



Unsignalized Intersection Safety Strategies

NCHRP Report 500, Volume 5:

A Guide for Addressing Unsignalized Intersection Collisions

Speaker Name Goes Here

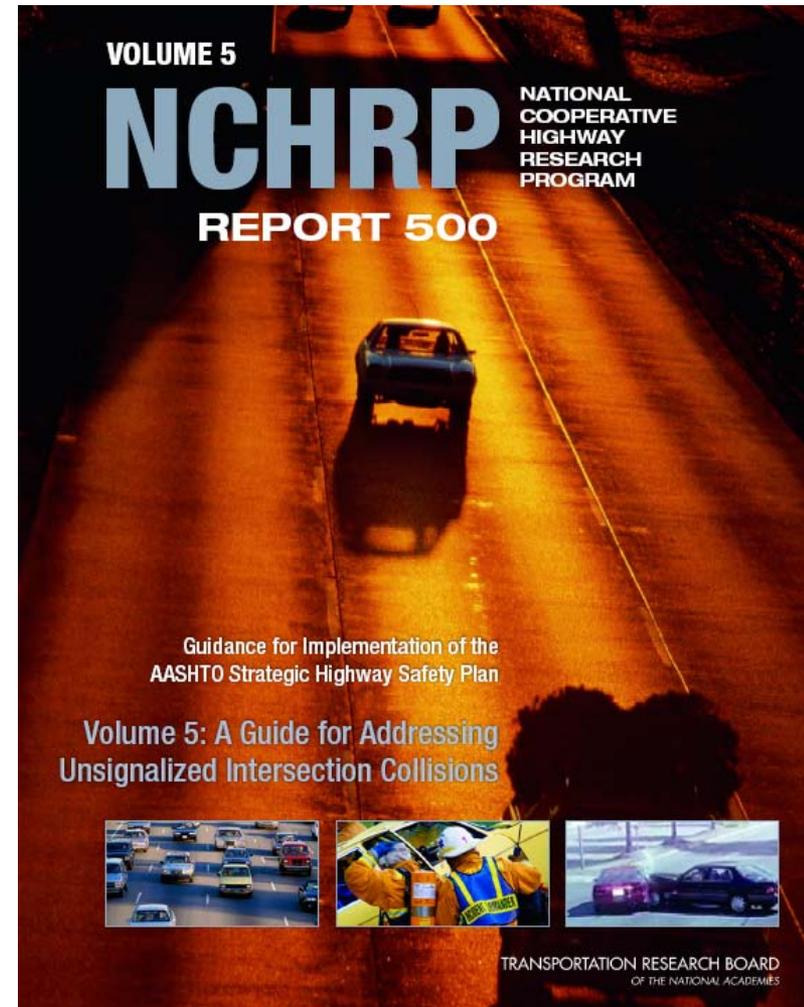


U.S. Department of Transportation
Federal Highway Administration



NCHRP Report 500

- Companion to NCHRP Report 500
Volume 5: A Guide for Addressing
Unsignalized Intersection
Collisions
- Available at:
<http://safety.transportation.org/>



Explanation of Time, Cost, and Effectiveness

- Time Frame

- Short: a few months up to 1 year
- Medium: 1 to 2 years
- Long: More than 2 years

- Cost

- Low
- Moderate
- Moderate-High
- High
- Relative cost to other strategies discussed

- Effectiveness

- **Proven:** Strategies that have been used in one or more locations and properly designed evaluations have been conducted that show it to be effective.
- **Tried:** Strategies that have been implemented in a number of locations and may even be accepted as standards, but for which valid evaluations have not been conducted.
- **Experimental:** Strategies that have been suggested and that at least one agency has considered sufficiently promising to try on a small scale in at least one location.



Strategy Categories

- A. Improve management of access
- B. Reduce conflicts through geometric design improvements
- C. Improve sight distance
- D. Improve availability of gaps in traffic and assist drivers in judging gaps
- E. Improve driver awareness on approaches
- F. Choose appropriate intersection traffic control
- G. Improve compliance with traffic control devices and traffic laws
- H. Reduce operating speeds on approaches
- I. Guide motorists more effectively on approaches



Implement Driveway Closures/Relocations

NCHRP Report 500 • Vol. 5
Strategy: A1



While this photo depicts driveways closed by guardrail, permanent curb and gutter is the preferred countermeasure design.

Where to use

Unsignalized intersections with high crash frequencies related to driveways adjacent to the intersection. Generally, driveways within 250 feet of the intersection are the greatest concern.

Key to success

Work with owners of properties to assure them that some restriction of access to their properties will improve safety and will not affect their ability (or their customers') to reach their properties. Where practical, this strategy should be implemented as part of a comprehensive corridor access management plan.

Cost:



Time Frame:



Effectiveness: Tried



Implement Driveway Turn Restrictions

NCHRP Report 500 • Vol. 5
Strategy: A2



Where to use

Driveways located near unsignalized intersections that experience high crash frequencies but that cannot practically be closed or relocated.

Key to success

Agencies should work with owners of adjacent properties to assure them that some restriction of access to their properties will improve safety and will not affect their ability (or, in the case of a retail business, their customers' ability) to reach their properties. Where practical, this strategy should be implemented as part of a comprehensive corridor access management plan.

Cost:



Time Frame:



Effectiveness: Tried



Provide Left-Turn Lanes at Intersections

NCHRP Report 500 • Vol. 5
Strategy: B1



Where to use

Unsignalized intersections with a high frequency of crashes resulting from the conflict between (1) vehicles turning left and following vehicles and (2) vehicles turning left and opposing through vehicles.

Key to success

Make sure that any left-turn lane considered is operationally warranted based on traffic volumes or justified on the basis of an existing pattern of left-turn collisions.

Cost: ●●○○
Time Frame: ●●○○
Effectiveness: Proven



Provide Longer Left-Turn Lanes at Intersections

NCHRP Report 500 • Vol. 5
Strategy: B2



Where to use

Unsignalized intersections with existing left-turn lanes that are not long enough to store all left turning vehicles and have a high frequency of rear-end crashes resulting from the conflict between vehicles waiting to turn left and following vehicles.

