LTAP
KANSAS LOCAL TECHNICAL ASSISTANCE PROGRAM

Field Guide for Rural Roads

2020 EDITION

A safety guide on application of traffic control devices and road management techniques for local road agencies.

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Kansas Department of Transportation
KAC KANSAS ASSOCIATION OF COUNTIES

Kansas LTAP meets the needs of road and bridge departments in local governments for information, training and technical assistance.

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Cover photo: Rural road near Lebanon, Kansas
Michael Hudson / Alamy Stock Photo

Purpose

The purpose of this guide is to provide assistance to local government officials and workers responsible for maintenance and safety of rural roads. It provides a convenient reference to help address safety concerns commonly encountered in the field. To provide a safer road environment, always look for potential safety issues during your daily operations. Use this guide for advice in mitigating or eliminating safety issues.

Disclaimer

This field guide is not all-encompassing and should not be considered a legal document. This guide offers suggestions and guidance for many typical situations that arise on rural roads, but specific site conditions may make that guidance inappropriate. As it relates to traffic control devices, this guide is meant to provide completely compatible, supplementary material as an aid to understanding and complying with the Manual on Uniform Traffic Control Devices (MUTCD). In the case of any actual or implied difference between this field guide and the MUTCD, the MUTCD would govern. This guide provides guidance on complying with the MUTCD and is not a standard. *The decision to use a particular traffic control device at a specific location should be made on the basis of either an engineering study or the application of engineering judgment. Thus, while this guide provides guidance for design and application of traffic control devices, it should not be considered a substitute for engineering judgment.*

Acknowledgment and History

The original version of this field guide is a publication by the Wyoming Technology Transfer Center in cooperation with the Wyoming Department of Transportation, March 1997. The guide was revised and updated by Kansas Local Technical Assistance Program (LTAP) in 2004 and 2013. Special thanks to Norm Bowers, Local Road Engineer with the Kansas Association of Counties (KAC), for his contributions in updating this guide.

Duty to The Motorist

Generally, road agencies have a duty to construct and maintain public roads reasonably safe for use by motorists. Kansas state law has specified these three duties:

- Counties and townships are required to keep their roads in repair and remove or cause to be removed all obstructions (KSA 68-115).
- Cities, counties and townships are required to place and maintain traffic control devices upon roads under their jurisdiction as they may deem necessary to regulate, warn or guide traffic (KSA 8–2005)
- All traffic control devices on public roads must comply with the Manual on Uniform Traffic Control Devices abbreviated as MUTCD (KSA 8-2003)

CONTENTS

SECTION 1
ROADWAY SAFETY CONSIDERATIONS

One of the major duties of a road department is to provide a reasonably safe road system. This section offers some suggestions on major items that will help make your road system safer. Many solutions to safety problems are obvious and can be handled in the daily course of business. More difficult problems may need to be referred to a supervisor to make the decision, or you might need to seek advice from experts. Technical help is available from peers in other agencies, the Kansas Department of Transportation (KDOT), Kansas LTAP, and KAC, as well as consultants.

Think Safety

In all your decisions, "think safety." If something you are about to do could adversely affect the safety of the public, it is likely not the right decision. On maintenance work where there are no plans or design, the project should be thought-out in terms of safety for the traveling public. For instance, it may not be a good idea to cut a deep road ditch if the only reason for the deeper ditch is to drain a farmer's field. Road ditches are for road drainage, not for field drainage.

Follow Agency Policies

If policies are adopted, you should follow those policies; failure to follow those policies may be negligence. For instance, if your agency has a policy that brick mailboxes are not allowed, and you allow one to be constructed, the agency may be negligent if a vehicle hits the brick mailbox and someone is injured.

Uniform Road Surface

Drivers have a tendency to drive with speeds in accordance with general road conditions. It is a good policy to maintain roads so that road conditions do not surprise a driver. For instance, a rough spot in a good road is more likely to surprise a driver and lead to a crash than a rough spot in a bad road. Areas of loose gravel, potholes and washboards are the most common irregularities that may cause an issue with drivers.

