

Table 70. General accident pattern table.

Accident Pattern	Probable Cause	General Countermeasure
<p><b>Left-turn head-on collisions</b></p>	<p>Large volume of left-turns</p> <p>Restricted sight distance</p> <p>Too short amber phase</p> <p>Absence of special left-turning phase</p> <p>Excessive speed on approaches</p>	<ul style="list-style-type: none"> <li>• Create one way street</li> <li>• Widen road</li> <li>• Provide left-turn signal phases</li> <li>• Prohibit left-turns</li> <li>• Reroute left-turn traffic</li> <li>• Channelize intersection</li> <li>• Install stop signs (see MUTCD)</li> <li>• Revise signal sequence</li> <li>• Provide turning guidelines (if there is a dual left-turn lane)</li> <li>• Provide traffic signal if warranted by MUTCD</li> <li>• Retime signals</li> <li>• Remove obstacles</li> <li>• Provide adequate channelization</li> <li>• Provide special phase for left-turning traffic</li> <li>• Provide left-turn slots</li> <li>• Install warning signs</li> <li>• Reduce speed limit on approaches</li> <li>• Increase amber phase</li> <li>• Provide all red phase</li> <li>• Provide special phase for left-turning traffic</li> <li>• Reduce speed limit on approaches</li> </ul>
<p><b>Rear-end collisions at unsignalized intersections</b></p>	<p>Driver not aware of intersection</p> <p>Slippery surface</p> <p>Large numbers of turning vehicles</p> <p>Inadequate roadway lighting</p>	<ul style="list-style-type: none"> <li>• Install/improve warning signs</li> <li>• Overlay pavement</li> <li>• Provide adequate drainage</li> <li>• Groove pavement</li> <li>• Reduce speed limit on approaches</li> <li>• Provide "slippery when wet" signs</li> <li>• Create left- or right-turn lanes</li> <li>• Prohibit turns</li> <li>• Increase curb radii</li> <li>• Improve roadway lighting</li> </ul>

Figure 70. General accident pattern table (continued).

Accident Pattern	Probable Cause-	General Countermeasure
Rear-end collisions at unsignalized intersections	<p>Excessive speed on approach</p> <p>Lack of adequate gaps</p> <p>Crossing pedestrians</p>	<ul style="list-style-type: none"> <li>. Reduce speed limit on approaches</li> <li>. Provide traffic signal if warranted (see MUTCD)</li> <li>. Provide stop signs</li> <li>. Install/improve signing or marking of pedestrian crosswalks</li> </ul>
Rear-end collisions at signalized intersections	<p>Slippery surface</p> <p>Large number of turning vehicles</p> <p>Poor visibility of signals</p> <p>Inadequate signal timing</p> <p>Unwarranted signals</p> <p>Inadequate roadway lighting</p>	<ul style="list-style-type: none"> <li>. Overlay pavement</li> <li>. Provide adequate drainage</li> <li>. Groove pavement</li> <li>. Reduce speed limit on approaches</li> <li>. Provide "slippery when wet" signs</li> <li>. Create left- or right-turn lanes</li> <li>. Prohibit turns</li> <li>. Increase curb radii</li> <li>. Provide special phase for left-turning traffic</li> <li>. Install/improve advance warning devices</li> <li>. Install overhead signals</li> <li>. Install 12-in. signal lenses (see MUTCD)</li> <li>. Install visors</li> <li>. Install back plates</li> <li>. Relocate signals</li> <li>. Add additional signal heads</li> <li>. Remove obstacles</li> <li>. Reduce speed limit on approaches</li> <li>. Adjust amber phase</li> <li>. Provide progression through a set of signalized intersections</li> <li>. Add all-red clearance</li> <li>. Remove signals (see MUTCD)</li> <li>. Improve roadway lighting</li> </ul>

Figure 70. General accident pattern table (continued).

