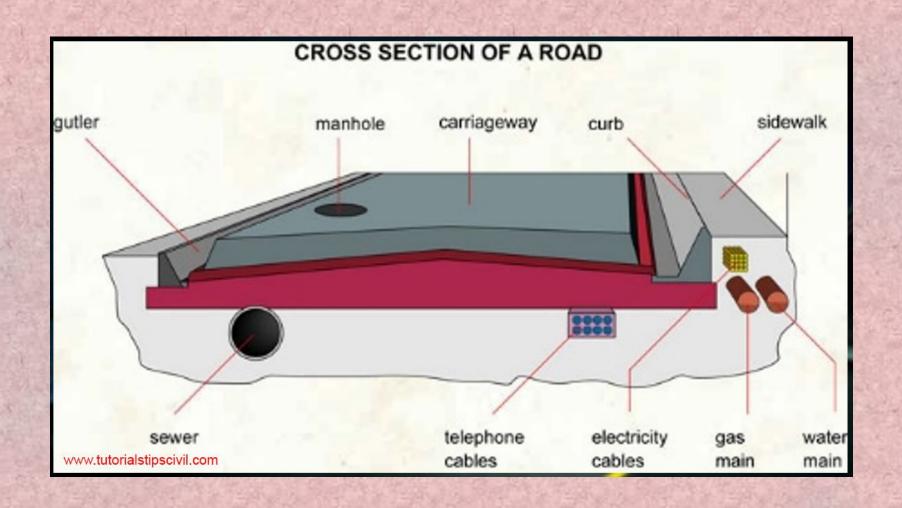
Utilities will also be made underground to create more space for surface utilization for further development. Traffic calming measures will also be used to ensure pedestrian safety on all these streets. Additionally, the aim is to also make all these spaces accessible to all users, regardless of age, gender or physical ability through the adoption of global best practices.

### Danger Tape

- Features:
- Accurate dimension
- Durable
- Excellent finish



### Cross section Elements



- The major cross section elements considered in the design of streets and highways include the pavement surface type, cross slope, lane widths, shoulders, roadside or border, curbs, sidewalks, driveways, and medians.
- What are the cross sectional elements of pavement?
- Image result for cross section components of road
  - Cross Sectional Elements of A Pavement

Camber.

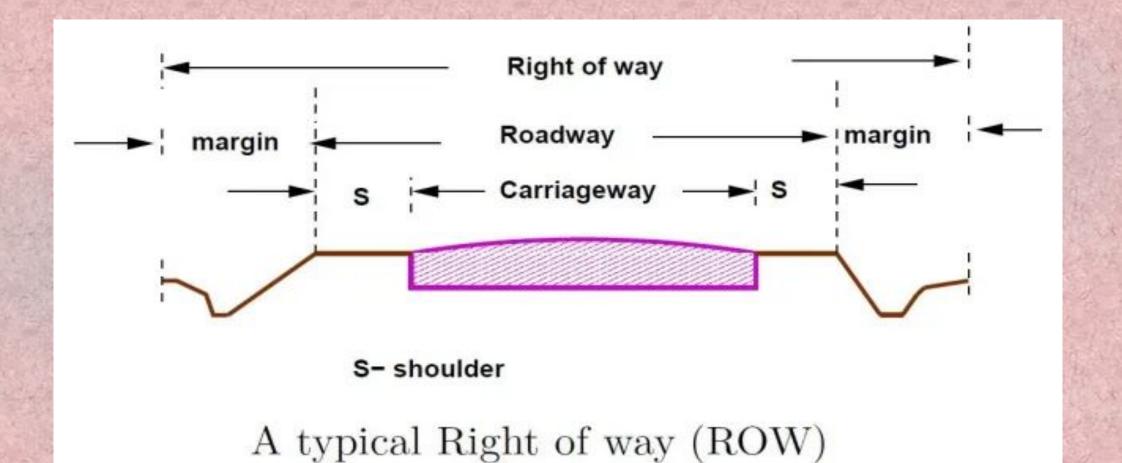
Width of Carriage way.

Kerb.

Road Margin.

Width of Formation.