Report Problem Areas and Items Needing Attention

Field personnel are the eyes and ears of the agency. All employees should keep an eye out for road hazards and unusual situations that can affect the road or road right-of-way.

Following are items that should be reported to your supervisor:

a. Downed, damaged, and faded signs
b. Signs obscured by brush and trees
c. Collapsed or damaged bridges and culverts
d. Oil field or other activity that is damaging the road or leaving debris on the road
e. New driveways, culvert headwalls and landscaping
f. Blocked ditch or change in drainage by a landowner
g. Ornamental mailboxes that could be a safety hazard
h. Utility work
i. Oil or chemical spills
j. Dumped trash
k. New fences closer to the road

Public Contact

Field personnel are the most visible representatives of the agency and an important link between the citizens and the agency. Listen to all requests and comments and treat citizens with respect. Take the name and phone number of the citizen and follow agency policy in reporting citizen requests to supervisors.

SECTION 2
RIGHT-OF-WAY ISSUES

A road agency is the custodian of many miles of road right-of-way (ROW). In a way, the road agency is a neighbor with every landowner and resident located in their jurisdiction. With that many neighbors, many issues can arise.

Maintenance of Right-of-Way & Clear Zone

A public road consists of several components, the traveled way or road surface, shoulders, slopes and ditches. While the road surface receives the most attention, shoulders, slopes, and ditches should be kept in good repair to prevent deterioration of the roadbed and unnecessary traffic hazards. A clear zone is an area adjacent to the traveled way that has a mild slope and is free of obstructions. The clear zone allows errant vehicles to leave the traveled way without encountering rigid objects and steep slopes, and allows for the passage of wide farm equipment. It is desirable to have as wide a clear zone as possible so obstructions such as utility facilities should be placed as close to the right-of-way line as possible. To improve safety, keep the existing clear zone well maintained and when practical widen the clear zone at problem locations.

The desirable order of treatment to improve the clear zone is as follows:

Remove: Remove fixed objects (culvert headwalls, ornamental handrails, trees, bales, farm equipment, etc.).

Relocate: Relocate objects to a safer place farther away from road or behind guardrail.

Retrofit: Improve objects that cannot be removed or relocated by making them breakaway or crashworthy (replace posts, slope the ends of entrance culverts, replace ornamental mailboxes).

Shield: Objects that cannot be improved may sometimes be mitigated by using guardrail.

Delineate: If all of the above are impractical, delineate the object in accordance with the MUTCD.

Road Easements

Most rural road right-of-way is what is called an easement. An easement is a right to use the land in a certain way, and when the easement is no longer needed, it can be vacated and the land would revert back to the adjacent owner. The road easement allows the agency to do almost anything that is necessary to construct and maintain a road for public travel. State law (KSA 68-545)

prohibits any work on the right-of-way without written permission from the road agency. Unfortunately, not all landowners are aware of the law and may damage the road or construct an obstruction or traffic hazard. The road agency may need to take action to correct the situation or remove the obstruction.

Work By Others on the Right-of-Way

State law requires that all work on the right-of-way by private individuals must be approved in writing by the road agency (KSA 68-545). It is not unusual for property owners to work in the right-of-way without permission. This work might include installing a culvert, landscaping, blading the road, digging a deeper ditch, etc. If private work is observed on the right-of-way notify supervision.

Public Utilities in the Right-of-way

Utility Issues: In Kansas the road agencies have the responsibility to maintain the public roads within their boundaries. To provide modern conveniences to our citizens, it is necessary that public utilities be allowed to use the same right-of-way originally acquired by the counties. However, the primary purpose of road right-of-way is for public travel. The road agency controls the right-of-way and has some responsibility to see that utilities are installed in a way that minimize traffic safety issues and do not unnecessarily hinder travel on the right-of-way. In addition, the road agency owns and maintains the road improvements such as gravel surfacing, pavement, curb, drainage structures and sidewalks. It is important that damage to these facilities is minimized, and when they are damaged, that they are repaired properly to obtain the maximum service life and minimize public expense. State law provides that cities and counties may establish rules and regulations governing the use of public right-of-way as long as the rules are competitively neutral and are not unreasonable or discriminatory. Many road agencies have a permit system that authorizes utilities to be placed in the right-of-way in accordance with plans furnished by the utility and construction requirements specified by the road agency. If a permit system is not in place, seek assistance from your county counselor and authorization from the county commission to establish one.

