

**Simple Intersection Signing Study Template
For
Uncontrolled Rural Intersections**

**KCHA Design and Maintenance Standards Committee
November 2010**

Disclaimer and Application: The contents of this template reflect the views of the KCHA Design Committee, and is intended to be a guide for a regulatory signing study for simple uncontrolled intersections. This template is not intended to constitute a standard, specification or regulation. While the committee believes the use of this template will yield reasonable result, it is not a substitute for engineering judgment based on the specific conditions at an intersection.

Background: This template is for use in determining needed regulatory signing at normal 4 way intersections in rural areas where no signing is in place to assign right of way. These are normally called uncontrolled intersections as right of way is determined without signing by the normal right of way rule in state law. At uncontrolled intersections the first vehicle that enters the intersection has the right of way, if two vehicles are approaching the intersection at approximately the same time then the vehicle on the right has the right of way. Uncontrolled intersections are common in rural areas and small towns and seem to work well in most situations. It is not anticipated that a study is needed at all uncontrolled intersections, but a study may be needed if there are safety complaints from citizens or a history of traffic accidents at an intersection.

2009 MUTCD Signing Warrants

Section 2B.04 Right-of-Way at Intersections

Support:

01 State or local laws written in accordance with the "Uniform Vehicle Code" (see [Section 1A.11](#)) establish the right-of-way rule at intersections having no regulatory traffic control signs such that the driver of a vehicle approaching an intersection must yield the right-of-way to any vehicle or pedestrian already in the intersection. When two vehicles approach an intersection from different streets or highways at approximately the same time, the right-of-way rule requires the driver of the vehicle on the left to yield the right-of-way to the vehicle on the right. The right-of-way can be modified at through streets or highways by placing YIELD (R1-2) signs (see [Sections 2B.08](#) and [2B.09](#)) or STOP (R1-1) signs (see [Sections 2B.05](#) through [2B.07](#)) on one or more approaches.

Guidance:

02 *Engineering judgment should be used to establish intersection control. The following factors should be considered:*

- A. Vehicular, bicycle, and pedestrian traffic volumes on all approaches;
- B. Number and angle of approaches;
- C. Approach speeds;

- D. Sight distance available on each approach; and
- E. Reported crash experience.

03 YIELD or STOP signs should be used at an intersection if one or more of the following conditions exist:

- A. An intersection of a less important road with a main road where application of the normal right-of-way rule would not be expected to provide reasonable compliance with the law;
- B. A street entering a designated through highway or street; and/or
- C. An unsignalized intersection in a signalized area.

04 In addition, the use of YIELD or STOP signs should be considered at the intersection of two minor streets or local roads where the intersection has more than three approaches and where one or more of the following conditions exist:

- A. The combined vehicular, bicycle, and pedestrian volume entering the intersection from all approaches averages more than 2,000 units per day;
- B. The ability to see conflicting traffic on an approach is not sufficient to allow a road user to stop or yield in compliance with the normal right-of-way rule if such stopping or yielding is necessary; and/or
- C. Crash records indicate that five or more crashes that involve the failure to yield the right-of-way at the intersection under the normal right-of-way rule have been reported within a 3-year period, or that three or more such crashes have been reported within a 2-year period.

05 YIELD or STOP signs should not be used for speed control.

This template basically interprets the MUTCD warrants and how to apply them to low volume intersections in rural areas.

Situations where STOP or YIELD signs are appropriate based on type of intersection per 2009 MUTCD Section 2b.04.03.

Through Roads: Most counties have what is recognized as main or through roads that carry traffic for a number of miles. These are typically classified as major rural collectors or minor collectors. These through roads usually are given the right of way by STOP signs placed on intersecting side roads. Historically these STOP signs were installed in the late 1960's on what were then called FAS (Federal Aid Secondary) routes and may not be classified as major or minor rural collectors. If the intersection being studied happens to be on a through route it is appropriate to install the STOP or YIELD signs on the intersecting side roads, unless there is a sight distance issue that can only be alleviated by a STOP or YIELD on the main road. Due to driver expectancy it is best to have consistent right of way designation at all side roads along the through road, whether it be YIELD signs or STOP signs.

T Intersections: 3 way or “T” intersections on low volume roads are seldom signed with a YIELD or STOP sign. The vehicle approaching the intersection from the base of the “T” has to almost stop to make a left or right turn, so it is apparent that he has to yield to through traffic from the left or right. The normal signing at a “T” intersection would be a yield or stop on the leg that has to turn. An exception might be when the sight distance is bad on one of the other approach legs. Due to potential right of way confusion a YIELD or STOP sign on the through road is seldom a good solution.

