Highway Blackspot Identification & Remedial Measures

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1) Average Annual Total Crashes Values
2) Setting Reaction Level

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- Annexure 6.2: Operational Checklist for Site Investigation

Prioritization of Blackspot for Treatment

- All blackspots that are identified may not be taken up for rectification immediately due to budget constraints.
- Thus identified blackspots can be prioritized for treatment in a given financial year depending on available budget.
- A blackspot site will have different number of crashes with different severity. Depending on severity of any road crash, severity score can be assigned as under:
  * Fatal Road Crashes - 10 points
  * Serious Injury Crashes - 5 points
  * Minor Injury Crashes - 2 points and
  * Damage only Crashes - 1 point

- A blackspot with a higher severity score may be prioritized for treatment over other crash locations.
4) BLACKSPOTS – PRIORITIZATION

Stick Analysis Using a Spread Sheet

<table>
<thead>
<tr>
<th>Accident No.</th>
<th>Date</th>
<th>Time</th>
<th>Severity</th>
<th>Dark/Light</th>
<th>Weather</th>
<th>Road Feature</th>
<th>No. of Vehicles</th>
<th>Vehicle 1</th>
<th>Vehicle 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4/1/2009</td>
<td>6:55 p.m.</td>
<td>Grievous Injury</td>
<td>Darkness</td>
<td>Fine</td>
<td>Four Lane</td>
<td>1</td>
<td>Two Wheeler</td>
<td>Trailer Truck</td>
</tr>
<tr>
<td></td>
<td>4/4/2009</td>
<td>7:00 p.m.</td>
<td>Minor Injury</td>
<td>Darkness</td>
<td>Fine</td>
<td>Four Lane</td>
<td>1</td>
<td>Truck</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4/5/2009</td>
<td>6:30 p.m.</td>
<td>Grievous Injury</td>
<td>Darkness</td>
<td>Fine</td>
<td>Four Lane</td>
<td>1</td>
<td>Car</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4/6/2009</td>
<td>3:10 a.m.</td>
<td>Minor Injury</td>
<td>Darkness</td>
<td>Fine</td>
<td>Four Lane</td>
<td>1</td>
<td>Truck</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4/15/2009</td>
<td>01:00 p.m.</td>
<td>Fatal</td>
<td>Day Light</td>
<td>Light Rain</td>
<td>Four Lane</td>
<td>2</td>
<td>Two Wheeler</td>
<td>Two Wheeler</td>
</tr>
</tbody>
</table>

6) Site Investigation

6.1 Site Visit
6.2 Recording Of Findings
6.3 Site Investigation Form
6.4 Site Investigation Checklists
6.5 Additional Surveys And Studies

6) Site Investigation

OPERATIONAL CHECKLIST FOR SITE INVESTIGATION

Site Reference: ____________________________

Site: ____________________________ District: ____________________________

Road No. and change: ____________________________ Location description: ____________________________

Police station: ____________________________ Landmarks: ____________________________

1. Is the driver’s view of other vehicles/ pedestrians obstructed?
2. Do drivers respond incorrectly to signals, signs, or other control devices?
3. Do drivers have trouble understanding and finding the correct path through the location?
4. Are there hidden hazards such as a sharp bend beyond a crest?
5. Are there hazards that vehicle approaching junction cannot see each other?
6. Are vehicle speeds excessive for this situation? Are there speed differences? If yes, in which driving direction?
7. Are parking or other traffic regulations regularly violated?
8. Are vehicles delayed? Can the delays be reduced?
9. Are there traffic flow deficiencies or traffic conflict patterns associated with turning movements?

6.6 Site Investigation

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9. Are there traffic flow deficiencies or traffic conflict patterns associated with turning movements?

7) Final Diagnosis & Develop Countermeasures

➢ Final Diagnosis
➢ Identify Treatable Problems
➢ Develop Countermeasures

- Match solutions to diagnosed problems
- Site Specific Consideration
- Selection of Appropriate measures
Develop Countermeasures

- Single Vehicle Crashes (run-off, overturning crashes)
- Pedestrian Crashes
- Crashes for Vehicles Driving in the Same Direction (usually rear end collisions, side swipe, etc.)
- Crashes at Junctions (usually right-angled collisions)
- Crashes Between Vehicles Travelling in Opposite Directions (usually head-on collisions)
- Railway Crossing Crashes

Cont’d……

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<thead>
<tr>
<th>Likely Contributory Factor</th>
<th>Possible Countermeasures</th>
</tr>
</thead>
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<tr>
<td>• Incorrect super elevation</td>
<td>• Install hazard markers on obstructions close to the edge of the road and / or paint the obstruction with black and yellow strips.</td>
</tr>
<tr>
<td>• Tree / pole / bridge parapet / other hazard is too close to edge of road</td>
<td>• Install clearly visible junction warning signs before all junctions.</td>
</tr>
<tr>
<td>Improve road markings</td>
<td>• Mark centre and edge lines.</td>
</tr>
<tr>
<td>• Apply hatch markings in advance of medians and traffic islands to guide the driver through the lane.</td>
<td></td>
</tr>
<tr>
<td>• Mark STOP lines or Give Way lines at all junctions; along with STOP / Give Way Sign.</td>
<td></td>
</tr>
</tbody>
</table>