Authority to Use Public Road Right-of-Way for Utilities. In Kansas the authority to place public utilities in road right-of-way has been established by a series of Kansas Supreme Court decisions. These court cases generally allow the use of road right-of-way by public utilities, provided that it does not "seriously impede or endanger public travel or unnecessarily interfere with the reasonable use of the highway by other members of the public and there is no invasion of the rights of the owners of abutting lands." There are specific statutory provisions for electric cooperatives, sewerage corporations, telegraph and telecommunications companies, broadband, and wind power. Private lines running along the road are not authorized by state law, but crossings are allowed.

Removing Landowner Obstructions

Landowners may not build, store, or grow anything in the right-of-way that creates a traffic hazard or leads to road deterioration. Storing hay bales, vehicles, heavy equipment, or other property in the right-of-way creates an obstruction to wide farm equipment and a hazard to a vehicle that accidentally leaves the roadway. Entrance-culvert headwalls, masonry mailboxes, retaining walls and large trees are obvious hazards for vehicles that leave the roadway. Utilities and mailboxes are necessarily located on right-of-way but their location or design should minimize the hazard to motorists. State law (KSA 68-115) requires the road agency to remove obstructions, but landowners many times do not see their work as being a serious safety issue. Following are some tips related to removal of obstructions.

- Address violations in progress. If a fence, sign, masonry mailbox, or other structure being installed in the right-of-way is observed, seek out the landowner to explain the restrictions and halt construction.
- Do not grant permission. The road agency should not give permission to install an item that is an unnecessary traffic hazard.
- Communicate. When observing vehicles, equipment, hay bales, construction materials, or any other obstruction in the right-of-way, it is appropriate to call the landowner and follow up with a notice to remove their property from the ROW. It may be a good idea to have an attorney draft a template for the letter to cover the appropriate statutes, including penalties for violations.
- Ask first. Anything of value belongs to landowners, so notify them before removing items of value such as mailboxes, ornamental rock, trees or shrubs, which they might want to transplant or salvage.
- Be consistent. If you have a policy, then follow it. For instance, if you mow one pass or spray 10 feet from the shoulder, do not skip crops, as it sends the message that farming the right-of-way is acceptable. If you change or implement a policy, notify the public to minimize misunderstandings.

Figure 1: Hay bales in right-of-way obstruct wide farm equipment and can be a safety issue to errant vehicles.

Tree Removal: Rural roads typically are a road easement, so trees on the right-of-way belong to the adjacent owner. The agency has authority to remove obstructions, and tree limbs and most trees could be considered an obstruction. Generally, agencies can remove, when needed for road purposes, trees where the trunks are entirely on road right-of-way. Consult with the land owner prior to removing trees with landscape or wood value, as the land owner may want to salvage the wood. A good road-related reason is needed to remove trees with value, and if the decision is arbitrary, the agency can be sued for damages. Agencies cannot remove or kill trees that are on the right-of-way line without permission from the land owner, except within 350 feet of a corner. KSA 19-2612 authorizes the board of county commissioners to cut all hedge fences, trees and shrubs growing upon the highway right of way or on right of way boundary, within three hundred fifty (350) feet of a railroad grade crossing or abrupt corner in the highway, and thereafter keep the same trimmed to provide clear vision.

Trimming Trees: Trees, brush, and overhanging limbs can obstruct maintenance and travel on the road and are sometimes a traffic safety hazard or sight distance restriction. Trees can be trimmed back to the right-of-way line. Trimming past the right-of-way line is trespassing and could subject the agency to liability for damages. This is especially important for evergreen trees that when trimmed do not grow back.