Intersecting minor roads: Intersecting minor roads such as a subdivision road or a dead end road are just a low volume “T” intersection and are normally controlled with a YIELD or STOP sign if the major road is a through road, and may not be controlled at intersections with a low volume section line road.

Driveways: State law requires traffic entering a road from a driveway or alley to yield right of way to traffic on the road. For this reason it is seldom appropriate to install a YIELD or STOP sign on an alley or driveway. For safety reasons the operator of the facility may install their own STOP or YIELD sign to emphasize the need to yield to traffic on the road.

Situations where STOP or YIELD signs are appropriate based on approaching sight distance per 2009 MUTCD Section 2b.04.04 item B.

Approach Sight Triangle: The driver of a vehicle approaching an intersection needs a view of vehicles approaching the intersection from the intersecting roads both left and right. The unobstructed views to intersecting traffic form triangular areas known as sight triangles. Approach sight triangles provide the driver of a vehicle approaching an intersection an unobstructed view of potential conflicting vehicles. The 2004 Green Book states that a departure sight triangle is not needed on low volume roads as it is very unlikely that another potentially conflicting vehicle will be encountered as the first vehicle departs the intersection. An approach sight triangle is illustrated in the following figure.

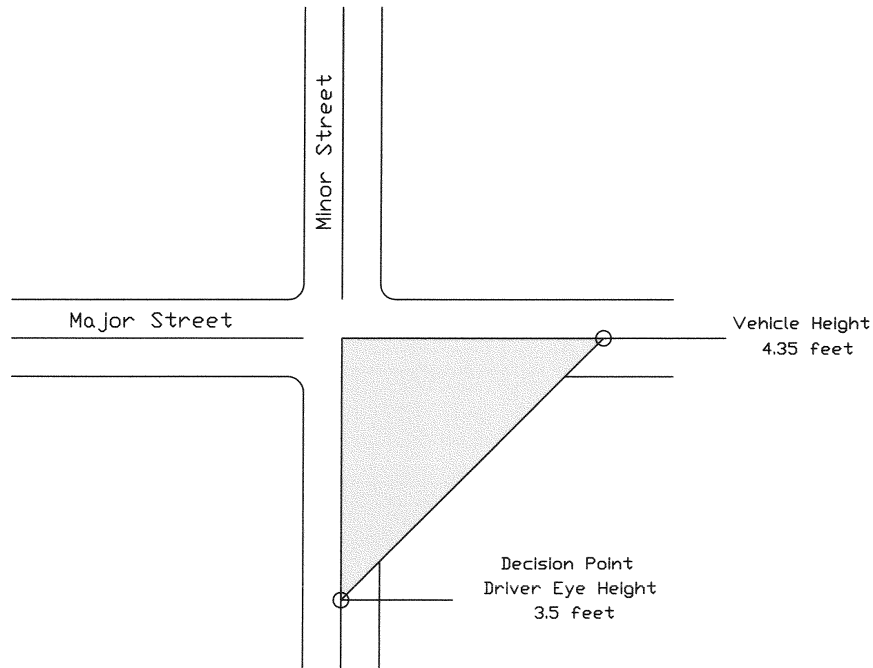


Figure 1: Approach Sight Triangle

Required approach sight triangle: For uncontrolled intersections, the drivers of both approaching vehicles should be able to see conflicting vehicles in adequate time to stop or slow to avoid a crash. Approach speeds must be estimated or measured. The speed limit is a conservative estimate for paved roads, subdivision roads and improved well maintained gravel roads. A 2009 study by K-State (K-TRAN KSU-06-5) found that speeds on gravel roads that were not main county roads in eastern Kansas are about 45 MPH. It is likely that unimproved roads, poorly maintained township roads and minimum maintenance roads will have lower prevailing speeds.

