

**Table 7-14 Accident Pattern Countermeasures**

Accident Type	Possible Cause	Possible Study	Safety Enhancement
Overturn	Roadside features	Determine sideslope Investigate recovery zone	Provide traversable culvert end treatments Extend culverts Install/improve traffic barriers Flatten slopes and ditches Relocate drainage facilities
	Inadequate shoulder	Determine shoulder dimensions and composition Check for shoulder dropoffs	Upgrade shoulder surface Remove curbing/obstructions Widen lane/shoulder
	Pavement feature	Check for potholes and rutting Check for water ponding	Eliminate edge dropoff Improve superelevation/crown
Fixed object	Obstruction in or too close to roadway	Field observation to locate obstructions	Delineation/reflectorize safety hardware Remove/relocate obstacles Install breakaway features to light poles, signposts, etc. Protect objects with guardrail Install crash cushions
	Inadequate lighting	Check illumination	Improve roadway lighting
	Inadequate pavement markings	Review pavement markings	Install reflectorized pavement lines/raised markers
	Inadequate signs, delineators and guardrails	Review signs, delineators and guardrails	Install reflectorized paint, and/or reflectors on the fixed object Add special signing Upgrade barrier system
	Inadequate road design	Check roadside shoulders and maintenance Check superelevation Perform ball-bank study	Install warning signs/delineators Improve alignment/grade Provide proper superelevation Provide wider lanes
	Slippery surface	Check skid resistance Check for adequate drainage	Reduce speed limit if justified by spot speed study Provide adequate drainage
Right-angle collisions at unsignalized intersections	Restricted sight distance	Field observation for sight obstructions Check roadway illumination Perform spot speed study	Install warning signs (see MUTCD) Install stop signs (see MUTCD) Install yield signs (see MUTCD) Restrict parking near corners Reduce speed limit if justified by spot speed study Remove sight obstructions Install signals (see MUTCD) Install/improve street lighting Channelize intersection
	Large total intersection volume	Volume count on all approaches	Install signals (see MUTCD)
	High approach speed	Perform spot speed study	Reduce speed limit on approaches if justified by spot speed study Install rumble strips
Right-angle collisions at signalized intersections	Poor visibility of signals	Review existing signals and placement Field observation for sight obstructions Perform spot speed study	Install advanced warning devices (see MUTCD) Install visors Install back plates Reduce speed limit on approaches if justified by spot speed study Remove sight obstructions Add additional signal heads Install 12-inch signal lenses (see MUTCD) Improve location of signal heads Install overhead signals
	Inadequate signal timing	Volume count on all approaches Review signal timing	Adjust amber phase Provide all-red clearance phases Add multi-dial controller Install signal actuation Retime signals Provide progression through a set of signalized intersections

**Table 7-14 Accident Pattern Countermeasures (continued)**

Accident Type	Possible Cause	Possible Study	Safety Enhancement
Collisions at railroad crossings	Restricted sight distance	Review sight distance	Install advance warning signs (see MUTCD) Remove sight obstructions Install train actuated signals (see MUTCD) Install gates (see MUTCD) Reduce grades
	Poor visibility	Check roadway illumination Review signing	Increase size of signs Improve roadway lighting
	Inadequate pavement markings	Review pavement markings	Install advance markings to supplement signs Install stop bars Install/improve pavement markings
	Rough crossing surface	Check crossing surface	Improve crossing surface
	Sharp crossing angle	Check crossing angle	Rebuild crossing with proper angle
	Improper pre-emption timing of traffic signals, railroad signals, or gates	Review traffic signal timing Review railroad signal and gate timing	Retime traffic signals Retime railroad signals and gates
Nighttime	Poor visibility or lighting	Check roadway illumination	Install/improve warning signs Install/improve delineation/markings Install/improve street lighting
	Poor sign quality	Review signing	Upgrade signing Provide illuminated reflectorized signs
	Inadequate channelization or delineation	Review channelization/delineation	Install pavement markings Improve channelization/delineation
Wet pavement	Slippery pavement	Check skid resistance Check for adequate drainage Perform spot speed study	Provide "SLIPPERY WHEN WET" signs Reduce speed limit if justified by spot speed study Provide adequate drainage Groove existing pavement Overlay existing pavement
	Inadequate pavement markings	Review pavement markings	Install raised/reflectorized pavement markings
Rear-end collisions at unsignalized intersections	Pedestrian crossing	Review pedestrian signing and crosswalk marking	Install/improve signing or marking of pedestrian crosswalks Relocate crosswalk
	Driver not aware of intersection	Review signing	Install/improve warning signs
	Slippery surface	Check skid resistance Check for adequate drainage Perform spot speed study	Provide "SLIPPERY WHEN WET" signs Reduce speed limit on approaches if justified by spot speed study Provide adequate drainage Groove pavement Overlay pavement
	Large numbers of turning vehicles	Perform turning count Perform volume count for thru traffic	Prohibit turns Increase curb radii Create left-or-right-turn lanes
Collisions with parked cars or cars being parked	Inadequate road design	Check lane width Review angle parking	Change from angle to parallel parking Prohibit parking Widen lanes/shoulders
	Large parking turnovers	Perform parking turnover study	Prohibit parking Change from angle to parallel parking Reduce speed limit if justified by spot speed study Create one-way streets Create off-street parking
	Improper pavement markings	Review pavement markings	Correct pavement markings
	Illegal parking	Law observance study	Enforcement
Collision at driveways	Left-turning vehicles	Perform turning count	Install median divider Install two-way left-turn lanes
	Improperly located driveway	Review driveway placement	Regulate minimum spacing of driveways Regulate minimum corner clearance Move driveway to side street Install curbing to define driveway location Consolidate adjacent driveways