Right of Way (ROW)



- A slight imbalance in cross section elements can lead to accidents
- Camber is higher than required value can lead to overturning of overloaded vehicles leading to accidents.
  - Drainage facility at the corner along the length of the road if not provided needs to be provided and along the width of the road also the drainage needs to be provided
  - Other pipelines need to be provided at a proper position to avoid the reconstruction of the roads

## Reconstruction and Rehabilitation of Roads

#### Maintenance

The combined effects of traffic loading and the environment will cause every pavement, no matter how well-designed/constructed to deteriorate over time. Maintenance and rehabilitation are what we use to slow down or reset this deterioration process. Maintenance actions, such as crack sealing, joint sealing, fog seals and patching help slow the rate of deterioration by identifying and addressing specific pavement deficiencies that contribute to overall deterioration. Rehabilitation is the act of repairing portions of an existing pavement to reset the deterioration process. For instance, removing and replacing the wearing course in a pavement provides new wearing course material on which the deterioration process begins anew.

## This Module discusses the maintenance options for HMA and PCC pavement

#### Rehabilitation

The combined effects of traffic loading and the environment will cause every pavement, no matter how well-designed/constructed to deteriorate over time. Maintenance and rehabilitation are what we use to slow down or reset this deterioration process. Maintenance actions help slow the rate of deterioration by identifying and addressing specific pavement deficiencies that contribute to overall deterioration. Rehabilitation is the act of repairing portions of an existing pavement to reset the deterioration process. Reconstructing an entire pavement, however, is not considered rehabilitation but rather new construction because the methods used are generally those developed for new pavement construction.

"Measures to improve, strengthen or salvage existing deficient pavements to continue service with only routine maintenance. Deficient pavements exhibit distress in excess of what can be handled through routine maintenance."

In other words, although maintenance can slow the rate of pavement deterioration, it cannot stop it. Therefore eventually the effects of deterioration need to be reversed by adding or replacing material in the existing pavement structure.

## Rehabilitation options depend upon local conditions and pavement distress types but typically include:

HMA overlays. Overlays are used for two primary purposes:

- Structural overlays are designed to add structural support to the existing pavement. Because of this, they are structurally designed and are thicker than non-structural overlays.
- Non-structural overlays are designed to add or replace the existing pavement wearing course. Because of this they contribute very little to the pavement structure and are generally assumed to provide no additional structural support. Because most agencies consider non-structural overlays to be maintenance items, they are discussed on the Maintenance page.

In-place recycling. There are two types of common in-place recycling:

- Hot in-place recycling (HIPR). Covered on the recycling page.
- Cold in-place recycling (CIPR). Covered on the recycling page. Full-depth CIPR, known as full-depth reclamation (FDR) is considered reconstruction

### Structural Overlays

- Engineering judgment. This approach to overlay design selects an overlay thickness and the associated materials based on local knowledge of existing conditions, which can result in cost effective solutions; however, local expertise is fragile and subject to retirements, agency reorganizations, etc. This method is highly subjective and can be heavily influenced by political and budget constraints. Currently, more agencies appear to be relying on quantifiable overlay design approaches but tempered with local expertise.
- Component analysis. This approach to overlay design essentially requires that the total pavement structure be developed as a new design for the specified service conditions and then compared to the existing pavement structure (taking into account pavement condition, type, and thickness of the pavement layers). Current component design procedures require substantial judgment to effectively use them. This judgment is mainly associated with selection of "weighting factors" to use in evaluating the structural adequacy of the existing pavement layers (i.e., each layer of the pavement structure is assigned a layer coefficient often on the basis of experience).

Non-destructive testing with limiting deflection criteria. This approach to overlay design uses pavement surface deflection measurements to determine pavement structural properties, which can then be used to determine the required amount of additional pavement structure. Basically, a pavement's surface deflection in response to a known loading is used as a measure of effective strength. This "effective strength" is influenced by a variety of factors including material properties (including subgrade), thickness of pavement layers, and environmental effects. Most currently used deflection based overlay design procedures do not attempt to isolate material properties of individual pavement layers.

Mechanistic-empirical analysis. This approach to overlay design uses the same mechanistic-empirical methods that were discussed in the Structural Design section. These methods are quite versatile because they can evaluate different materials under various environments and pavement conditions. In many places these procedures have replaced limiting deflection overlay methods, since the latter do not account for subsurface material properties.

