

LOW COST SAFETY IMPROVEMENTS

Practitioner Workshop

The Tools –

Intersections

– Session #6



Intersections

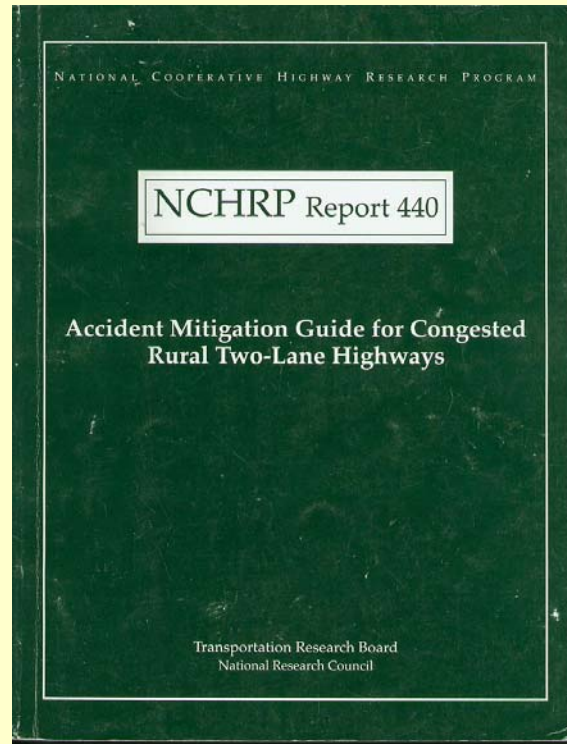
Learning Objectives:

**Recognize Deficiencies in Operation/Design
of Intersections**

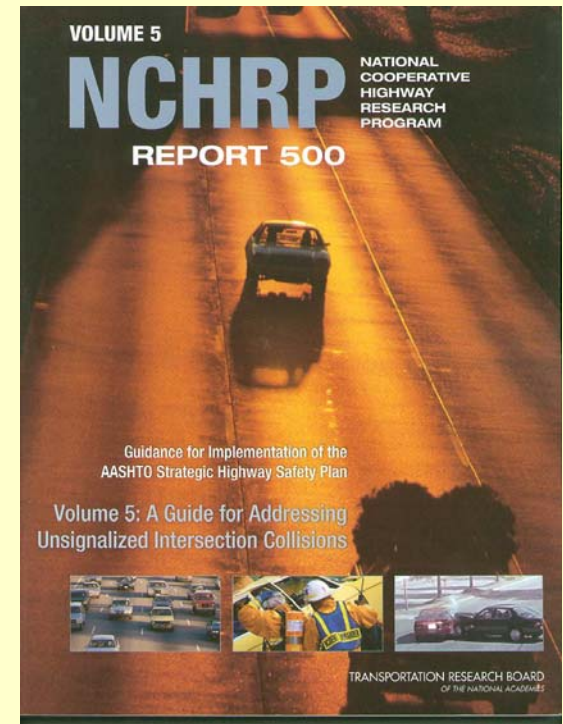
**Select appropriate Enhanced Application
Countermeasures for Intersections**

Intersections

New Tools:



NCHRP 440 – *Accident Mitigation Guide for Congested Rural Two-Lane Highways*



NCHRP 500 – **Volume 5: A Guide for Addressing Unsignalized Intersection Collisions**

Intersections

Intersections are Points of Conflict:

Relevant crash Types

- Angle and turning
- Rear-end
- Head-on



Intersections

Intersection Types:

- Unsignalized (two-way, all stop)
- Signalized
- Roundabouts
- T versus 4-leg



Intersections

Collision Types at Rural Intersections:

TABLE 59 Variation in accident type and rate with type of control—rural municipalities (128)

Type of Control	Accident Type - Percent of Total				Accident Rate (accidents per million entering vehicles)
	Rear-End	Angle	Sideswipe	Other	
Traffic Signal	43	37	12	8	1.26
Yield or Stop Sign	29	49	10	12	1.08