Develop Countermeasures

- Single Vehicle Crashes
  - Likely Contributory Factor
  - Possible Countermeasures
    - • Excessive speed not matching the road environment
      - Speed limiting measures
      - • Install vertical speed calming measures- rumble strips, bar markings, speed breakers, speed tables, etc., with traffic signs, etc. |
      - • Provide speed limit signs and initiate speed enforcement |
      - • Install warning signs as per IRC 67 |
      - • Install Chevrons sign or delineator posts |
      - • Consider applying speed limits |
      - • Ensure that all traffic islands, medians conform to the requisite road signs and markings |
    - • Driver fatigue
      - Improve lighting |
      - • Install vertical speed calming measures- rumble strips, bar markings, speed breakers, speed tables, etc., with traffic signs, etc. |
      - • Provide speed limit signs and initiate speed enforcement |
      - • Install warning signs as per IRC 67 |
      - • Install Chevrons sign or delineator posts |
      - • Consider applying speed limits |
      - • Ensure that all traffic islands, medians conform to the requisite road signs and markings |
    - • Poor lighting / Dark conditions
      - Improve signing |
      - • Install vertical speed calming measures- rumble strips, bar markings, speed breakers, speed tables, etc., with traffic signs, etc. |
      - • Provide speed limit signs and initiate speed enforcement |
      - • Install warning signs as per IRC 67 |
      - • Install Chevrons sign or delineator posts |
      - • Consider applying speed limits |
      - • Ensure that all traffic islands, medians conform to the requisite road signs and markings |
    - • Road alignment is unclear
      - • Install vertical speed calming measures- rumble strips, bar markings, speed breakers, speed tables, etc., with traffic signs, etc. |
      - • Provide speed limit signs and initiate speed enforcement |
      - • Install warning signs as per IRC 67 |
      - • Install Chevrons sign or delineator posts |
      - • Consider applying speed limits |
      - • Ensure that all traffic islands, medians conform to the requisite road signs and markings |
    - • High speed on curves
      - • Install vertical speed calming measures- rumble strips, bar markings, speed breakers, speed tables, etc., with traffic signs, etc. |
      - • Provide speed limit signs and initiate speed enforcement |
      - • Install warning signs as per IRC 67 |
      - • Install Chevrons sign or delineator posts |
      - • Consider applying speed limits |
      - • Ensure that all traffic islands, medians conform to the requisite road signs and markings |
    - • Restricted forward visibility for the actual approach speed
      - • Install vertical speed calming measures- rumble strips, bar markings, speed breakers, speed tables, etc., with traffic signs, etc. |
      - • Provide speed limit signs and initiate speed enforcement |
      - • Install warning signs as per IRC 67 |
      - • Install Chevrons sign or delineator posts |
      - • Consider applying speed limits |
      - • Ensure that all traffic islands, medians conform to the requisite road signs and markings |
    - • Narrow carriageway width after a long wide section
      - • Install vertical speed calming measures- rumble strips, bar markings, speed breakers, speed tables, etc., with traffic signs, etc. |
      - • Provide speed limit signs and initiate speed enforcement |
      - • Install warning signs as per IRC 67 |
      - • Install Chevrons sign or delineator posts |
      - • Consider applying speed limits |
      - • Ensure that all traffic islands, medians conform to the requisite road signs and markings |
    - • Sharp sag or crest curve
      - • Install vertical speed calming measures- rumble strips, bar markings, speed breakers, speed tables, etc., with traffic signs, etc. |
      - • Provide speed limit signs and initiate speed enforcement |
      - • Install warning signs as per IRC 67 |
      - • Install Chevrons sign or delineator posts |
      - • Consider applying speed limits |
      - • Ensure that all traffic islands, medians conform to the requisite road signs and markings |
Pedestrian Road Crashes

**Likely Contributory Factors**
- Dark conditions – pedestrians not visible to the in-coming traffic.
- Children playing in the road.

**Possible Countermeasures**
- Construct Foot Over Bridge (FOB) at pedestrian crossings at UJVF where this is justified by the volume of pedestrian and traffic.
- If pedestrians cross at a signal-controlled intersection, consider provision of pedestrian signals and an exclusive pedestrian phase.
- Use of vehicle actuated signal heads, overhead signals, backing boards. Consider provision of vehicle actuated signal control. Moderate the cycle time according to the actual traffic volumes.
- Where there is no motorway parking, construct a bus island to improve visibility for pedestrians.
- Construct street lighting especially (if needed) in urban areas.
- Reduce bus stops so that these do not obstruct visibility.

Road Crashes at Junctions

**Likely Contributory Factors**
- Hit from side – vehicle from side road crashes the stop/ give way line and hits a vehicle on the main road.