Key to success

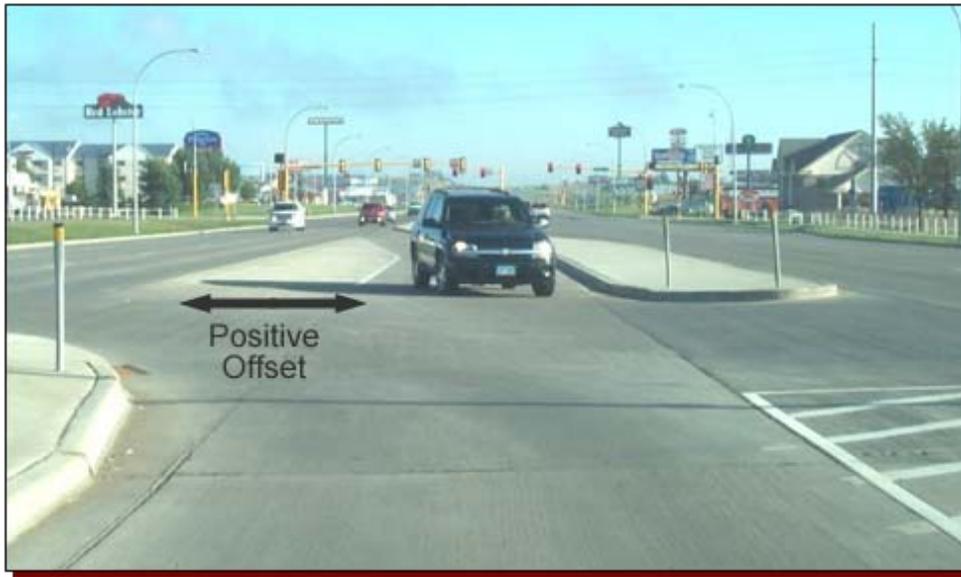
Make sure that a longer left-turn lane is warranted or justified on the basis of left-turn volumes or an existing pattern of left-turn related rear-end crashes.

Cost: ●●○○
Time Frame: ●●○○
Effectiveness: Tried



Provide Offset Left-Turn Lanes at Intersections

NCHRP Report 500 • Vol. 5
Strategy: B3



Where to use

Unsignalized intersections with a high frequency of crashes between vehicles turning left and opposing through vehicles, as well as rear-end crashes between through vehicles on the opposing approach. Also at intersections on divided highways with medians wide enough to provide the appropriate offset but can be implemented on approaches without medians if sufficient width exists.

Key to success

Identify candidate locations where opposing left-turn vehicles block drivers' views of approaching traffic. This can be determined by measuring the amount of offset (or lack of offset) present at existing intersections. Any intersection with a pattern of crashes between left-turning vehicles and opposing through vehicles that has existing left-turn lanes (or where installation of left-turn lanes is being considered) should be checked to determine the amount of available offset.

Cost:



Time Frame:



Effectiveness: Tried



Provide Bypass Lanes on Shoulders at T-Intersections

NCHRP Report 500 • Vol. 5
Strategy: B4



Where to use

At three-legged unsignalized intersections on two-lane highways with moderate through and turning volumes, especially intersections that have a pattern of rear-end collisions involving vehicles waiting to turn left from the highway.

Key to success

Provide a shoulder area for the bypass lane that has sufficient structural strength to withstand repeated usage, even by trucks.

Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Tried



Provide Left-Turn Acceleration Lanes at Divided Highway Intersections

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Strategy: B5



Where to use

Unsignalized intersections on divided highways that experience a high proportion of rear-end crashes related to the speed differential caused by vehicles turning left onto the highway. Also where intersection sight distance is inadequate or where there are high volumes of trucks or recreational vehicles entering the divided highway.

Key to success

Make sure that the acceleration lanes are operationally warranted by relatively high left-turn volumes, justified on the basis of an existing pattern of rear-end or sideswipe crashes related to left-turn maneuvers, or justified by having a high percentage of vehicles requiring more time to accelerate.

Another key is appropriate design of the median opening area to minimize conflicts between vehicles entering the left-turn acceleration lane and other vehicles using the median opening.

Cost: ●●○○
Time Frame: ●●○
Effectiveness: Tried



Provide Right-Turn Lanes at Intersections

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Strategy: B6



Where to use

Unsignalized intersections with a high frequency of rear-end crashes resulting from conflicts between (1) vehicles turning right and following vehicles and (2) vehicles turning right and through vehicles coming from the left on the cross street.

Key to success

Make sure that any right-turn lane considered is operationally justified on the basis of right-turning volumes or an existing pattern of right-turn related crashes.

At some locations, it may be desirable to create a right-turn roadway by a channelizing island on the intersection approach. This allows the turning radius to be increased without introducing a large unused pavement area that might lead to operational problems. The right-turn lane may be controlled by a yield sign where the roadway enters the intersecting street or may operate as a free-flow roadway.

Cost: ●●○○
Time Frame: ●●○○
Effectiveness: Proven



Provide Longer Right-Turn Lanes at Intersections

NCHRP Report 500 • Vol. 5
Strategy: B7



Where to use

Unsignalized intersections with an existing right-turn lane that is not long enough to store all right-turning vehicles and that are experiencing a high frequency of rear-end crashes resulting from the conflict between vehicles waiting to turn right and following vehicles.

Key to success

Make sure that a longer right-turn lane is warranted or justified on the basis of right-turn volumes or an existing pattern of right-turn crashes.

If access to adjacent properties will potentially be affected, it will be important to include the stakeholders early in the planning process.

Cost: ●●○○
Time Frame: ●●○
Effectiveness: Tried



Provide Offset Right-Turn Lanes at Intersections

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Strategy: B8



Where to use

Unsignalized intersections with a high frequency of crashes between vehicles on the minor road that are turning left, turning right, or proceeding straight through, and vehicles on the major road.

Key to success

Identify candidate locations where right-turn vehicles block drivers' views of approaching traffic. Any intersection with a pattern of crashes between minor-road vehicles and major-road vehicles with existing right-turn lanes (or where installation of right-turn lanes is being considered) should be checked to determine the amount of available offset.

Cost: ●●●○
Time Frame: ●●○
Effectiveness: Tried



Provide Right-Turn Acceleration Lanes at Intersections

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Strategy: B9



Where to use

Unsignalized intersections that experience a high proportion of rear-end and/or sideswipe crashes related to the speed differential caused by vehicles making a right-turn maneuver onto the highway.

Key to success

Make sure that right-turn acceleration lanes are operationally warranted by relatively high right-turn volumes or justified on the basis of an existing pattern of rear-end or sideswipe crashes related to right-turn maneuvers.