### Traffic control

#### Road Safety Rules And Regulations

- Keep To Your Left Always drive or ride on the left side of the road and let other vehicles overtake you from the right side.
- Stay Left When You Turn Left When turning towards left, start with approaching the curb from the left-most lane and ensure there's enough distance for oncoming vehicles to pass.
- Turn Right Come to the centre of the road before you start turning right but when going around the curb, try to stay towards the left-most part of your lane to avoid contact with oncoming traffic.
- Always Overtake from the right side.
  - When being overtaken by another vehicle, never increase your speed to prevent the other driver from overtaking you.
  - Be extra careful on intersections. Also, when passing through them, ensure your vehicle doesn't cause inconvenience to other road users.
  - Right of Way- Always give a right of way to vehicles on intersections by letting them continue without stopping in that particular direction in which you are about to proceed.
  - Emergency Vehicles It is your responsibility to give way to emergency services vehicles such as fire engines and ambulances.

- Pedestrians have the right of way at pedestrian crossings or zebra crossings.
  - "U" Turns- U-turns can only be taken when there is no warning sign nearby you give a proper indication to other vehicle drivers that you are going to take a U turn
  - Indicators Always use indicators to let other road users know about the planned change in the direction of travel. If your vehicle indicators get damaged without any warning, use hand signals
- Parking Make sure you don't park your vehicle in a way it causes any hurdle or disturbance to any other road users.
  - Registration Your vehicle's registration plate should be visible at all times. In case it is broken or damaged, you need to get it replaced at the earliest. Driving a vehicle with its registration number not being visible is a serious offence.
  - One way Roads Always drive only in the permissible direction on a one-way road. Also, never park your vehicle in reverse on a one way street.
  - Stop Lines Always stop your vehicle behind the stop lines. On roads with no stop lines, make sure your vehicle comes to a halt before the Zebra-crossing.
- Towing No vehicles should be towed closer to other vehicles on the road. However, vehicles that are mechanically disabled and those confiscated by the police are exceptions to this rule.

- Noise Drivers should not horn needlessly or excessively or use them in no-honking zones like hospital zones and school zones, etc. Also, one should not drive with non-OEM-spec silencers
- Traffic Lights and Signs should be always obeyed. One should respect instructions given by a traffic cop when there are no traffic lights available.
- Following Distance Always keep a safe distance from the vehicle in front of you as this will give you enough time to come to a stop in case the vehicle in front brakes suddenly.
- Right of way on Steep Roads When going up on an incline, you have the right of way as it might be difficult for you to stop and regain momentum. The vice versa holds true when you're driving downhill.
- Obstruction of View You should always have a clear view of the road ahead. Therefore, your car's windshield shouldn't have stickers that might obstruct your view.
  - Passing Pedestrians Do not drive at more than 25 km/hr, when you passing a procession, meeting, strike, or a march.
- Tractor and Goods Carriages It is prohibited to carry passengers on a tractor or a goods carrier
- Loading Overloading a vehicle is not only dangerous but even illegal. Therefore, one should not carry more than a permissible number of passengers or excessive luggage that the vehicle isn't designed to carry.

- Dangerous Materials One should not carry explosives, inflammable or harmful substances as they are a fire hazard.
- Driving in Reverse When driving in reverse, you should make sure you do not cause annoyance to any other people on the road.
- Essential Documents Always carry the following documents Driving license,
  Registration certificate of the vehicle, Insurance certificate, fitness certificate (in case of commercial vehicle), tourist permit (in case of commercial vehicle) and PUC certificate.
  - Additional Regulations In addition to the above, the drivers should be aware of al the road safety rules, such as those of speed limit, one-way streets, etc.

### Avoiding Blind Spots

- Never Cross Road At Bends There are blind spots for many motorists on a bend and they might not be able to see your child crossing a road on the bend. Hence, kids should avoid crossing the road at bends.
- Staying Safe On A Bicycle In case your child uses a bicycle, he should avoid riding it fast and always wear a helmet. Also, he should ensure the bicycle is in good condition and always ride it in a bicycle lane. In case the bicycle lane isn't present, he should ride it in the left-most lane.
  - Staying Safe Inside A Moving Vehicle In a moving vehicle, a kid should be always belted up, never stand or disturb the driver.