Accident Pattern	Probable Cause	General Countermeasure
Rear-end collisions at signalized intersections	Crossing pedestrians	<ul style="list-style-type: none"> <li>. Install/improve signing or marking of pedestrian crosswalks</li> <li>. Provide pedestrian "WALK" phase</li> </ul>
Right-angle collisions at signalized intersections	<p>Restricted sight distance</p> <p>Excessive speed on approaches</p> <p>Poor visibility of signal</p> <p>Inadequate signal timing</p> <p>Inadequate roadway lighting</p> <p>Inadequate advance intersection warning signs</p> <p>Large total intersection volume</p>	<ul style="list-style-type: none"> <li>. Remove sight obstructions</li> <li>. Restrict parking near corners</li> <li>. Install warning signs (see MUTCD)</li> <li>. Reduce speed limit on approaches</li> <li>. Channelize intersections</li> <li>. Install advance markings to supplement signs</li> <li>. Reduce speed limit on approaches</li> <li>. Increase amber phase</li> <li>. Install rumble strips</li> <li>. Install advanced warning devices</li> <li>. Install 12-in. signal lenses</li> <li>. Install overhead signal</li> <li>. Install visors</li> <li>. Install back plates</li> <li>. Improve location of signal heads</li> <li>. Add additional signal heads</li> <li>. Add illuminated name signs</li> <li>. Adjust amber phase</li> <li>. Provide all-red clearance phase</li> <li>. Add multi-dial controller</li> <li>. Install signal actuation</li> <li>. Retime signals</li> <li>. Provide progression through a set of signalized intersections</li> <li>. Improve roadway illumination</li> <li>. Install advance intersection warning signs</li> <li>. Retime signals</li> <li>. Add traffic lane</li> </ul>
Right-angle collisions at unsignalized intersections	Restricted sight distance	<ul style="list-style-type: none"> <li>. Remove sight obstructions</li> <li>. Restrict parking near corners</li> <li>. Install stop signs (see MUTCD)</li> <li>. Install warning signs (see MUTCD)</li> <li>. Reduce speed limit on approaches</li> </ul>

Table 70. General accident pattern table (continued).

Accident Pattern	Probable Cause	General Countermeasure
<p>Right-angle collisions at unsignalized intersections</p>	<p>Restricted sight distance</p> <p>Large total intersection volume</p> <p>Excessive speed on approaches</p> <p>Inadequate roadway lighting</p> <p>Inadequate advance intersection warning signs</p> <p>Inadequate traffic control devices</p>	<ul style="list-style-type: none"> <li>• Install signal (see MUTCD)</li> <li>• Install yield signs (see MUTCD)</li> <li>• Channelize intersection</li> <li>• Install advance markings to supplement signs</li> <li>• Install limit lines</li> <li>• Install signal (see MUTCD)</li> <li>• Reroute through traffic</li> <li>• Reduce speed limit on approaches</li> <li>• Increase amber phase</li> <li>• Install rumble strips</li> <li>• Improve roadway illumination</li> <li>• Install advance intersection warning signs</li> <li>• Upgrade traffic control devices</li> <li>• Increase enforcement</li> </ul>
<p>Pedestrian-vehicle collisions</p>	<p>Restricted sight distance</p> <p>Inadequate protection for pedestrians</p> <p>School crossing area</p> <p>Inadequate signals</p> <p>Inadequate phasing signal</p>	<ul style="list-style-type: none"> <li>• Remove sight obstructions</li> <li>• Install pedestrian crossings</li> <li>• Install/improve pedestrian crossing signs</li> <li>• Reroute pedestrian paths</li> <li>• Prohibit curb parking near crosswalks</li> <li>• Add pedestrian refuge islands</li> <li>• Install pedestrian barriers</li> <li>• Use crossing guards at school crossing areas</li> <li>• Install pedestrian signals (see MUTCD)</li> <li>• Change timing of pedestrian phase</li> </ul>

Table 70. General accident pattern table (continued).

Accident Pattern	Probable Cause	General Countermeasure
<p><b>Pedestrian-vehicle collisions</b></p>	<p>Driver had inadequate warning of frequent mid-block crossings</p> <p>Inadequate pavement markings</p> <p>Inadequate gaps at unsignalized intersections</p> <p>Inadequate roadway lighting</p> <p>Excessive vehicle speed</p>	<ul style="list-style-type: none"> <li>• Prohibit parking</li> <li>• Install warning signs</li> <li>• Lower speed limit</li> <li>• Install pedestrian barriers</li> <li>• Install thermoplastic markings</li> <li>• Supplement markings with appropriate signing (see MUTCD)</li> <li>• Upgrade pavement markings (see MUTCD)</li> <li>• Install traffic signal, if warranted by MUTCD</li> <li>• Install pedestrian crosswalk and signs</li> <li>• Install pedestrian "WALK-DON'T WALK" signals</li> <li>• Improve roadway lighting</li> <li>• Reduce speed limit</li> <li>• Install proper warning signs</li> <li>• Install pedestrian barriers</li> <li>• Enforcement</li> </ul>
<p><b>Run-off-roadway collisions</b></p>	<p>Slippery pavement</p> <p>Roadway design inadequate for traffic conditions</p> <p>Poor delineation</p> <p>Inadequate roadway lighting</p> <p>Inadequate shoulder</p>	<ul style="list-style-type: none"> <li>• Overlay existing pavement</li> <li>• Provide adequate drainage</li> <li>• Groove existing pavement</li> <li>• Reduce speed limit</li> <li>• Provide "slippery when wet" signs</li> <li>• Widen lanes</li> <li>• Relocate islands</li> <li>• Close curb lanes</li> <li>• Install guardrails</li> <li>• Improve/install pavement markings</li> <li>• Install roadside delineators</li> <li>• Install advance warning signs</li> <li>• Improve roadway lighting</li> <li>• Upgrade roadway shoulders</li> </ul>

Table 70. General accident pattern table (continued).