Cost: ●●○○
Time Frame: ●●○
Effectiveness: Tried



Provide Full-Width Paved Shoulders in Intersection Areas

NCHRP Report 500 • Vol. 5
Strategy: B10



Where to use

Unsignalized intersections on divided highways with no shoulder or shoulder widths less than 8 feet that experience a high proportion of run-off-road crashes as a result of avoidance maneuvers or a high proportion of rear-end crashes that could have been avoided had a full-width paved shoulder been provided.

Key to success

Make sure that full-width paved shoulders are operationally justified on the basis of an existing crash pattern.

Cost: ●●○○
Time Frame: ●●○○
Effectiveness: Tried



Restrict or Eliminate Turning Maneuvers by Signing

NCHRP Report 500 • Vol. 5
Strategy: B11



Where to use

Unsignalized intersections with patterns of crashes related to particular turning maneuvers where it is impractical to reduce that pattern of crashes by improving sight distance or providing a left turn or shoulder bypass lane.

Key to success

Anticipate the destinations of traffic making the affected turning maneuver and ensure the availability of alternatives that can safely accommodate that traffic. It is also important that the turn restriction or prohibition be clearly signed so that motorists become aware of the restriction or prohibition and do not make illegal turns.

Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Tried



Restrict or Eliminate Turning Maneuvers by Providing Channelization or Closing Median Openings

NCHRP Report 500 • Vol. 5
Strategy: B12



This photo depicts a channelizing device that prohibits turning and crossing maneuvers from driveways not visible in the photo.

Where to use

Unsignalized intersections with patterns of crashes related to particular turning maneuvers where it is impractical to reduce that pattern of crashes by improving sight distance or providing a left turn or shoulder bypass lane. Also, at locations where it is possible to restrict or eliminate turning maneuvers by providing channelization or by closing the median opening.

Key to success

Anticipate the destinations of traffic making the affected turning maneuver and ensure that alternatives that can safely accommodate that traffic are available. It is also important that the turn restriction or prohibition be clearly signed so that motorists become aware of the restriction or prohibition and do not make illegal turns. Furthermore, it will be important to include all stakeholders in the early planning stages, especially business property owners whose access may be made less convenient for customers.

Cost: ● ○ ○ ○
Time Frame: ● ○ ○
Effectiveness: Tried



Close or Relocate "High-Risk" Intersections

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Strategy: B13



This location was previously a T-intersection, but due to a high frequency of crashes, it was closed. Vehicles can only turn right.

Where to use

Unsignalized intersections with high levels of intersection-related crashes that other strategies have not been successful in reducing or for which other strategies are not considered appropriate. Also at locations where a particular strategy such as installing a turn lane or increasing sight distance is impractical at the current location, but could be applied if the intersection were moved.

Key to success

Involve the affected neighborhood early in the decision-making process to develop and maintain support for the project.

Cost:



Time Frame:

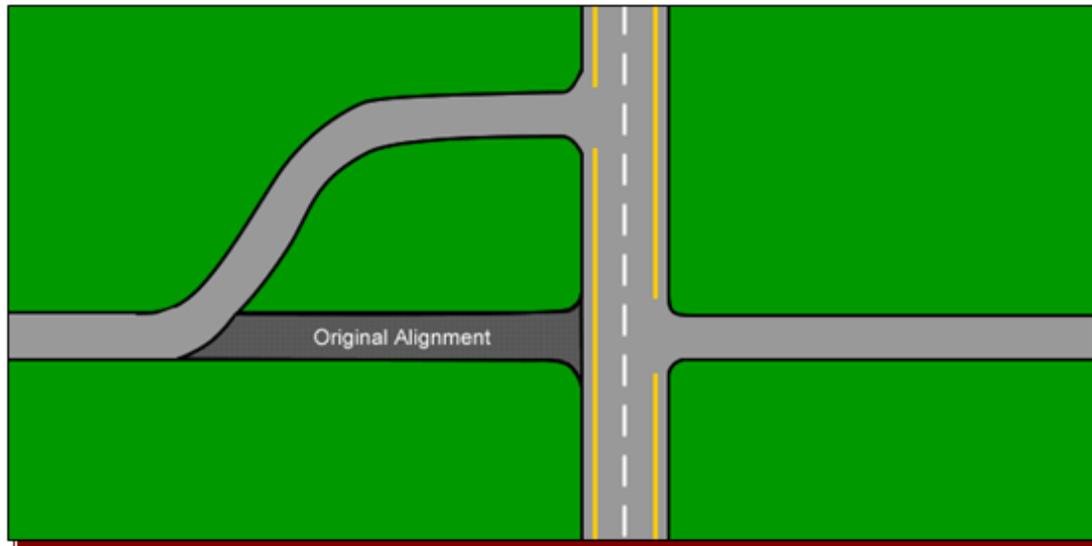


Effectiveness: Tried



Convert Four-Legged Intersections to Two T-Intersections

NCHRP Report 500 • Vol. 5
Strategy: B14



By realigning a skewed roadway, two T-intersections can be created with perpendicular approaches.

Where to use

Unsignalized four-legged intersections with very low through volumes on the cross street.

Key to success

Depends upon the through volume of the cross street. If through volumes are high, the intersection may be safer if left as a conventional four-legged intersection. Converting it to two T-intersections would only create excessive turning movements at each of the T-intersections.

Cost:



Time Frame:

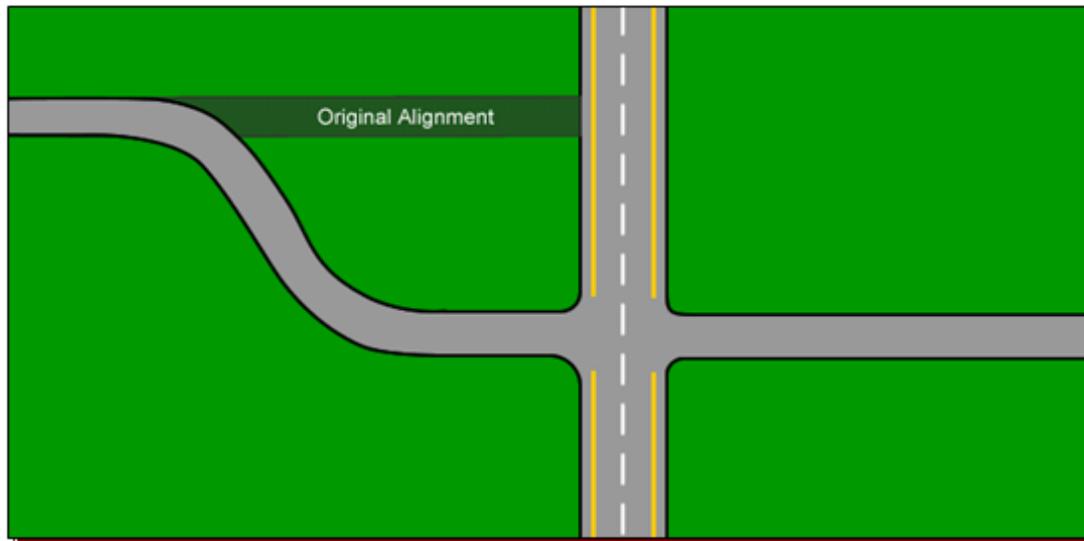


Effectiveness: Tried



Convert Offset T-Intersections to Four-Legged Intersections

NCHRP Report 500 • Vol. 5
Strategy: B15



By realigning a roadway, T-intersections with inadequate storage space between them can be combined into a single 4-leg intersection.

Where to use

Unsignalized offset T-intersections where through volumes on the cross street are very high.

Key to success

Depends upon the through volume of the cross street. If through volumes are low, the intersection may be safer if left as two offset T-intersections. Two offset T-intersections with low cross-street through volumes are generally safer than a four-legged intersection.

Cost:



Time Frame:



Effectiveness: Tried



Realign Intersection Approaches to Reduce or Eliminate Intersection Skew

NCHRP Report 500 • Vol. 5
Strategy: B16



Where to use

Unsignalized intersections with a high frequency of crashes resulting from insufficient intersection sight distance and awkward sight lines at a skewed intersection.

Key to success

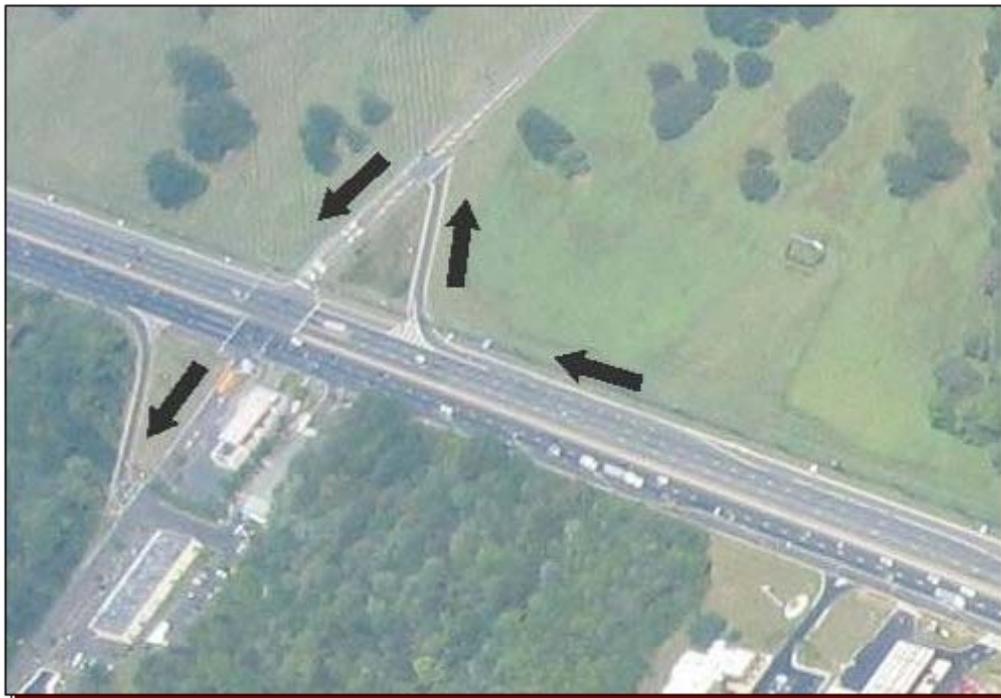
Identify candidate locations where there exist crash patterns related to the intersection angle. Any intersection with a pattern of right-angle or turning crashes should be checked to determine whether the skew angle of the intersection is contributing to these crashes.

Cost: ●●●●
Time Frame: ●●○
Effectiveness: Proven



Use Indirect Left-Turn Treatments to Minimize Conflicts at Divided Highway Intersections

NCHRP Report 500 • Vol. 5
Strategy: B17



Drivers are prohibited from turning left at the intersection. To complete the left hand turn, they must use the right lane exit and turn left at the minor intersection and subsequently travel through the major intersection.

Where to use

Unsignalized intersections with operational and safety problems that can be traced to difficulties of accommodating left-turn demand.

Key to success

Make sure that this strategy is justified on the basis of high left-turn demand or an existing pattern of left-turn collisions.

Also, involve the affected owners of adjacent property and residents in the decision-making process to develop and maintain support for the project.

Cost:



Time Frame:



Effectiveness: Tried



Improve Pedestrian and Bicycle Facilities to Reduce Conflicts Between Motorists and Nonmotorists

NCHRP Report 500 • Vol. 5
Strategy: B18

The addition of a sidewalk can increase pedestrian safety.



Where to use

Unsignalized intersections that experience crashes involving pedestrians and/or bicyclists with motor vehicles or that have the potential for such crashes.

Key to success

Get the appropriate agencies to look at pedestrian and bicycle facilities from a more systematic point of view. That is, rather than making improvements where problems occur, the needs of pedestrians and bicyclists should be anticipated during the design of other intersection improvements, and appropriate improvements should be incorporated in the design before such problems occur. It is desirable to involve groups representing pedestrians and bicyclists in the early stages of a program's development.

Cost: ●●○○
Time Frame: ●●○○
Effectiveness: Varies



Clear Sight Triangles on Stop- or Yield-Controlled Approaches to Intersections

NCHRP Report 500 • Vol. 5
Strategy: C1



Where to use

Unsignalized intersections with restricted sight distance and patterns of crashes related to lack of sight distance, where sight distance can be improved by clearing roadside obstructions without major construction.

Key to success

Effectively diagnose whether a specific crash pattern observed at an intersection is, in fact, related to restricted sight distance. Currently this is a judgment made by an experienced safety analyst.

Cost: ● ○ ○ ○
Time Frame: ● ○ ○
Effectiveness: Tried



Clear Sight Triangles in the Medians of Divided Highways near Intersections

NCHRP Report 500 • Vol. 5
Strategy: C2



Note the vehicle hidden behind the median landscaping.