### Road Safety Rules for Cars

- Always wear your seat-belt Make sure you're belted up at all times, even if you're in the rear seat. This will not only save you from fines but will even keep you protected.
- Avoid distractions Distracted driving is among the major causes of accidents. Hence, one should avoid taking phone calls while driving. Basically, a driver should stay fully focussed on road at all times.
- Never ever drive under the influence of alcohol or any sort of intoxicating substance.

  Doing so can lead you to lose control while driving and end up in a mishap. It's also illegal to drive drunk or in an intoxicated state.
  - Always respect the speed limits as driving at higher speeds can land you with a challan and worst, still, cause an accident.
- Maintain your car One should always maintain his car to ensure high road safety as driving an ill-maintained vehicle can cause an accident, thereby causing injury to you as well as other road users.

### Traffic and Road Safety Issues

- Negligence of Civilians: It's true that the civilians make the most hue and cry about the road safety issues. Still, however, the same people can be often seen not respecting the traffic rules. This is something that is quite worrying as they take rules lightly even after knowing that breaking the road safety rules is dangerous.
- Poor Condition of roads: Another huge road safety issue that we face is that of poor infrastructure. Poor road designs and badly maintained roads often lead to mishaps.

  They also take a toll on the vehicles.
  - Unsafe Vehicle Design: It is not uncommon to see Indian manufacturers not paying as much importance to the safety quotient of their vehicles as they do on vehicles they sell in the west. It's important to look into this urgently and come up with a solution.

- Under-implementation of Road Safety Standards: At times, the required road signs or markings are missing, which is something that should be corrected at the earliest.
- Indifferent Government: Lack of proper planning by the government often leads to motorists suffering from poor road safety standards. It has also been seen that the contractors who offer at least 10 years of warranty on their projects abroad make sub-standard roads in India that get washed away in monsoon.
  - Lack of proper law enforcement's: Having laws is one thing and their enforcement is something other. While proper laws are already in place, the need of the hour is to implement them to the fullest.
  - Lack of Emergency Services: Often, some of our roads lack emergency services and in case of an accident, a quick response team is simply not available. Often, the victim succumbs to his injuries by the time he is taken to a hospital.

- Launch and proper implementation of road safety policies.
- Effective use of resources to ensure high road safety.
- Allocate higher funds for road safety programmes
- Local government can play a leading role in proper implementation of road safety rules in India by proper planning of road facilities in residential areas
- Curb the menace of drunk driving
- Provide support and leadership for road safety campaigns and initiatives.
  - Persuade local communities to participate in workshops on an understanding of road safety rules in India.
  - Promote road safety education in schools so that the required knowledge can be provided at an early age
  - Assist in the life-long education of road users.
- Media can help improve community awareness by getting an understanding of factors that cause road accidents and then spreading awareness on the same.
- Media can also support road safety initiatives through

- Police and Enforcement Agencies can behaviour and temperament of road user behaviour and vehicle standards through a balance of education, encouragement and effective enforcement strategies.
- Maximise the effectiveness of enforcement through the use of proven techniques and technology.
- Police can also use crash data to identify sensitive areas and then work on mitigating the mishap-causing factors.
- Health Agencies can ensure the development of effective emergency services
- Advise patients of the effects of drugs and medication on road user performance.
  - Provide feedback from injury assessment to improve vehicle occupant protection and road safety policy.
  - The authorities should adopt effective and safe traffic management measures in planning transport and land-use developments.
  - Pay particular attention to the safety requirements of people with disabilities, older people, children, pedestrians, bicycle riders and other non-motorised road users in the planning task.
  - Road Engineers and Highway Authorities can Improve the safety performance of the road network by ensuring proper planning, construction and maintenance

- Apply crash reduction and crash prevention techniques to create safer roads
- Alcohol and Hospitality Entertainment Industry can adopt responsible standards of alcohol serving and host responsibility programmes for drivers
- Usage of better labelling of the alcoholic content of beverages.
- Promote the consumption of low-alcohol beverages in preference to higher ones
- Car companies can improve the crashworthiness of their vehicles.
- Introduce in-vehicle crash avoidance technology.
- Use advertisements and CSR activities to promote road safety rules in India.
- Only less than 5-year-old to be imported
- Use more modern vehicles, particularly in the Heavy Commercial Vehicle segment
- Advertisers can stop advertising products which glamorize unsafe driving practices
- Advertisers can also encourage safer practices and products.
- Universities can ensure there is equal importance given to basic and applied topics.