**Possible Countermeasures**
- If it is a cross-road, consider altering it to a staggered junction.
- If it is a skewed junction, consider re-aligning the minor road so that it joins the major road at a right angle.
- Reshape the junction layout to include a right turn protected lane wherever possible with all safety elements.
- Ensure adequate warning signs/ advance direction signs on the side road.
- Ensure there is a clearly visible Give Way or STOP signs.
- Install a splitter island in the side road.
- If a lot of the crashes are at night consider installing/improving street lighting.
- Consider installation of rumble strips or other traffic calming measures in the side road.

**Likely Contributory Factors**
- Hit from side – vehicle from side road hits a vehicle on the main road after crossing the stop/give way line.

**Possible Countermeasures**
- If the junction is signal-controlled, improve the visibility of the signals (additional signal heads, overhead signals, backing boards). Consider provide vehicle actuated signal control. Moderate the cycle time according to the actual traffic volume.
- Improve visibility at the stop/give way line by clearing obstructions.
- If it is a skewed junction, consider re-aligning the minor road so that it joins the major road at a right angle.
- Consider installing traffic signs, if visibility cannot be improved.
- Consider installing traffic signs or roadworks if the volume of traffic warrants.

**Likely Contributory Factors**
- Hit from side – vehicle turning out of main road it hit by oncoming vehicle.

**Possible Countermeasures**
- Clear any obstructions to visibility for vehicles waiting to turn right out of main road.
- Consider providing protected turning lane.
- If the junction is signal-controlled consider provision of a fully controlled right turn phase.
Road Crashes Between Vehicles Travelling in Opposite Directions on Undivided Roads

Likely Contributory Factors

- Excessive speeds - loss of control
- Inadequate overtaking sight distance
- Short straight road section between consecutive curves
- Slow gradient with slow heavy traffic
- Slow traffic uses center of road
- Vehicles “cut the corner” at bends
- Poor forward visibility
- Vehicle swerves to avoid pothole
- Vehicle swerves to avoid bad edge
- No centre line
- Narrow road

Possible Countermeasures

- Improve control
- Mark no overtaking zones and consider installing no overtaking signs
- Supplement markings with reflective studs
- Use “hatch” markings on centre line to create a painted median - and reinforce the markings with rumble strips
- Install warning signs (e.g., for bends, junctions, narrow roads)
- Install delineator posts on the centre line of sharp horizontal curves
- Install speed limit signs and provide active police enforcement
- If there is a median, consider: improving the signing/marking, widening of the median or provision of a median barrier
- Provide rumble strips/raised bar marking along the centre line

Cont’d…

Likely Contributory Factors

- Excessive speed - loss of control
- Inadequate overtaking sight distance
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- Slow traffic uses center of road
- Vehicles “cut the corner” at bends
- Poor forward visibility
- Vehicle swerves to avoid pothole
- Vehicle swerves to avoid bad edge
- No centre line
- Narrow road

Possible Countermeasures

- Improve the road surface
- Patch potholes
- Repair damaged edges
- Improve the alignment
- Improve sight distances by improving geometry or cleared by clearing bushes or obstructions
- Increase the number of sections with opportunity for safe overtaking
- Construct overtaking/dividing lines
- Upgrade the road
- Consider widening the lanes and/or shoulders (but note that excessive width might encourage dangerous overtaking)
- Upgrade the road to a dual carriageway

At-Grade Rail Road Crossing Crashes

Likely Contributory Factors

- Excessive speed
- Poor visibility
- Careless overtaking
- Inattention by driver
- Failure of crossing control system
- Crossing may be narrower than approach roads

Possible Countermeasures

- Install speed reducing measures (in the form of rumble strips, road humps, etc.) on the approaches.
- Improve visibility of the crossing and light signals associated with it.
- If the crossing is unmanned, improve the visibility along the rail track on the approach to the crossing.
- Upgrade the signing and marking so that no-one can be in doubt that they are approaching a crossing - consider using “countdown posts”.
- Discourage overtaking by means of signs, markings or delineator posts.
- Consider provision of street lighting.
- Consult the railway authority about changing the control system (unmanned to manned or automatic).
- Consult the railway authority about widening the crossing if it is narrower than the approach roads.
- Consider replacing the crossing with an over bridge or underpass.

1st Principle in Junction Design

Visibility Funnel
Provisions for all road users in Junction

Road Signs: IRC 67 2012
Pavement Markings: IRC 35 2015
Road safety Audit Manual: IRC SP 88 2019, Chap 5 & 6
Traffic Calming: IRC 99 2018
Junction Design: Chapter 3 of:
  IRC SP 73 2018 (2 lane)
  IRC SP 84 2019 (4 lane)
  IRC SP 87 2019 (6 lane)
Roundabout: IRC 65 2017
Road Safety Features: Chapter 9 of:
  IRC SP 73 2018 (2 lane)
  IRC SP 84 2019 (4 lane)
  IRC SP 87 2019 (6 lane)

THANK YOU....