Where to use

Unsignalized intersections on divided highways with (a) fixed sight obstructions in the median near the intersection and (b) patterns of crashes related to the lack of sight distance.

Key to success

Effectively diagnose whether a specific crash pattern observed at an intersection is, in fact, related to restricted sight distance. Currently this is a judgment made by an experienced safety analyst.

Cost: ● ○ ○ ○
Time Frame: ● ○ ○
Effectiveness: Tried



Change Horizontal and/or Vertical Alignment of Approaches to Provide More Sight Distance

NCHRP Report 500 • Vol. 5
Strategy: C3

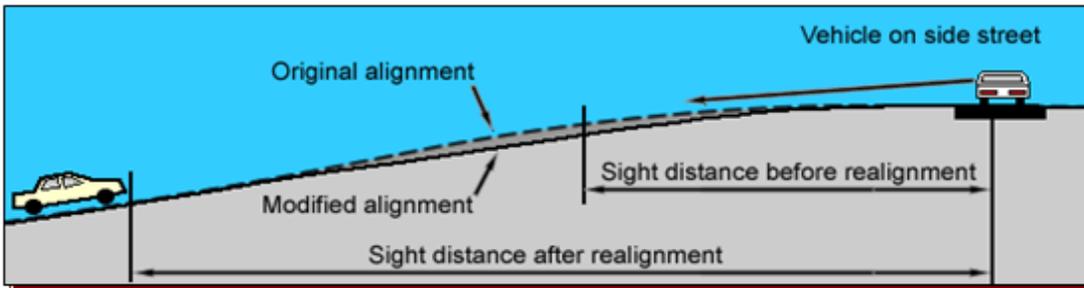
Where to use

Unsignalized intersections with restricted sight distance due to horizontal and/or vertical geometry and with patterns of crashes related to that lack of sight distance that cannot be ameliorated by less expensive methods.

Key to success

Effectively diagnose whether a specific crash pattern observed at an intersection is, in fact, related to restricted sight distance. Currently this is a judgment made by an experienced safety analyst.

Because adjacent properties may be affected by the redesign, all the stakeholders should be involved early in the planning process.



This graphic depicts how changes in the vertical alignment can affect sight distance. Even small changes in grade can have a significant impact.

Cost:



Time Frame:



Effectiveness: Tried



Eliminate Parking That Restricts Sight Distance

NCHRP Report 500 • Vol. 5
Strategy: C4



This photo depicts a “parking box” that prevents vehicles from parking too close to the intersection and obstructing the side street driver’s line of sight.

Where to use

Unsignalized intersections with restricted sight distance due to parking.

Key to success

Effectively diagnose whether a specific crash pattern observed at an intersection is, in fact, related to restricted sight distance due to parking. Currently this is a judgment made by an experienced safety analyst. It may often require detailed study of individual crash reports for the intersection, as well as field visits and measurements.

Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Tried



Provide an Automated Real-Time System to Inform Drivers of the Suitability of Available Gaps for Making Turning and Crossing Maneuvers

NCHRP Report 500 • Vol. 5
Strategy: D1



Where to use

Unsignalized intersections with a high frequency of right-angle collisions due to restricted sight distance.

Key to success

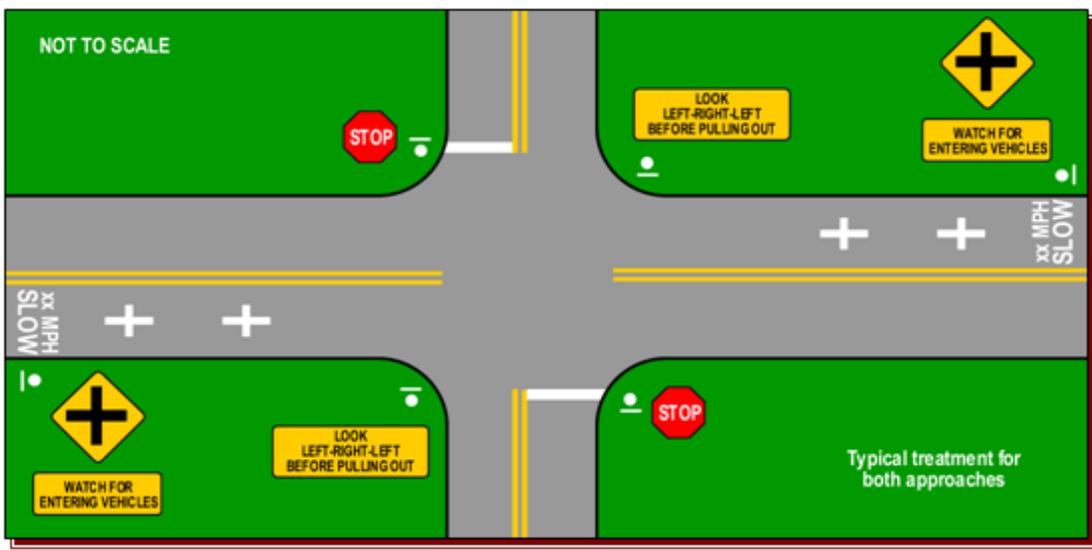
Eliminate as many sight obstructions as practical or possible before implementing an automated system. Signage on the highway that does not stop should be used to alert motorists of the approaching intersection. The system must be maintained in excellent working condition.

Cost: ●●○○
Time Frame: ●●○
Effectiveness: Experimental



Provide Innovative Signs and Markings to Assist Drivers in Judging the Suitability of Available Gaps for Making Turning and Crossing Maneuvers

NCHRP Report 500 • Vol. 5
Strategy: D2



This diagram represents one example of how such a system of markings and signs may be used.

Where to use

Unsignalized intersections where crash data shows a high occurrence of crashes where vehicles on secondary roadways intersecting at grade misjudge the gap between approaching vehicles.

Key to success

It is very important that a driver on the secondary road, while stopped to make the decision whether to enter the intersection, can clearly view the “Look Left-Right-Left Before Pulling Out” warning sign. If the warning sign is not easily viewed from the decision point on the secondary road, it should be shifted to a more visible location.



Retime Adjacent Signals to Create Gaps at Stop-Controlled Intersections

NCHRP Report 500 • Vol. 5
Strategy: D3



Where to use

Unsignalized intersections (between signalized intersections) with a high frequency of right-angle or turning-related crashes due to a lack of sufficient gaps in through traffic on the major road.