Rear-end, left turn and angle collisions predominate at rural intersections

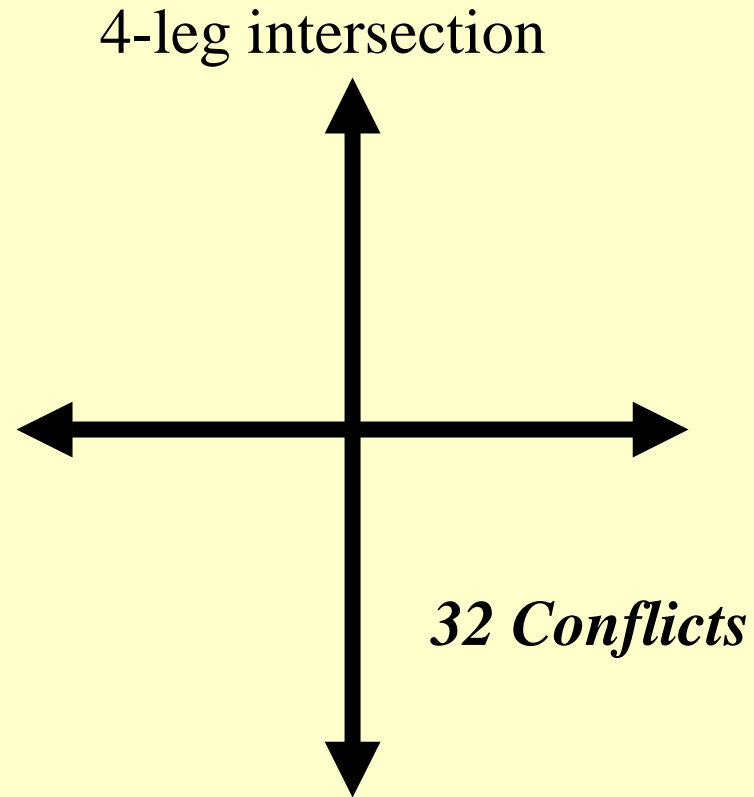
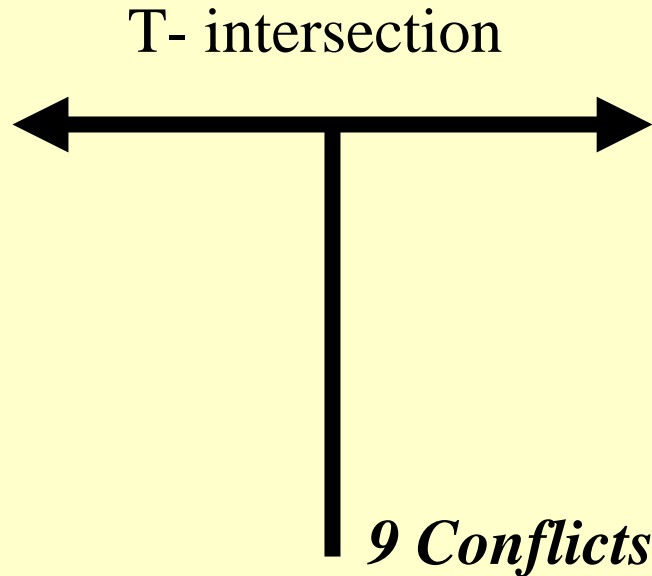
Intersections

Intersection Countermeasures:

1. Configuration
2. Adjacent Access
3. Traffic Control (No Control, 2-Way Stop, All-Way Stop, Traffic Signal)
4. Signing
5. Transverse Rumble Strips
6. Sight Distance (Visibility)
7. Turn Lanes and Shoulder Widening
8. Lighting

