ROADSIDE HAZARD MANAGEMENT

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Outline

➢ Learning Outcomes:
  ➢ Identify roadside hazards
  ➢ Clear zone concept
  ➢ Investigate a roadside hazard using the roadside hazard management strategy
  ➢ Recommend the most appropriate treatments for “Forgiving Roadside Concept”
What is a Roadside Hazard?

➢ A roadside hazard is any roadside object or feature located on or near the roadway
➢ May adversely affect the safety
➢ Diameter > 10 cm
➢ Likely to create a danger to occupants / riders of any vehicle leaving the carriageway
Roadside Crashes

➢ Causes: driver fatigue, speed, alcohol, distraction, inexperience, ice, snow, heavy rain, or other weather conditions, vehicle failure, poor geometric design, sudden change in traffic conditions

➢ Types of Crashes
  ➢ Run-off
  ➢ Single vehicle
  ➢ Head-on collision
Identifying Roadside Hazard
Types of Hazards

➢ Point Hazards
  • Trees (Dia>10 cm),
  • Bridge End Posts
  • Non-breakaway Signposts (Dia>10 cm)
  • Interchange Supporting Piers
  • Driveway Headwalls
  • Culvert Headwalls
  • Utility Poles (Dia>10 cm)
  • Solid Walls
  • Pedestrian Overpass Piers and/or Stairs
Types of Hazards

➢ Continuous Hazard

• Rows and Forests of Large Trees
• Uncovered Longitudinal Drains
• Retaining Walls
• Steep Embankments
• Rock Cuttings
• Cliffs
• Waterbodies (depth>0.6 m)
• Unshielded Hazards (Such as Cliffs) Beyond Clear Zone and Within Reach of an Errant Vehicle
• Curbs with a Vertical Face>10 cm High on Roads with Operating Speeds >80 Kmph
• Fences with Horizontal rails that Can Spear Vehicles.
Clear Zone (CZ)

- Area beside a road (measured at right angles from the edge line or the edge of the nearest traffic lane) that needs to be kept free of fixed roadside hazards.

Factors influencing CZ:

1. Operating speed (not the design speed)
   - 60 kmph → CZ = 3m; Speed 100 kmph → CZ = 9m
2. Traffic volume
3. Curve radius of the road
4. Steepness of the side slope
   - Case 1: Recoverable → 1V:4H or Flatter
   - Case 2: Non-Recoverable → Between 1V:4H and 1V:3H
   - Case 3: Critical → Steeper than 1V:3H
     - Needs to be flattened or provide hazard shields (e.g., barriers)
Clear Zone (CZ)

➢ Operating speed (Straight Roads)

Speed is 80 kmph and the volume is 4,000 veh/day. What is the clear zone width?

6 meters
Clear Zone (CZ)

- Adjustment for curve radius
  - Radius > 1,000 m → adjustment factor = 1

Radius is 300 meters speed is 90 kmph, What is the adjustment factor for zone width?

1.5
Clear Zone (CZ)

➢ Steepness of side slope (Not required)

No need to consider batter slope → Effective CZ=CZ

Barrier requirement depends on:
1. Fill section height
2. Fill section slope


Clear Zone (CZ)

➢ Steepness of side slope (case 1: Recoverable)

\[
\begin{align*}
\text{ECZ Case 2(b)} & \quad \text{WB/2} \quad \text{CZ} \\
W_2 & \quad W_2 \quad \text{WB/2} \quad W_1 \\
\text{Traffic lane} & \\
\text{Batter slope} & \\
\text{1 on 4 to 1 on 6} & \\
\text{Case 2(a)} \text{ if } & \quad \text{CZ} - W_1 \leq \text{WB/2} \\
& \quad \text{ECZ} = W_1 + 2 \ (\text{CZ} - W_1) \\
\text{Case 2(b)} \text{ if } & \quad \text{CZ} - W_1 > \text{WB/2} \\
& \quad \text{ECZ} = \text{CZ} + \text{WB/2} \\
& \quad \text{or } \quad \text{ECZ} = W_1 + \text{WB} + W_2 \\
\text{where } W_2 & \quad \text{CZ} - W_1 - \text{WB/2} \\
\end{align*}
\]
Clear Zone (CZ)

- Steepness of side slope (case 2: Non-recoverable)

Batter slope is not part of CZ. Hence $ECZ=W_1+W_B+W_2$

Roadside Safety Management Strategy
Roadside Safety Management Strategy

➢ Roadside safety management assists in:
  ➢ Reducing the likelihood of a crash
  ➢ Reducing the severity of a crash

➢ Five Steps:
  1. Keep vehicles on the road
  2. Remove the hazard
  3. Relocate the hazard
  4. Modify the hazard
  5. Shield the hazard

When steps 1, 2 and 3 are not feasible, reduce severity.
1. Keep Vehicles on the Road

➢ What keeps vehicles on the road?