Key to success

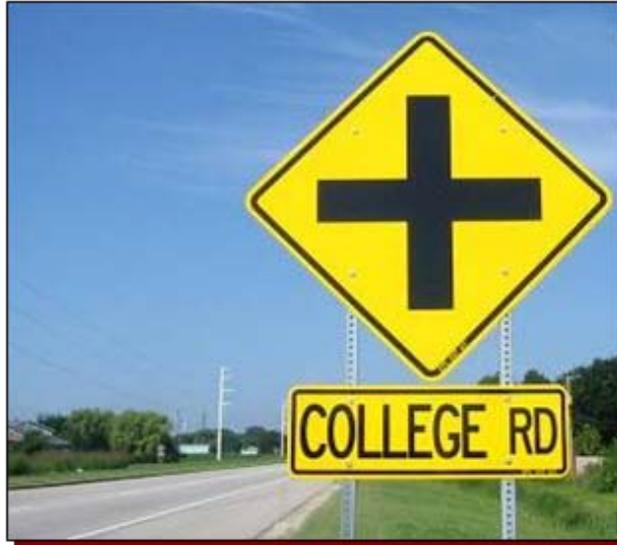
Identify signal timing for operation of the signalized intersections that results in suitable gaps in traffic at downstream unsignalized intersections.

Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Tried



Improve Visibility of Intersections by Providing Enhanced Signing and Delineation

NCHRP Report 500 • Vol. 5
Strategy: E1



Where to use

Unsignalized intersections that are not clearly visible to approaching motorists, particularly approaching motorists on the major road. The strategy is particularly appropriate for intersections with patterns of rear-end, right-angle, or turning crashes related to lack of driver awareness of the presence of the intersection.

Key to success

Select a combination of signing and delineation techniques appropriate to conditions on particular unsignalized intersection approaches. This engineering assessment should, where possible, be accompanied by a human factors assessment of signing and delineation needs.

Also, the ability and commitment of the highway agency to adequately maintain the signing or delineation is important.

Cost: ● ○ ○ ○
Time Frame: ● ○ ○
Effectiveness: Tried



Improve Visibility of the Intersection by Providing Lighting

NCHRP Report 500 • Vol. 5
Strategy: E2



Where to use

Unsignalized, unlit intersections with substantial patterns of nighttime crashes. In particular, patterns of rear-end, right-angle, or turning crashes on the major-road approaches to an unsignalized intersection may indicate that approaching drivers are unaware of the presence of the intersection.

Key to success

Identifying sites where a lack of lighting is truly a significant factor in the nighttime crash experience. Also, develop an appropriate lighting system following AASHTO and the Illuminating Engineering Society of North America (IESNA) criteria.

Cost: ●●●○
Time Frame: ●●○
Effectiveness: Proven



Install Splitter Islands on the Minor Road Approach to an Intersection

NCHRP Report 500 • Vol. 5
Strategy: E3



Where to use

Minor road approaches to unsignalized intersections where the presence of the intersection or the stop sign is not readily visible to approaching motorists. The strategy is particularly appropriate for intersections where the speeds on the minor road are high.

Key to success

Designing the island in accordance with the principles of channelization presented in the *AASHTO Policy on Geometric Design of Highways and Streets* and *NCHRP Report 279: Intersection Channelization Design Guide*. The visibility of the splitter island will, in part, depend on its placement relative to the profile of the major road.

Cost:



Time Frame:



Effectiveness: Tried



Provide a Stop Bar (or Provide a Wider Stop Bar) on Minor Road Approaches

NCHRP Report 500 • Vol. 5
Strategy: E4



This photo shows the use of a wide stop bar on the minor approach to an intersection within a horizontal curve.

Where to use

Approaches to unsignalized intersections having traffic control devices that are not currently being recognized by some approaching motorists. Locations should be identified by patterns of crashes related to lack of driver recognition of the traffic control device (e.g., right-angle crashes related to stop sign violations).

Key to success

Identify appropriate intersection approaches that would benefit from its use. The strategy is expected to be especially effective when applied on approaches where conditions allow the stop bar to be seen by an approaching driver at a significant distance from the intersection. This strategy is appropriate for locations with a pattern of angle crashes associated with stop sign violations where approaching drivers may not realize that an intersection is present until it is too late to stop.

Cost: ● ○ ○ ○
Time Frame: ● ○ ○
Effectiveness: Tried



Install Larger Regulatory and Warning Signs at Intersections

NCHRP Report 500 • Vol. 5
Strategy: E5



Where to use

Approaches to unsignalized intersections with patterns of rear-end, right-angle, or turning collisions related to lack of driver awareness of the presence of the intersection.

Key to success

Select a combination of regulatory and warning sign techniques appropriate to conditions on particular approaches to unsignalized intersections. This engineering judgment should, where possible, be accompanied by a human factors assessment of the need for regulatory and warning signs.

Another key is the ability and commitment of the highway agency to adequately maintain the signs.

Cost: ● ○ ○ ○
Time Frame: ● ○ ○
Effectiveness: Tried



Call Attention to the Intersection by Installing Rumble Strips on Intersection Approaches

NCHRP Report 500 • Vol. 5
Strategy: E6



Where to use

Approaches to unsignalized intersections with traffic control devices that are not currently being recognized by some approaching motorists. Locations should be identified by patterns of crashes related to lack of driver recognition of the traffic control device (e.g., right-angle crashes related to stop sign violations). Rumble strips should be considered only after an adequate trial of less intrusive treatments.

Key to success

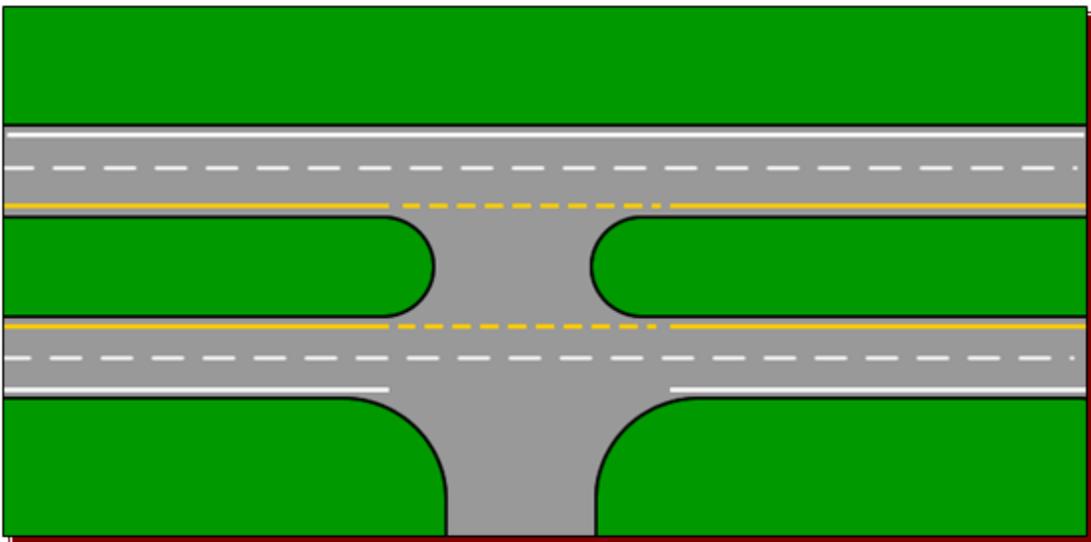
Use rumble strips sparingly so that they retain their surprise value in gaining the driver's attention.

Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Tried



Provide Dashed Markings (Extended Left Edgelines) for Major Road Continuity Across the Median Opening at Divided Highway Intersections

NCHRP Report 500 • Vol. 5
Strategy: E7



Where to use

Unsignalized intersections on divided highways. The strategy is particularly appropriate for intersections with patterns of rear-end, right-angle, or turning crashes related to lack of awareness by the driver on the minor road to the presence of the intersection.

Key to success

Select a combination of marking techniques appropriate to conditions on particular unsignalized intersection approaches on divided highways. This engineering judgment should, where possible, be accompanied by a human-factors assessment of marking needs.

Another key is the ability and commitment of the highway agency to maintain the markings adequately.

Cost: ● ○ ○ ○
Time Frame: ● ○ ○
Effectiveness: Tried



Provide Supplementary Stop Signs Mounted Over the Roadway

NCHRP Report 500 • Vol. 5
Strategy: E8



Where to use

Unsignalized intersections with patterns of right-angle crashes related to lack of driver awareness of the presence of the intersection. In particular, it might be appropriate to use this strategy at the first stop-controlled approach (possibly of a series) located on a long stretch of highway without any required stops, or at an intersection located after a sharp horizontal curve.

Key to success

Locate the supplementary overhead sign (or signs) in the direct line of sight of approaching drivers.

Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Tried



Provide Pavement Markings With Supplementary Messages

NCHRP Report 500 • Vol. 5
Strategy: E9



Where to use

Unsignalized intersections with patterns of rear-end, right-angle, or turning crashes related to lack of driver awareness of the presence of the intersection.

Key to success

Select a combination of marking techniques appropriate to conditions on particular unsignalized intersection approaches.

Another key is the ability and commitment of the highway agency to maintain the markings adequately.

Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Tried



Provide Improved Maintenance of Stop Signs

NCHRP Report 500 • Vol. 5
Strategy: E10



This photo illustrates a poorly maintained stop sign.

Where to use

All stop-controlled intersections.

Key to success

Determine an effective maintenance schedule that may be adequately sustained by highway agencies.

Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Tried



Install Flashing Beacons at Stop-Controlled Intersections

NCHRP Report 500 • Vol. 5
Strategy: E11



Where to use

Unsignalized intersections with patterns of right-angle crashes related to lack of driver awareness of the intersection on an uncontrolled approach and lack of driver awareness of the stop sign on a stop-controlled approach.

Key to success

Select intersections with crash patterns appropriate to mitigation by flashing beacons. Otherwise, the use of a flashing beacon may provide no safety benefit (or a negative safety benefit). Crash types mitigated by flashing beacons may include right-angle, rear-end, and turning crashes.

Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Tried



Avoid Signalizing Through Roads

NCHRP Report 500 • Vol. 5
Strategy: F1



This driveway into a major shopping center is close to a nearby signalized intersection. Rather than signalize this intersection, traffic is restricted to right-in/right-out.

Where to use

Medium- to high-volume unsignalized intersections where installation of signals is being considered. Before a decision to install a signal is made, adequate consideration should be given to less restrictive forms of traffic control.

Key to success

Identify an appropriate alternative design or traffic control method that will operate more safely than a signalized intersection. Some intersections serve traffic volumes that are so high that signalization may not be avoided.

Cost:



Time Frame:



Effectiveness: Tried



Provide All-Way Stop Control at Appropriate Intersections

NCHRP Report 500 • Vol. 5
Strategy: F2



Where to use

Unsignalized intersections with patterns of right-angle and turning crashes and moderate and relatively balanced volumes on the intersection approaches.

Key to success

Identify moderate volume situations where all-way stop control will operate efficiently without substantially more delay than a signalized intersection.

It is important that the driving public be alerted to the change of control during a transition period.

Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Proven



Provide Roundabouts at Appropriate Locations

NCHRP Report 500 • Vol. 5
Strategy: F3



Where to use

Unsignalized intersections that are experiencing right-angle, rear-end, and turning crashes. Roundabouts are appropriate at most intersections, and at intersections with large traffic delays roundabouts are oftentimes a superior alternative to signalization. Roundabouts can also be very effective at intersections with complex geometry and intersections with frequent left-turn movements.

Key to success

One key to success is designing the roundabout and its approaches in accordance with accepted geometric design and traffic control criteria. Designs that accommodate the needs of non-motorized users and include proper signing, pavement marking, and intersection lighting are keys to the success of a roundabout. Because public understanding of roundabouts is somewhat limited in many parts of the United States, educating the general public and local units of government about the effectiveness of roundabouts in reducing crashes is advisable.

Cost:



Time Frame:



Effectiveness: Proven



Provide Targeted Enforcement to Reduce Stop Sign Violations

NCHRP Report 500 • Vol. 5
Strategy: G1



Where to use

Unsignalized intersections where stop sign violations and patterns of crashes related to stop sign violations have been observed. Crash types potentially related to stop sign violations include right-angle and turning collisions.

Key to success

Identify the intersections that can potentially benefit from increased enforcement. Such intersections should have a combination of high stop sign violation rates and related crash patterns. It is important that both the highway agency and the law enforcement agency(ies) in the jurisdiction be involved jointly in planning and operating the program.

The success of any enforcement program depends substantially on the performance of the officer in the field.

Cost: ●●○○
Time Frame: ●○○
Effectiveness: Tried



Provide Targeted Public Information and Education on Safety Problems at Specific Intersections

NCHRP Report 500 • Vol. 5
Strategy: G2

Where to use

Jurisdictions that have experienced a large number of safety problems at unsignalized intersections.