Accident Pattern	Probable Cause	General Countermeasure
Run-off-roadway collisions	Improper channelization Inadequate pavement maintenance Poor visibility Excessive speed on approaches	<ul style="list-style-type: none"> <li>• Improve channelization</li> <li>• Perform road surface repair</li> <li>• Increase size of signs</li> <li>• Reduce speed limit</li> </ul>
Fixed object collisions	Obstructions in or too close to roadway  Inadequate roadway lighting  Inadequate pavement marking  Inadequate signs, delineators and guardrails  Inadequate road design  Slippery surface  Excessive vehicle speed	<ul style="list-style-type: none"> <li>• Remove obstacles</li> <li>• Install barrier curbing</li> <li>• Install breakaway features to light poles, signposts, etc.</li> <li>• Protect objects with guardrail</li> <li>• Install crash cushioning devices</li>   <li>• Improve roadway lighting</li>   <li>• Install reflectionized pavement lines</li> <li>• Install reflectionized paint and/or reflectors on the obstruction</li>   <li>• Provide proper superelevation</li> <li>• Improve superelevation at curve</li> <li>• Install appropriate warning signs and delineators</li>   <li>• Improve skid resistance</li> <li>• Provide adequate drainage</li> <li>• Provide "slippery when wet" signs</li> <li>• Provide wider lanes</li>   <li>• Reduce speed limit</li> </ul>
Collisions with parked or parking vehicles	Improper pavement markings  Improper parking clearance at driveways	<ul style="list-style-type: none"> <li>• Paint parking stall limits 7 feet from curb face</li> <li>• Post parking restrictions near driveways</li> </ul>

Table 70. General accident pattern table (continued).

Accident Pattern	Probable Cause	General Countermeasure
Collisions with parked or parking vehicles	<p>Angle parking</p> <p>Excessive vehicle speed</p> <p>Illegal parking</p> <p>Improper parking</p> <p>Large parking turnover</p>	<ul style="list-style-type: none"> <li>• Convert angle parking to parallel parking</li> <li>• Reduce speed limit if justified by spot speed studies</li> <li>• Widen lanes</li> <li>• Enforcement</li> <li>• Prohibit parking</li> <li>• Create off street parking</li> <li>• Create one-way streets</li> <li>• Reroute through traffic</li> </ul>
Sideswipe or head-on collisions	<p>Inadequate roadway design</p> <p>Improper road maintenance</p> <p>Inadequate shoulders</p> <p>Excessive vehicle speed</p> <p>Inadequate pavement markings</p> <p>Inadequate channelization</p> <p>Inadequate signing</p>	<ul style="list-style-type: none"> <li>• Create one-way streets provide wider lanes</li> <li>• Perform necessary road surface repairs</li> <li>• Improve shoulders</li> <li>• Reduce speed limit</li> <li>• Install median devices</li> <li>• Remove constriction such as parked vehicles</li> <li>• Install or refurnish center lines, lane lines and pavement edge lines</li> <li>• Install reflectorized lines, edges</li> <li>• Install acceleration and deceleration lanes</li> <li>• Channelize intersection</li> <li>• Provide turning bays</li> <li>• Place direction and lane change signs to give proper advance warning</li> <li>• Add illuminated name signs</li> </ul>

Table 70. General accident pattern table (continued).