Figure 2. Know the location of the right-of-way line when trimming trees.

Mailboxes: Mailboxes are private property, and they are usually located within the right-of-way near the road. Mailboxes can be a hazard to traffic, and large solid mailboxes should be discouraged. A few agencies have regulations prohibiting ornamental and solid mailboxes. Theoretically landowners need permission from the road agency to install a mailbox (KSA 68-545), however, mailbox installation is relatively random and hard to control. Certainly, mailboxes that are a hazard can be removed by the road agency, but this action may have political consequences. Sometimes mailboxes are damaged by agency equipment, with most of those incidents occurring during snow removal. Most agencies will not repair mailboxes that are a traffic hazard, as public money should not be used to repair hazards. Agencies typically replace damaged mailboxes with standard crashworthy mailboxes or allow the owner to repair the mailbox at his or her own expense.

Figure 3: Ornamental mailboxes are a hazard that should not be repaired with public funds.

Figure 4: Crashworthy plastic mailbox that fits over a 4" wood post.

Source: homedepot.com

Entrance culvert headwalls: Landowners sometimes install concrete or stone headwalls on entrance culverts without permission from the road agency. Like monument mailboxes these headwalls are a hazard to vehicles that leave the road. If this entrance culvert is replaced, the headwall should not be replaced but just slope the end of the entrance culvert to match the slope of the embankment.

Figure 5: When an entrance culvert like this one needs to be replaced, the new culvert should have sloped ends.

SECTION 3
TRAFFIC CONTROL DEVICES (SIGNS)

General Sign Requirements and Placement

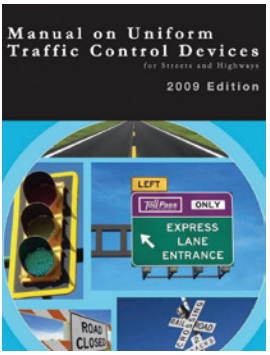
Traffic control devices are all signs, markings, and devices placed on or along a road to assist the driver in traveling the road in a safe and efficient manner. This field guide provides limited information on signing. The intent of this guide is to provide field personnel sufficient information to properly repair and replace existing signing, and recognize locations where additional signs may be warranted. If it seems like additional signing may be needed it will be necessary to refer to additional information in the MUTCD or LVR Guide described in the next section.

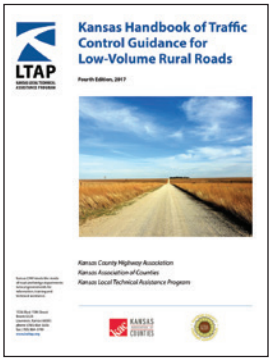
MUTCD & LVR Guide

MUTCD: The Kansas Secretary of Transportation has adopted the Manual on Uniform Traffic Control Devices (MUTCD) (2009 Edition) as the standard for public roads in Kansas including city, county and township roads (KSA 8-2003). The MUTCD is a national standard developed by the Federal Highway Administration (FHWA), and contains over 700 pages. The MUTCD covers almost all situations that might be encountered on freeways, expressways, city streets, rural roads and bike trails. The MUTCD is available online at mutcd.fhwa.dot.gov.

LVR Guide: The Kansas Handbook of Traffic Control Guidance for Low-Volume Rural Roads, Fourth Edition, 2017 (aka LVR Guide), is just for rural roads with less than 400 vehicles per day. The LVR Guide covers situations that are unique to low volume roads, so it is smaller and easier to use than the MUTCD. The intent of the LVR Guide is to meet the standards in the MUTCD; it is not a separate standard. The LVR Guide is available at https://kutc.ku.edu/sites/kutc.ku.edu/files/docs/ltap-news/LVR%20guide%202017_interactive.pdf.

Figure 6: MUTCD and LVR Guide





Division of Responsibilities for Signing

Outside of cities, KDOT is responsible for the STOP signs on side roads approaching State highways, as well as STOP AHEAD signs installed by KDOT. The county is responsible for installing and maintaining traffic control signs on county roads. In counties where townships maintain roads, KSA 8-2005 makes the county responsible for signs related to county culverts and county bridges, and construction signage related to county projects on township roads. Counties may maintain street name signs on township roads. Townships are responsible for all other signing. All regulatory signs on township roads must be authorized by a resolution of the county commission.