Key to success

Reach as much of the targeted audience as possible, whether it is through television, radio, distribution of flyers, driver education classes, or other methods. Targeted drivers need to be defined in terms of both the location of the hazardous intersection(s) and the attributes of the drivers who may have been identified as overrepresented in the population involved in crashes.



Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Tried



Provide Targeted Speed Enforcement

NCHRP Report 500 • Vol. 5
Strategy: H1



Where to use

Unsignalized intersections where speed violations and patterns of crashes related to speed violations are observed. Crash types potentially related to speed violations include right-angle, rear-end, and turning crashes.

Key to success

Plan the enforcement and prioritize the intersections that need it. Such intersections should have a combination of high speed-violation rates and related crash patterns. It is important that both the highway agency and the law enforcement agency(ies) in the jurisdiction be involved jointly in planning and operating the program.

The success of any enforcement program depends substantially on the performance of the officer in the field. It is important that all officers involved be told of the objectives and expected benefits of the program and that they be given regular feedback on their effectiveness.

Cost: ●●○○
Time Frame: ●○○
Effectiveness: Proven



Provide Traffic Calming on Intersection Approaches Through a Combination of Geometrics and Traffic Control Devices

NCHRP Report 500 • Vol. 5
Strategy: H2



Where to use

Specific approaches to unsignalized intersections that are experiencing crash types potentially related to speed violations, specifically right-angle, rear-end, and turning collisions.

Key to success

Carefully plan and determine the type of traffic calming measure viable for the specific intersection approach. Such intersections should have a combination of high-speed violation rates and related crash patterns.

Cost: ●●○○
Time Frame: ●●○○
Effectiveness: Proven



Post Appropriate Speed Limit on Intersection Approaches

NCHRP Report 500 • Vol. 5
Strategy: H3



Where to use

Unsignalized intersections experiencing a high frequency of speed related crashes.

Key to success

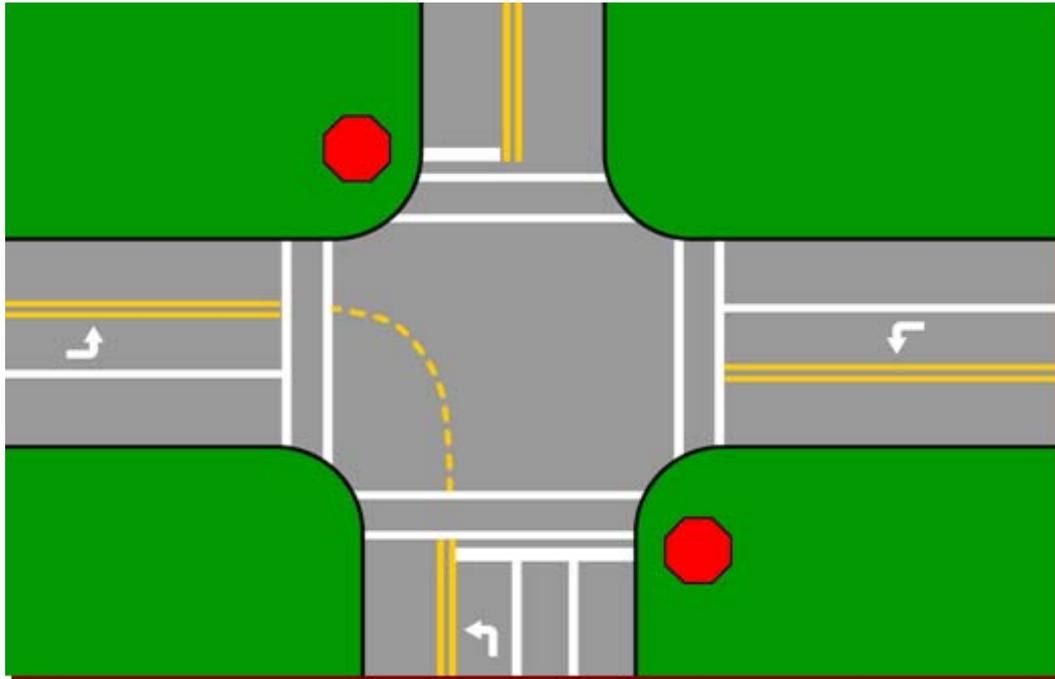
Determine the appropriate speed limit for intersection approaches (based upon the functional class of the roadways, average operating speeds, traffic volume, geographical area, and roadside characteristics) and determine whether the speed limit should be reduced in the vicinity of the intersection.

Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Tried



Provide Turn Path Markings

NCHRP Report 500 • Vol. 5
Strategy: I1



This diagram shows how path markings could be used to assist drivers at a slightly offset unsignalized intersection.

Where to use

Complex unsignalized intersections with a high frequency of crashes related to turning vehicle positioning (e.g., sideswipe crashes).

Key to success

Determine which maneuvers drivers are having trouble performing, and define and mark the appropriate turning paths. This may require extensive review of individual crash reports, as well as observations and measurements at a site.

Proper maintenance of the markings will also be important to the success of this strategy.

Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Tried



Provide a Double Yellow Centerline on the Median Opening of a Divided Highway at Intersections

NCHRP Report 500 • Vol. 5
Strategy: I2



Where to use

Unsignalized intersections on divided highways that are experiencing a high degree of crashes caused by side-by-side queuing and angle stopping within the median area.

Key to success

Ensure that the median is of sufficient width (at least 100 feet) so that vehicles can follow a desired path.

Proper maintenance of the striping will be important to the strategy's success. Presence of snow or ice on the roadway area may significantly reduce the strategy's effectiveness at critical times.

Cost:



Time Frame:



Effectiveness: Tried



Provide Lane Assignment Signing or Marking at Complex Intersections

NCHRP Report 500 • Vol. 5
Strategy: I3



While this photo shows lane assignment signing at a signalized intersection, a similar strategy can be used at complex unsignalized intersections.

Where to use

Unsignalized intersections with a high frequency of crashes caused by driver indecision in lane assignment.

Key to success

Ensure that lane assignment signs and/or markings are visible to drivers. Overhead signs are preferred to post-mounted signs (placed on the shoulder) because the overhead signs can be placed directly over the lanes to which they apply. In addition, the lane assignment signing/marking should be placed far enough in advance of the intersection so that vehicles can maneuver to the appropriate lane.

Cost: ● ○ ○ ○ ○
Time Frame: ● ○ ○ ○ ○
Effectiveness: Tried