Accident Pattern	Probable Cause	General Countermeasure
<p>Driveway-related collisions</p>	<p>Left-turning vehicles</p> <p>Improperly located driveway</p> <p>Right-turning vehicles</p> <p>Large volume of through traffic</p> <p>Large volume of driveway traffic</p> <p>Restricted sight distance</p> <p>Inadequate roadway lighting</p> <p>Excessive speeds on approaches</p>	<ul style="list-style-type: none"> <li>• Install median devices</li> <li>• Install two-way left-turn lanes</li> <li>• Regulate minimum spacing of driveways</li> <li>• Regulate minimum corner of clearance</li> <li>• Move driveway to sidestreet</li> <li>• Install curbing to define driveway location</li> <li>• Consolidate adjacent driveways</li> <li>• Provide right-turn lanes</li> <li>• Restrict parking near driveways</li> <li>• Increase the width of driveways</li> <li>• Widen through lanes</li> <li>• Increase curb radii</li> <li>• Move driveway to sidestreet</li> <li>• Construct a local service road</li> <li>• Reroute through traffic</li> <li>• Signalize driveway</li> <li>• Provide acceleration and deceleration lanes</li> <li>• Channelize driveway</li> <li>• Remove sight obstructions</li> <li>• Restrict parking near driveway</li> <li>• Install/improve street lighting</li> <li>• Reduce speed limit</li> <li>• Improve street lighting</li> <li>• Reduce speed limit</li> </ul>
<p>Train-vehicle accidents</p>	<p>Restricted sight distance</p>	<ul style="list-style-type: none"> <li>• Remove sight obstructions</li> <li>• Reduce grade</li> <li>• Install train actuated signals (see MUTCD)</li> <li>• Install stop signs (see MUTCD)</li> <li>• Install advance warning signs (see MUTCD)</li> <li>• Install automatic flashers and gates</li> </ul>



Table 70. General accident pattern table (continued).

Accident Pattern	Probable Cause	General Countermeasure
<p><b>Train-vehicle accidents</b></p>	<p>Poor visibility</p> <p>Improper traffic signals pre-emption timing</p> <p>Excessive vehicle speeds on approaches</p> <p>Inadequate pavement markings</p> <p>Slippery surface</p> <p>Improper pre-emption of RR signals or gates</p> <p>Rough crossing surfaces</p> <p>Sharp crossing angle</p>	<ul style="list-style-type: none"> <li>• Improve roadway lighting</li> <li>• Increase size of signs</li> <li>• Retime traffic signals</li> <li>• Revise speed limit</li> <li>• Install advance markings to supplement signs</li> <li>• Install limit lines</li> <li>• Install/improve pavement markings</li> <li>• Skidproof roadway</li> <li>• Retime RR signals and gates</li> <li>• Improve crossing surface</li> <li>• Rebuild crossing with proper angle</li> </ul>
<p><b>Wet-pavement accidents</b></p>	<p>Slippery pavement</p> <p>Inadequate drainage</p> <p>Inadequate pavement markings</p>	<ul style="list-style-type: none"> <li>• Overlay existing pavement</li> <li>• Groove existing pavement</li> <li>• Reduce speed limit</li> <li>• Provide "slippery when wet" signs</li> <li>• Skidproof roadway</li> <li>• Provide adequate drainage</li> <li>• Upgrade pavement markings</li> </ul>
<p><b>Night accidents</b></p>	<p>Poor visibility or Lighting</p> <p>Poor sign quality</p> <p>Inadequate channelization or delineation</p>	<ul style="list-style-type: none"> <li>• Install/improve street lighting</li> <li>• Install/improve delineation markings</li> <li>• Install/improve warning signs</li> <li>• Upgrade signing</li> <li>• Provide illuminated signs</li> <li>• Install pavement markings</li> <li>• Improve delineation markings</li> <li>• Provide raised markers</li> <li>• Upgrade advance warning signing</li> </ul>

- Add additional signal heads.
- Reduce speed limit on approaches.
- Add illuminated street name signs.

The findings obtained from the study procedures would produce a list of feasible countermeasures. This list would then be subjected to economic analysis to develop a single project.

A similar approach would be used to develop feasible countermeasures where two or more accident patterns are defined at a location. The countermeasures would be assessed collectively to develop feasible countermeasures.

### ● Limitations

#### Advantages:

1. Provides a method which is inexpensive.
2. Tables are simple to use.
3. Requires very little manpower needs.

#### Disadvantages:

1. May result in incomplete or inconclusive findings.
2. Requires individuals with substantial highway safety experience to develop countermeasures.
3. Is difficult to apply for complex situations.

This procedure requires that an individual experienced in highway safety be used for selection of feasible countermeasures. This process has been found favorable for most locations due to its low cost and ease of application. Where situations are complex, an alternate method, such as the team approach, may be more favorable.

### Findings

This procedure is conducted to develop a list of feasible countermeasures for a location based on the identified accident patterns and probable causes. The output will be used as input in the economic analysis and project selection activities.

## **Procedure 2 Multi-Disciplinary Investigation Team**

### Purpose

The purpose of this procedure is to define feasible countermeasures based on the input received from a study of the location by a team of individuals from varying disciplines. From the input and discussion of the team members, a consensus of the causal factors and countermeasures to correct the hazards at a location is developed.