Intersections

4-leg versus 3-leg Intersections -- Safety vs. Mobility/Efficiency

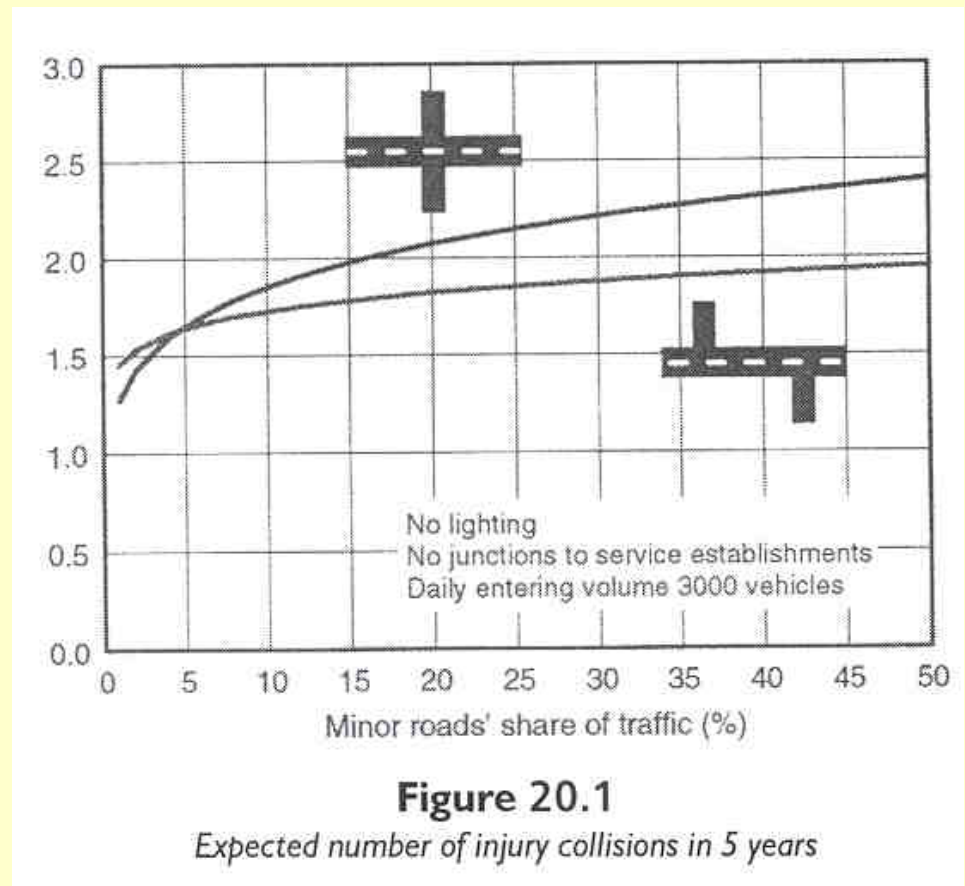


Intersections

Number of Intersection Legs:

Collision rates at 4-leg intersections are 1.3 to 1.4 times those at 3-leg

Safety of 3-leg intersections increases as minor road traffic increases



Number of Intersection Legs:



Collision rates for intersections with more than 4 approaches are 2 to 8 times greater than for 4 approach Intersections

**NCHRP 500, Strategy
17.2 B14**

Roundabouts



Benefits and Considerations

Safer for motorists at low and medium traffic flows

At least as safe as other types of intersections for pedestrians

Mixed safety record for bicyclists, especially at double-lane roundabouts

Findings of the INSURANCE INSTITUTE FOR HIGHWAY SAFETY

Studied 24 intersections

Accident reduction is:

- 39 % for all crashes**
- 76 % for injury and fatal crashes**
- 90 % for incapacitating injuries and fatal crashes**

Roundabouts



Potential Complications

R.O.W. limitation

Proximity to high traffic generators

**Proximity to signalized intersections or
signal progression**

Proximity to bottlenecks

Heavy pedestrian or bicycle traffic

Intersections

Intersection Countermeasures:

2. Improve Management of Access near Unsignalized Intersections

- ❑ “Access points within 250 feet upstream and downstream of an intersection are generally undesirable.”*
- ❑ “Implement turn restricts to prevent identified crash pattern”*

*NCHRP 500, Strategy 17.1 A1 – Implement Driveway Closures & Relocations

Intersections

Intersection Countermeasures:

3. Traffic Control – 2-Way to **All-Way STOP**

- ❑ All-Way STOP control can reduce right-angle and turning movement crashes
- ❑ Suitable only at intersections with moderate and relatively balanced volume levels on the approaches
- ❑ Harwood, 2000, reported 53% reduction in total intersection crashes (data set was limited in size)

*NCHRP 500, Strategy 17.1 F2 – Provide All-Way Stop Control

Intersections

Intersection Countermeasures:

4. Signing – Advance Warning Signs



CRF = 30% Rural
CRF = 40% Urban



Intersections

Intersection Countermeasures:

5. Transverse Rumble Strips

- ❑ Rumble Strips are particularly appropriate on stop-controlled approaches to rural intersections
- ❑ Up to a 50% reduction in rear-end and stop violation crashes
- ❑ Key to effectiveness is to apply sparingly so that they retain their “surprise” value in gaining driver attention

Intersections

Countermeasures:

5. Transverse Rumble Strips

Transverse Rumble
in Advance of a
Rural Traffic Signal

-Indiana 41
at Indiana 2



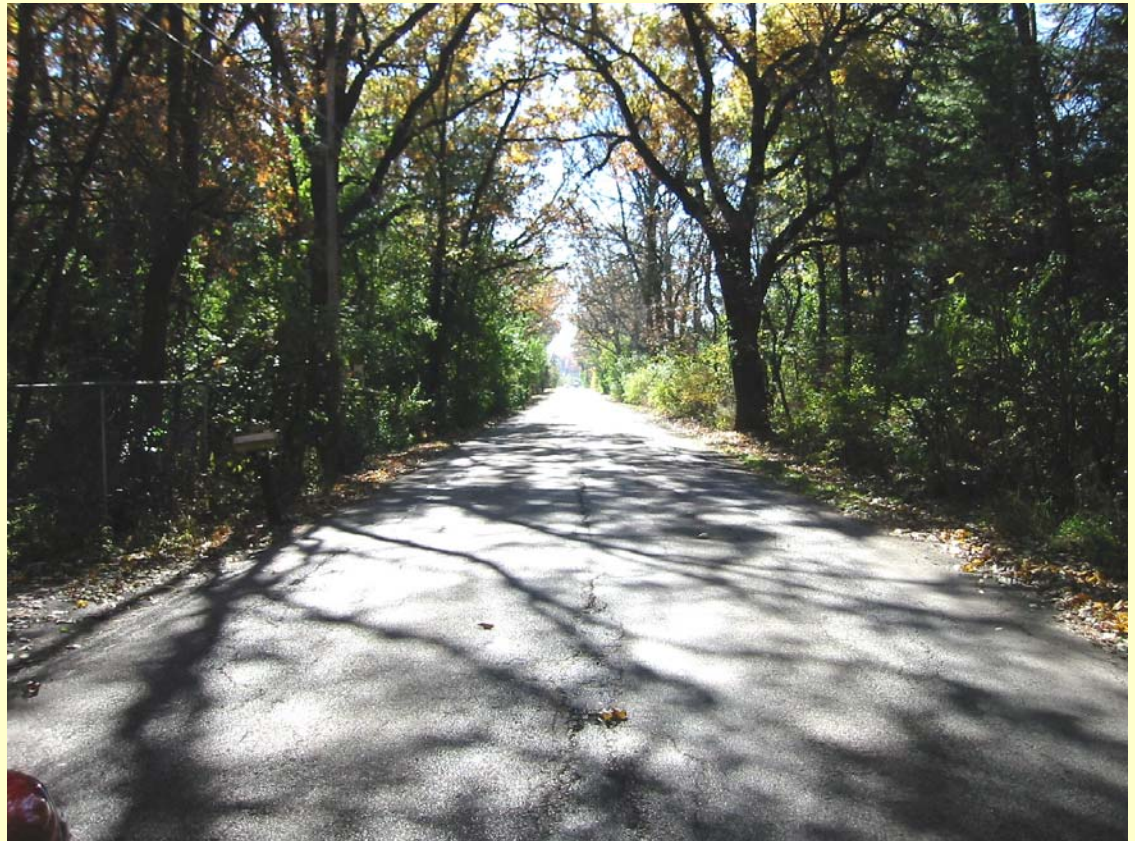
Intersections

Intersection Countermeasures:

6. Sight Distance

- The Ability to see is crucial to the driving task

Obstructed view of entering traffic from driveways and side streets



Intersections

Intersection Countermeasures:

6. Sight Distance (visibility)

**20% Reduction
(4 quadrants)**

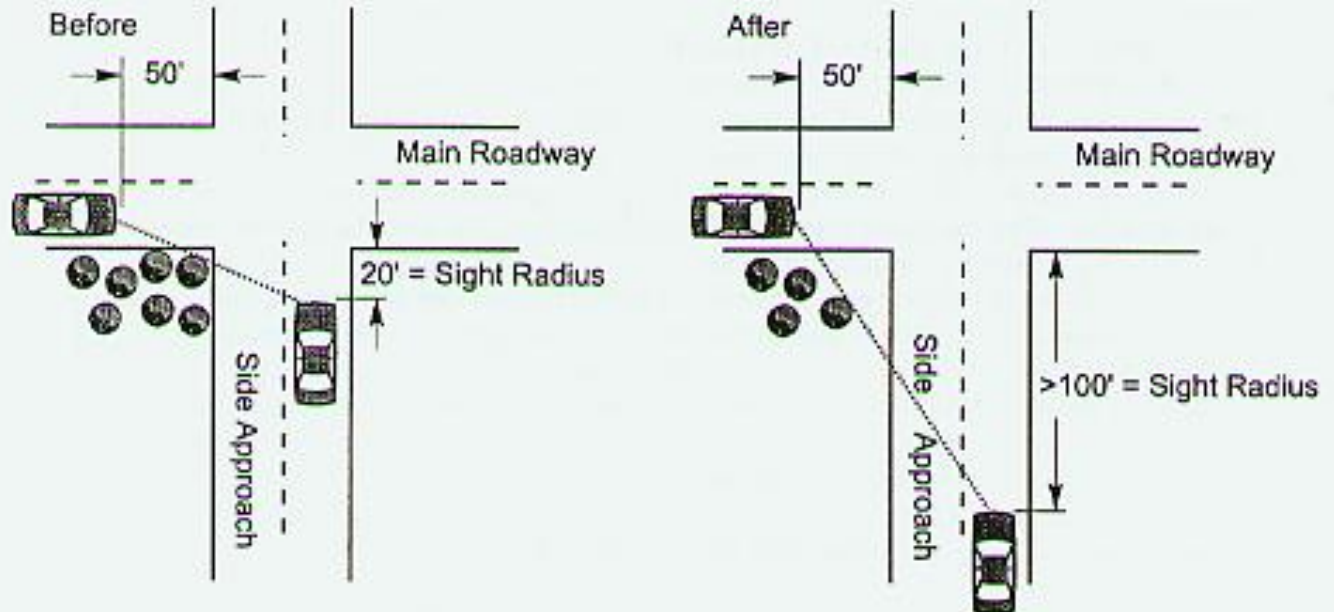


Figure 23. Example of increased sight radius on accident reduction (112).

Intersections

Markings to Remedy Sight Distance Limitation

- ❑ Add Centerline Markings and Move Stop Bar Forward to edge of pavement of Intersecting Road **26% Reduction**



Intersections

Intersection Countermeasures:

7. Turning Lanes – Left Turn Lanes (Rural)

“Capacity” is generally not the issue

Left turn lanes remove stopped traffic from through lanes

- mitigate rear-end conflict
- enable selection of safe gap

Left turn lane design should reflect need to decelerate from high speed



Intersections

Intersection Countermeasures:

7. Turning Lanes – Left Turn Lanes (Rural)

Table 1. Expected Percentage Reduction in Total Accidents from Installation of Left-Turn Lanes on the Major-Road Approaches to Rural Intersections

Intersection type	Intersection traffic control	Number of major-road approaches on which left-turn lanes are installed	
		One approach	Both approaches
Three-leg intersection	STOP sign ^a	44 ^b	
	Traffic signal	15 ^c	
Four-leg intersection	STOP sign ^a	28 ^b	48 ^b
	Traffic signal	18 ^c	33 ^c

^a STOP signs on minor-road approach(es)

^b based on EB evaluation in Reference 1

^c based on Reference 4

*NCHRP 500, Strategy 17.1 B1

Intersections

Intersection Countermeasures:

7. Turning Lanes – Right Turn Lanes

Table 3. Expected Percentage Accident Reduction in Total Accidents from Installation of Right-Turn Lanes on the Major-Road Approaches to Rural and Urban Intersections

Intersection traffic control	Number of major-road approaches on which right-turn lanes are installed	
	One approach	Both approaches
STOP sign ^a	14 ^b	26 ^b
Traffic signal	4 ^c	8 ^c

^a STOP signs on minor-road approach(es)

^b based on EB evaluation for rural intersections in Reference 1

^c based on EB evaluation for urban intersections in Reference 1

*NCHRP 500, Strategy 17.1 B6

Intersections

Intersection Countermeasures:

7. Shoulder Widening at Rural Intersections

Crash reduction per foot
of shoulder widening at
rural intersections **2.8%**

*NCHRP 500, Strategy 17.1 B10 – Provide Full-Width Paved Shoulders in Intersection Areas

Intersections

Intersection Countermeasures:

9. Lighting

-Installation of lighting of rural intersections reduced night time crashes by 25 to 50% - MN study

*NCHRP 500, Strategy 17.1
E2-Improve Visibility of Intersection by Providing Lighting (P)



Intersections

Intersection Countermeasures:

9. Lighting

*High-Volume
Signalized
Intersection
Handbook

Add lighting ⁸¹	0.85 – Night collisions
Add lighting ⁸²	0.70 – All
	0.50 – Night collisions
Improve lighting ⁸³	0.70 – Pedestrian
Add lighting ⁸⁴	0.70 – 0.80 – Adjacent approach
	0.70 – 0.80 – Head on
	0.70 – 0.80 – Opposing vehicles, turning
	0.70 – 0.80 – U turn
	0.70 – 0.80 – Rear End
	0.70 – 0.80 – Parallel Lanes, turning
	0.70 – 0.80 – Pedestrian
	0.70 – 0.80 – Permanent obstruction
Add lighting ⁸⁵	0.57 – Fatal
	0.83 – Injury

Intersections

Questions?