**Table 7-14 Accident Pattern Countermeasures (continued)**

Accident Type	Possible Cause	Possible Study	Safety Enhancement
Collision at driveways	Right-turning vehicles	Perform turning counts Review parking Check driveway and lane width Check curb radii	Restrict parking near driveways Increase the width of the driveway Increase curb radii Provide right-turn lanes Widen through lanes
	Large volume of through traffic	Perform volume count for thru traffic	Move driveway to side street Construct a local service road Reroute through traffic
	Large volume of driveway traffic	Perform volume count for driveway traffic Perform gap study	Signalize driveway Provide acceleration and deceleration lanes Channelize driveway
	Restricted sight distance	Field observation for sight obstructions Review parking Check roadway illumination Perform spot speed study	Restrict parking near driveway Reduce speed limit if justified by spot speed study Install/improve street lighting Remove sight obstructions
Sideswipe or head-on	Inadequate road design and/or maintenance	Review lane width Check alignment Perform no passing study Check road surface for proper maintenance	Perform necessary road surface repairs Sign and mark unsafe passing areas Provide roadside delineators Improve alignment/grade Provide wider lanes Provide passing lanes
	Inadequate shoulders	Review road shoulders	Improve shoulders
	Excessive vehicle speed	Perform spot speed study	Reduce speed limit if justified by spot speed study Install median devices
	Inadequate pavement markings	Review pavement markings	Install/improve centerlines, lane lines, and edgelines Install reflectorized markers
	Inadequate channelization	Review channelization	Install/improve channelization Install acceleration and deceleration lanes Provide turning bays
	Inadequate signing	Review signing and placement	Provide advance direction and warning signs Add illuminated name signs
Run-off-road	Slippery pavement/ponded water	Check skid resistance Check for adequate drainage Perform spot speed study	Reduce speed limit if justified by spot speed study Provide "SLIPPERY WHEN WET" signs Provide adequate drainage Groove existing pavement Overlay existing pavement
	Roadway design inadequate for traffic conditions	Check roadside shoulders and road maintenance Check superelevation Perform ball-bank study	Install/improve traffic barriers Close curb lane Flatten slopes/ditches Relocate islands Improve alignment/grade Provide proper superelevation Provide escape ramp Widen lanes/shoulders
	Poor delineation	Review pavement markings Review signs and placement	Install roadside delineators Install advance warning signs Improve/install pavement markings
	Poor visibility	Check roadway illumination	Increase sign size Improve roadway lighting
	Improper channelization	Review channelization	Improve channelization
Pedestrian/bicycle	Limited sight distance	Check sight distance	Remove sight obstructions Install/improve pedestrian crossing signs and markings Reroute pedestrian paths
	Inadequate protection	Check existing protection	Add pedestrian refuge islands
	Inadequate signal/signs	Review signal/signs	Install/upgrade signals/signs

**Table 7-14 Accident Pattern Countermeasures (continued)**

Accident Type	Possible Cause	Possible Study	Safety Enhancement
Pedestrian/ bicycle	Inadequate signal phasing	Review signal phasing	Change timing of pedestrian phase Add pedestrian "WALK" phase
	Inadequate pavement markings	Review pavement markings	Supplement markings with signing Upgrade pavement markings
	Inadequate lighting	Check roadway illumination	Improve lighting
	Driver has inadequate warning of frequent mid-block crossings	Review existing parking Perform spot speed study	Prohibit parking Install warning signs Reduce speed limit if justified by spot speed study Install pedestrian barriers
	Lack of crossing opportunity	Perform gap study	Install traffic/pedestrian signals Install pedestrian crosswalk and signs
	Excessive vehicle speed	Perform spot speed study	Reduce speed limits Install proper warning signs
	Pedestrians/bicycles on roadway	Review existence of sidewalks	Eliminate roadside obstructions Install curb ramps Install sidewalks Install bike lanes/paths
	Long distance to nearest crosswalk	Check distance and travel time to nearest crosswalk	Install pedestrian crosswalk Install pedestrian actuated signals
	Sidewalk too close to traveled way	Review existing sidewalks	Move sidewalk laterally away from roadway
	School crossing area	Check pedestrian crossing time and available gaps Check school's safe route to and from school program Check school's student awareness program	Establish safe route and awareness program Use school crossing guards Install crosswalks and traffic signals
Bridges	Alignment	Check alignment	Install advance warning signs Improve delineation/markings Realign bridge/roadway
	Narrow roadway	Review lane width Review signing	Improve delineation/markings Install signing/signals Widen structure
	Visibility	Field observation for site obstructions	Improve delineation/markings Install advance warning signs Remove obstruction
	Vertical clearance	Check clearance	Improve delineation/markings Install advance warning signs Provide height restrictor/warning device Rebuild structure/adjust roadway grade
	Slippery surface (wet/icy)	Check skid resistance Check for adequate drainage	Provide special signing Provide adequate drainage Improve skid resistance Resurface deck
	Rough surface		Rehabilitate joints Resurface deck Regrade approaches
	Inadequate barrier system	Field observation and checks against established barrier standards	Improve delineation/markings Remove hazardous curb Upgrade bridge rail Upgrade bridge approach rail connections Upgrade approach rail/terminals

Source: "Local Highway Safety Studies," U.S. DOT FHWA Report, July 1986, Appendix C, Accident Pattern Tables.