Sign Classifications

Functionally, signs are classified as Regulatory, Warning and Guide.

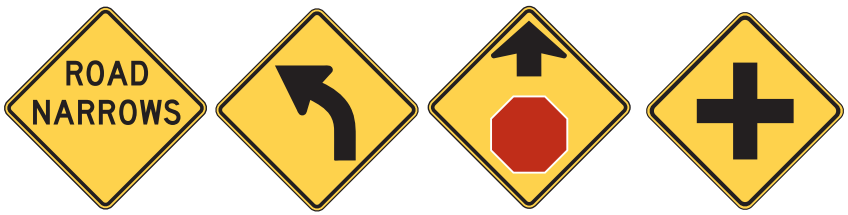
Regulatory signs give notice of traffic laws or regulations, and normally require a resolution to be legally enforceable. Regulatory signs are colored white, red, or black.

Figure 7: Regulatory signs

R5-1 R1-2 R1-1 R2-1

Warning signs give notice of unexpected conditions on or adjacent to the roadway, and to situations that might not be readily apparent to road users. Warning signs alert road users to conditions that could require a reduction of speed or an action in the interest of safety and efficient traffic operations. Traffic citations cannot be issued because of non-compliance with a warning sign. Warning signs are yellow, except work zone warning signs are orange.

Figure 8: Warning signs



W5-1 W1-2 W3-1a W2-1

Guide signs show route designations, destinations, directions, distances, services for travelers, points of interest, and other geographical, recreational, or cultural information. (Guide signs are not usually placed on low-volume roads and are not discussed in this field guide.)

Requirements of Traffic Control Devices

The MUTCD provides basic principles and guidelines that govern the design and usage of traffic control devices. It is important that these principles and guidelines be given consideration in the exercise of engineering judgment for the selection and use of each device. To be effective, a traffic control device should meet five basic requirements. They are:

1. Fulfill a need
2. Command attention and be easily seen
3. Convey a clear, simple message
4. Command respect
5. Give adequate time for proper response

Placement of a traffic control device should assure that:

- It can be easily seen by a driver, so it will command attention and will also provide an adequate time for driver response both day and night.
- It is properly positioned with respect to the location, object or situation to which it applies to aid in conveying the proper meaning.
- It is placed in a uniform and consistent manner.
- It is needed. Unnecessary devices should be removed.

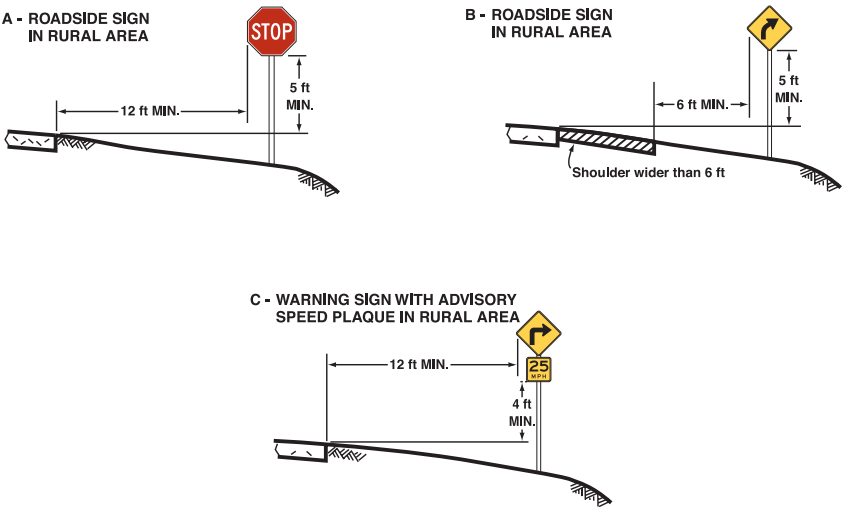
Sign Placement

Signs should be located on the right side of the roadway where they are easily recognized and understood by road users. Normally, signs on the left side of the road should be considered only as supplementary to signs on the right side of the road. Signs should be individually installed on separate posts or mountings except where:

- Plaques supplement the warning sign
- One sign supplements another
- Route or directional signs are grouped to clarify information for motorists,
- Regulatory signs that do not conflict with each other are grouped, such as street name signs posted with a stop or yield sign, or a parking regulation sign posted with a speed limit sign.