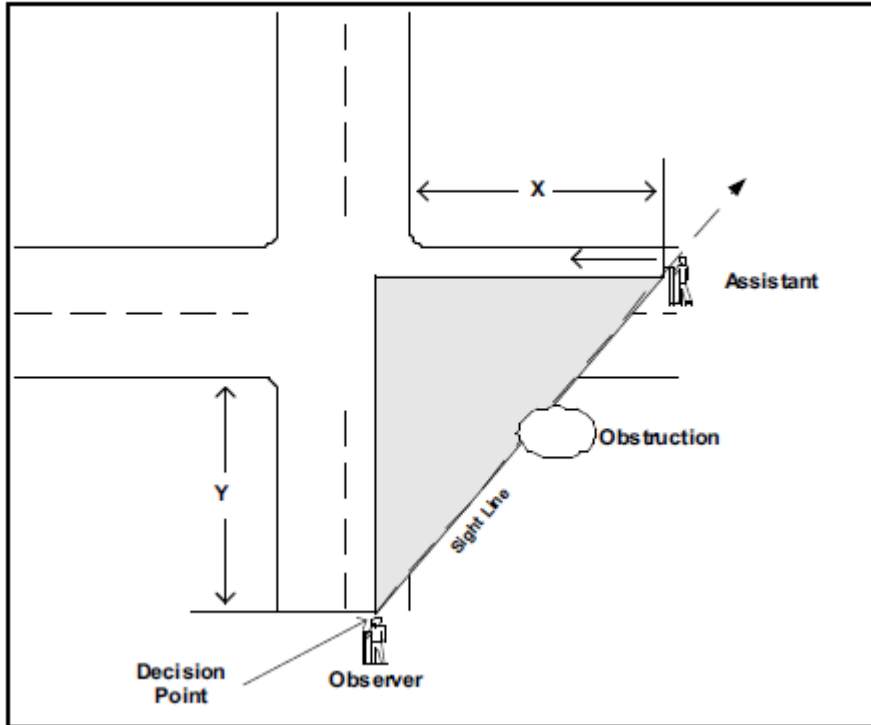
Chapter 9 of the 2004 AASHTO Green Book discusses intersection control with Case A- Intersection with No Control. The Green Book states that field observations have shown that vehicles approaching an uncontrolled intersection typically slow to approximately 50% of the mid block running speed. The required approach sight triangle based on the design speed and vehicles slowing to 50% of the design speed is shown in Exhibit 9-51 of the 2004 Green Book. For Kansas vehicles regularly slowing down to 50% of the design speed would have limited application and could be used on very low volume roads where there have been no accidents. Decision sight distance seems too conservative as traffic is predominately local traffic familiar with the area and an uncontrolled intersection is a common occurrence. A reasonable approach is to use the stopping sight distance, which assumes vehicles would not slow down for the intersection unless an approach vehicle is observed. Stopping sight distance is shown in the table below which was extracted from Exhibit 3-1 of the 2004 Green Book. Each leg of the sight

triangle is based on the design speed for that leg. Refer to adjustment factors in the Green Book if the grade exceeds 3%.

Estimated Speed (MPH)	Length of Leg (Ft.)
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570

Table 1-Required Approach Sight Triangle

Measuring the Approach Sight Triangle: It is usually only necessary to measure the quadrants where there is restricted sight distance. Although the sight triangle is based on stopping sight distance, the actual measurement is based on the height of eye of the intersection sight distance, the height of the drivers eye (3.5 ft.) and a conservative measure of the height of a vehicle (4.35 ft.). On gravel or dirt roads with three or less wheel paths it is appropriate to make the measurements along the centerline of the road. The observer will be stationed at the stopping sight distance for the approach speed on that approach(y in the drawing) (example: y=360 ft. for 45 MPH). The assistant will then walk away from the intersection down the crossing roadway and will mark that point where the observer losses sight of the measuring rod (distance x in the drawing). If the measured distance x is greater than the required stopping sight distance for that approach the sight distance is adequate in that quadrant, and a STOP or YIELD sign may not be warranted. If distance x is less than the stopping sight distance for the approach speed, and is more than 115 ft. (stopping sight distance for 20 MPH) a YIELD sign should be considered.



Signing Guidelines: If the approach sight triangle determined from the stopping sight distances in Table 1 is not available a YIELD or STOP sign may be appropriate based on inadequate sight distance. At a 4 way intersection it is seldom appropriate to put a sign on one leg of the intersection, as this may cause driver confusion. The normal signing should be a 2-way yield or 2-way stop either east & west, or north & south. If the sight distance is about equal the signs are placed on the road with the smallest amount of traffic. However, sight distance restrictions may make it appropriate to put the YIELD or STOP signs on the road with the best sight distance when stopped at the proposed YIELD or STOP.

If the required sight triangle is available, and the intersection has an accident history, it may be an indication that a warning sign may be appropriate..

Sight Triangle for a YIELD sign: The warrants for yield signs have changed over the years, at one time yields were the normal signing in the rural areas, and then as warrants changed the STOP sign became the standard signing. The 2009 MUTCD seems to encourage YIELD signs and states: "At intersections where a full stop is not necessary at all times, consideration should first be given to using less restrictive measures such as YIELD signs." The 2009 MUTCD goes on to state: "The YIELD sign assigns right-of-way to traffic on certain approaches to an intersection. Vehicles controlled by a YIELD sign need to slow down to a speed that is reasonable for the existing conditions or stop when necessary to avoid interfering with conflicting traffic." No specific guidance is provided on how much the vehicle is expected to slow down, so there is a judgment call depending on the circumstances. If a

YIELD sign is in place and visibility is routinely restricted it is reasonable that a vehicle approaching a YIELD sign would slow to at least 20 MPH, and that an approaching sight distance for 20 MPH (115 ft. from Exhibit 3-1 in 2004 Green Book) or more should be considered adequate for a YIELD sign. When measuring this sight triangle the distance down the cross roads should be based on the approach speed on the cross road as those vehicles will not be travelling 20 MPH due to the YIELD sign.