- Universities can also ensure that road safety research is of high quality and that its implication takes place properly
- Provide reliable research results and knowledge against which policy decisions can be made.
  - All Organization can promote safe practices in fleet operation.
  - Larger fleet operators can encourage staff to participate in defensive driving courses
  - Individual Road Users can commit to oneself to improve road safety by respecting the traffic safety rules

# Road Safety Initiatives taken by Indian Government

- The Ministry of Road Transportation and Highways (M.O.R.T.H.) has taken a number of steps to promote high traffic awareness and proper implementation of road safety. This is being done through
  - Important Schemes administered by Road Safety cell are:
  - **Publicity Programs**
  - Grants-in-aid to Voluntary Organizations for organizing road safety programs
  - National Highway Accident Relief Service Scheme
  - Refresher Training to Heavy Vehicle Drivers in Unorganized Sector
  - Setting up of Model Driving Training school

As per the huge road sector program undertaken by M.O.R.T.H., the government of India has been working closely with World Bank and Asian Development Bank to improve road safety. The steps that are taken for this include-

The most important project undertaken by the Indian Government has been the "National Highway Development Program", "Rural Roads Project" under the leadership of Mr Atal Bihari Vajpayee.

"NGOs" have come up in many cities to deal with this problem at their levels.

"Police Departments" hold road safety weeks, painting competitions.

"Road Safety Cell" of the ministry has also been working closely to strengthen institutions and organizations. They have come up with an awards scheme for awarding organizations/individuals making outstanding contribution in the fields.

### Vehicle Design

- Accident prevention cars
- Below are some of the upcoming safety features aimed at preventing crashes and making the vehicles well equipped for active safety:
- Vehicle-to-Vehicle communication: ...
- Traction control system (TCS): ...
- Active Kinematics Control: ...
  - Integrated Brake Control: ...
  - Pedal-Travel Sensor.

# LIST OF SOME OF THE TOP TECHNOLOGIES AVAILABLE NOW THAT ARE ASSISTING IN PREVENTING INJURIES AND CAR ACCIDENTS TODAY:

- AEB: AUTOMATIC EMERGENCY BRAKING SYSTEMS
- BACKUP CAMERAS
- BLIND SPOT DETECTION
  - LANE DEPARTURE WARNINGS
  - FCS: FORWARD COLLISION SYSTEMS
  - ADAPTIVE HEADLIGHTS
  - ECS: ELECTRONIC STABILITY CONTROL
  - VEHICLE COMMUNICATION (V2V)
  - TRACTION CONTROL SYSTEMS
- **AUTO-STEERING**

- REAR CROSS-TRAFFIC ALERT
- LED HEADLIGHTS
- REAR AEB(Automatic Rear Braking System)
  - ACC: AUTONOMOUS CRUISE CONTROL
  - VOICE CONTROL/BLUETOOTH
  - **INTERLOCK DEVICES**
  - DROWSINESS VIDEO SENSOR
  - GEAR SHIFT PALM DETECTION
  - PHONE SUPPRESSION TECHNOLOGY

As relates to the post-crash response, survivors and families affected by road traffic crashes have a range of physical, psychological and legal needs. Consequences may include physical injuries and resulting disability, psychological trauma that can impair reintegration into work and family life, and a range of economic and legal sequelae. A broad and integrated approach to support survivors and families can mitigate the short- and long-term effects of experiencing a road traffic crash and can help those affected return to function and independence at home and at work. An effective post-crash response requires integration of injury care, mental health services, legal support and legislation, and data on road traffic crashes and injuries.

Complemented by case studies from various countries, Post-crash response: supporting those affected by road traffic crashes describes the components of the post-crash response.

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