The MUTCD establishes a standard that signs installed at the side of the road in rural districts shall be at least 5 feet high, measured vertically from the bottom of the sign to the near edge of the pavement (edge of traveled way on unpaved roads). Where parking or pedestrian movements occur, the clearance to the bottom of the sign shall be at least 7 feet. The height to the bottom of a secondary sign or plaque mounted below another sign may be 1 foot less than the height specified. The MUTCD contains guidance for post-mounted signs and states that the minimum lateral offset should be 12 feet from the edge of the traveled way. To minimize the possibility of drivers colliding with signs, traffic signs should be located as far as practical from the edge of the roadway. On many roads, placing signs 12 feet from the edge of road will put the sign in a ditch or visibility will be blocked by brush or trees. In these cases, use engineering judgment to establish appropriate offset for visibility and maintenance but not less than 2 feet from the roadway edge to the roadside edge of a sign.

Figure 9: Example of height and lateral location of signs



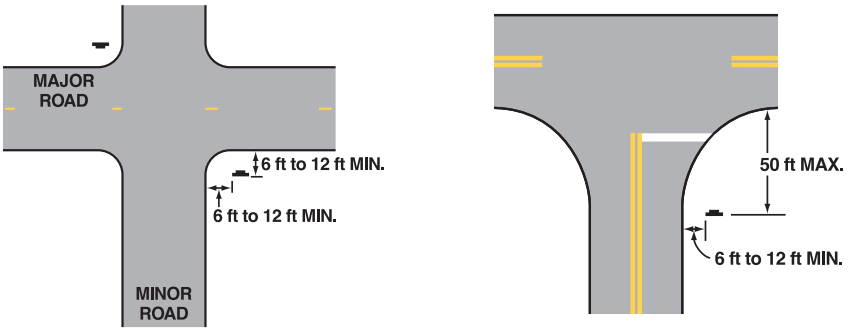
Note: Recommended lateral placement of signs is 12 ft. or greater from the traveled way; if clearance is not available the minimum is 2 ft.

Longitudinal Placement of Regulatory Signs

Regulatory signs are placed at the point of regulation. Speed limit signs are placed at the point where the speed limit changes. Weight limit signs are traditionally placed at or near a bridge, but when a weight limit sign is replaced, consider placing the new sign in advance of the bridge to allow trucks additional distance to stop before the bridge. The STOP or YIELD signs shall be located as close as practical to the intersection it regulates, while optimizing its visibility to the road user it is intended to regulate. The MUTCD shows a 6 feet to 12 feet

minimum distance from the edge of the road to the STOP or YIELD sign. The MUTCD has an option for wide throat intersections to set the sign up to 50 feet from the edge of the intersecting road.

Figure 10: Example locations of STOP and yield signs (Part of Figure 2A-3 of the MUTCD)



A - MINOR CROSSROAD

B - WIDE THROAT INTERSECTION

Note: Lateral offset is a minimum of 6 feet measured from the edge of the shoulder, or 12 feet measured from the edge of the traveled way. See text above for lower minimums that may be used where lateral offset space is limited.

Sign Location Hints

1. For better visibility, avoid placing signs on curves, over the crest of a hill, or in a dip in the road.
2. To avoid long posts, avoid placing signs in the bottom of ditches.
3. Space signs along the roadway, and don't crowd signs together. Provide 100 ft minimum spacing where possible.
4. Select locations that provide an unobstructed view of signs along the roadway.
5. Place signs behind guardrails where possible.