Yield Signs and Growing Crops: The 2009 MUTCD anticipates sight distance restrictions by vegetation which are only restrictions part of the year. The MUTCD states as follows: “The use of STOP signs on the minor-street approaches should be considered if engineering judgment indicates that a stop is always required because of one or more of the following conditions: . . . B. A restricted view exists that requires road users to stop in order to adequately observe conflicting traffic on the through street or highway;” So on low volume roads where growing crops are the only sight distance restriction that would require a STOP sign, a YIELD sign may be considered. Other vegetative restrictions, like brush, trees, or grass are present for a longer periods than growing crops, and should be considered permanent sight distance restrictions.

Documentation: The information compiled should be recorded in the Uncontrolled Intersection Study form attached and summarized in a form similar to the following Intersection Signing Report. These forms will document the measured sight triangles, estimated speeds, road widths, crash records, and other data on which the decision on the appropriate signing was made.

Intersection Signing Report
Bluestem Road and Tenth Avenue

(Note to Engineer: When preparing this report delete items that do not apply and provide detail where you feel it is needed.)

Reason for Study: A study of this intersection was initiated for the following reasons:

- Citizen report of accident or near misses at this location
- Report from law enforcement of an apparent issue at this location
- A recent crash at this location (May 2010)
- Crash records indicate a higher than average crash rate.
- Other:_____

Traffic Patterns: Tenth Avenue is a collector road and has the most traffic and higher speeds. Bluestem Road is a gravel road with 40 ft. r/w and appears to have a very low traffic volume.
(OR) Both roads are local roads and appear to have about the same amount of traffic.

Vehicle Types: Pedestrians and bicycles are rare. Vehicles are predominantly cars, trucks and farm equipment.

Crash History: Reliable crash records are not available at this intersection. The only known crash occurred in May 2010 which was a right angle crash when a northbound vehicle struck an eastbound vehicle in the intersection.
(OR) There is no record of any crashes at this intersection.

Existing Signing: There is no signing approaching the intersection from any direction.

Approach Speeds: Bluestem (north-south) Road is a local gravel road and the approach speed was estimated at 45 MPH. Tenth Avenue is a collector road an approach speeds was estimated at the speed limit of 55 MPH.

Approach Sight Triangles: A field review revealed that there were potential sight distance restrictions in the southeast and southwest quadrants of the intersection. For this reason approach sight triangles were measured for northbound both left & right. For eastbound to the right, and westbound to the left. The required sight triangle is based on the decision point (stopping sight distance) for the estimated speed of each leg.

Recommendations and Conclusions based on conditions other than sight distance: STOP or YIELD signs should be placed on Bluestem Road because it is:

- An intersection of a less important road with a main road where application of the normal right-of-way rule would not be expected to provide reasonable compliance with the law or would cause interference with traffic on the main road.
- Side road entering a designated through road.
- A “T” intersection where the leg of the “T” should stop or yield before turning.
- Crash records indicate a need to assign right-of-way.
- Traffic volume entering the intersection exceeds 2000 vpd.

Recommendations and Conclusions based on approach sight triangle: STOP or YIELD signs should be placed on Bluestem Road because:

- Sight distance is restricted in the southeast quadrant.
- Tenth Avenue has the higher traffic count.
- Bluestem Road has better sight distance when stopped at the intersection.

YIELD or STOP Sign:

- STOP sign is recommended as it is standard signing in the county.
- STOP sign is recommended as sight distance is not adequate for a YIELD sign.
- STOP sign is recommended as sight distance restrictions exist for a large portion of the year.
- YIELD sign is recommended as sight distance is adequate for 20 MPH.
- YIELD sign is recommended as sight distance restriction is caused by growing crops, so sight distance is adequate for a majority of the year.
- YIELD sign is recommended as all that is necessary at this location is to assign right-of-way.

Recommendations and Conclusions for no action: Although the sight distance is less than desirable, the traffic counts are low and there have been few accidents at this intersection, the intersection is a typical uncontrolled intersection in this area of the county.

This study was prepared under my supervision.

John Q. Public, P.E.