Road signs (IRC 67)  Road markings (IRC 35)
1. Keep Vehicles on the Road

Pavement Markings

Delineators

Tactile Edge lines

Must be FORGIVING (plastic or light weight)
1. Keep Vehicles on the Road

➢ Curve Warnings and Chevrons

In case of hill roads, the signs shall generally be installed on the valley side of the road, unless traffic and road conditions warrant these to be placed on the hill side (IRC 67).
1. Keep Vehicles on the Road

- Object Hazard (IRC 35, 2015)

NH 34: Several culvert/bridge Headwalls

Reflective marker

Safe road design:
- Horizontal vertical curves
- Sight distance
- Lane width
- Shoulder width
- Sight distances
2. Remove the Hazard

- Remove all existing roadside objects that are fixed and with Dia>10 cm
  - Trees (environmental damage)
  - Rocks
  - Cover pits

- Develop policies that will avoid the placement of new potentially hazardous objects on the roadside.

- When designing a new road, avoid locating any new hazardous objects within the clear zone.
3. Relocate the Hazard

➢ Relocating further from edge of road
➢ Relocating from outside of a curve to a location on a straight section of the road
➢ Relocation of even a few meters will reduce risk, even if it is not possible to place it outside the clear zone

➢ Common examples:
  ➢ Signposts
  ➢ Delineators
  ➢ Trees - not practical to relocate
4. Modify the Hazard

➢ Alter (or redesign) roadside hazard to reduce its potential for severe injury or death during a crash

➢ Common Examples:
  ➢ Modifying open longitudinal drains by piping them or covering them with a **drivable cover**
  ➢ Modifying end walls of driveway culverts to make them drivable
  ➢ Redesigning rigid signposts/columns to provide **frangible (breakaway) posts** (Impact-absorbent)
  ➢ Flattening a steep fill slope
5. Shield the Hazard

➢ Three types of barriers (IRC 119)

1. Flexible (Cable)
   ➢ Wire Rope Safety Barrier (WRSB)

2. Semi-rigid (Steel)
   ➢ Open box beam
   ➢ W beam
   ➢ Thrie beam

3. Rigid (Concrete)
   ➢ F Profile
   ➢ New Jersey
   ➢ Vertical
   ➢ Constant slope

Proper transition between these barriers is important.
5. Shield the Hazard

➢ Semi-Rigid Barriers

Spacing between kerb and beam should not be more than 10 cm, Else the vehicle topples.
5. Shield the Hazard

➢ Rigid Barriers

➢ F-profile or New Jersey are better
➢ F-profile is better if smaller vehicles are involved
5. Shield the Hazard

➢ Proper transitions and end treatment for barriers

Incorrect transition

- Concrete parapet
- Standard guardrail and posts
- Rail not fixed to parapet
- Guard rail deflects and leaves the parapet exposed
5. Shield the Hazard

➢ End treatment for crash barriers

Fish tail barrier

Impact attenuators (Crash cushions)
Crushable cells inside the steel structure to absorb much of the impacting energy
5. Shield the Hazard

➢ Slip base columns
5. Shield the Hazard

➢ Frangible (forgiving) lighting columns

- Column either slips (dismantles) or
- Absorbs the impact (wrap around the vehicle)
Hazard Management Strategy

Determine the clear zone distance

1. Are there any hazards within the clear zone?
   - Yes
   - No

2. Can hazard be removed?
   - Yes
   - No

3. Can hazard be relocated at least to edge of clear zone?
   - Yes
   - No

4. Can hazard be modified to reduce its crash frequency and/or crash severity risk to road users?
   - Yes
   - No

5. Can hazard be shielded with safety barrier?
   - Yes
   - No

Has everything been done to “keep vehicles on the road” with delineation, tactile edge lines, paved shoulders, and guideposts?

- Yes
- No

Keep vehicles on the road by signs, improving delineation, installing tactile edge lines, paving shoulders, and installing guideposts

No action required

Remove hazard

Relocate, preferably beyond CZ

Modify or redesign hazard to remove or reduce the danger.

Install an approved safety barrier (or impact attenuator)

Move on to the next run-off-road problem location
Are there any roadside hazards?

https://www.menti.com/
Code: 88 42 13

Results:
https://www.mentimeter.com/app/presentation/algjtqkohn7e1m8j2sqm2xscz31d3uee
References


➢ IRC code 67 (2012) Code of Practice for Road Signs
➢ IRC code 35 (2015) Code of Practice for Road Markings
➢ Austroads (2003) Rural road design, a guide to the geometric design of rural roads, Sydney, Australia
Thank you