Longitudinal Placement of Advance Warning Signs

The purpose of a warning sign is to provide advance warning to the road user of unexpected conditions on or adjacent to the roadway that might not be readily apparent. Warning signs should provide adequate time for the driver to perceive, identify, decide, and perform any necessary maneuver. The advance placement distances shown in Table 1 below are for guidance purposes and should be applied with engineering judgment. They are normally considered minimum but can be adjusted for roadway features, other signing and to improve visibility. Miscellaneous warning signs that advise drivers of potential hazards not related

to a specific location may be installed in the most appropriate locations. These include DEER CROSSING and SOFT SHOULDER signs.

Sign Post

Table 1: Guidelines for advance placement of warning signs (Part of Table 2C-4 of the MUTCD)

Posted or 85th Percentile Speed	Advance Placement Distance[1]				
	Deceleration to the listed advisory speed (mph) for the condition[3]				
	0[2] (Stop)	10	20	30	40
30 mph	100 ft.	N/A[4]	N/A[4]	---	---
35 mph	100 ft.	N/A[4]	N/A[4]	N/A[4]	---
40 mph	125 ft.	100 ft.	100 ft.	N/A[4]	---
45 mph	175 ft.	125 ft.	100 ft.	100 ft.	N/A[4]
50 mph	250 ft.	200 ft.	175 ft.	125 ft.	100 ft.
55 mph	325 ft.	275 ft.	225 ft.	200 ft.	100 ft.

Notes:

1. *The distances have been adjusted for a sign legibility distance of 250 feet, which is appropriate for an alignment warning symbol sign and signs with 6 inch letters.*
2. *A typical condition is the warning of a potential stop situation. Typical signs are RR Grade Crossing (W10-1), STOP AHEAD (W3-1), YIELD AHEAD (W3-2), and Intersection Warning signs. The minimum advance placement distance is listed as 100 feet to provide adequate spacing between signs.*
3. *Typical conditions are locations where the road user must decrease speed to maneuver through the warned condition. Typical signs are TURN, CURVE, REVERSE TURN, or REVERSE CURVE.*
4. *No suggested distances are provided for these speeds, as the placement location is dependent on site conditions and other signing to provide an adequate advance warning, advance warning signs on low-volume roads are rarely needed in these situations.*

The MUTCD states that post-mounted sign supports shall be yielding, or breakaway (crashworthy). There are 4 types of crashworthy posts currently in use:

a. "U" channel: 3 lb. max, direct bury or spliced

b. Round pipe: 2 inches inside diameter maximum

c. Square perforated steel: 2.25 inches maximum

d. Wood: 4x4 inches maximum, undrilled

Do not splice sign posts except near the ground line. The top of a splice or anchor section should be 4 inches or less above the ground line to prevent snagging if hit. Square perforated steel posts should have the top of the anchor section a maximum of 1.5 inches above ground line.

Sign Maintenance

Maintenance of traffic control devices should assure that legibility is retained for good visibility both day and night. Adequate retroreflectivity of a sign is necessary for good visibility at night. Maintenance includes removing weeds, brush, etc., that obstruct the driver's view of the device. Signs should be removed when they are no longer needed.

Curves and Turns

Horizontal Alignment signs may be used where engineering judgment indicates a need to inform the road user of a change in the horizontal alignment of the roadway (curves). For signing purposes, turns are just tighter curves that typically should be driven at 30 mph or less. Installation of horizontal alignment signs on low-volume roads is not a requirement of the MUTCD, but an option based on site-specific conditions. A CURVE sign (W1-2) may be used in advance of curves that may safely be driven in excess of 30 mph. If an advisory speed plaque is mounted below the curve sign, the advisory speed will be 35 mph or greater. A TURN sign (W1-1) shall be used instead of a curve sign in advance of curves that have advisory speeds of 30 mph or less. A REVERSE TURN sign (W1-3) is intended for use to mark two turns or a curve and a turn in opposite directions that are separated by a tangent of 600 feet or less. A REVERSE CURVE sign (W1-4) is intended for use to mark two curves in opposite directions that are separated by a tangent of 600 feet or less. A WINDING ROAD sign (W1-5) is intended for use where there are three or more turns or curves each separated by tangent distances of 600 feet or less.

Figure 11: Horizontal alignment warning signs

W1-1
Turn

W1-2
Curve

W1-3
Reverse Turn

W1-4
Reverse Curve

W1-5
Winding Road

Advisory Speed Plaque

An Advisory Speed Plaque (W13-1P) may be mounted below a warning sign when the condition requires a reduced speed. It may be used in conjunction with any standard yellow warning sign to indicate the maximum recommended speed around a curve or through a location where a lower speed would be appropriate. On major roads the Advisory Speed Plaque should be considered for use when the difference between the speed limit and the advisory speed is 10 mph or greater. It shall not be used alone. The 2009 MUTCD states the advisory speed is to be determined by an engineering study. Many advisory speed plaques were installed prior to the engineering study requirement. If an agency has reason to believe the existing advisory speed is inappropriate, an engineering study should be performed.

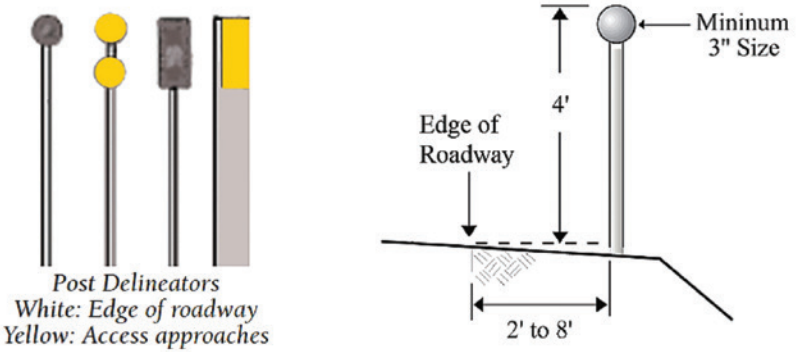
Figure 12: Advisory speed plaque under a warning sign

W13-1P

Delineators

Delineators may be used on low-volume roads based on engineering judgment, such as for curves, T-intersections, and abrupt changes in the roadway width. They may also be used to mark the location of driveways or other minor roads entering the low-volume road. There is no requirement or recommendation to use delineators on low-volume roads. The use of post-mounted delineators on curves is acceptable, but they need to be spaced closer than chevrons. Due to visibility and spacing considerations, many agencies prefer to use chevrons rather than delineators if curve delineation is thought appropriate. Delineators are sometimes installed on bridge-approach guardrail to provide delineation. See Chapter 3F of the MUTCD if more information is needed on delineators.

Figure 13: Delineators and delineator placement



Chevrons

A Chevron Alignment sign is intended to provide additional emphasis and guidance for a change in horizontal alignment. It may be used as an alternate or supplement to standard delineators. Chevron Alignment signs shall be installed on the outside of a turn or curve in line with and at approximately a right angle to approaching traffic. The approximate spacing of Chevron Alignment signs on the turn or curve should be as shown in Table 2.

Figure 14: Chevron location and height

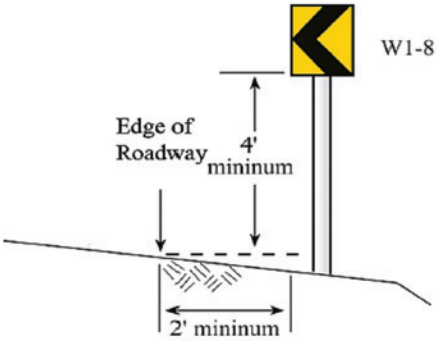


Table 2: Typical Chevron Spacing (Table 2C-6 of the MUTCD)

Advisory Speed	Curve Radius	Sign Spacing
15 mph or less	Less than 200 feet	40 feet
20 to 30 mph	200 to 400 feet	80 feet
35 to 45 mph	401 to 700 feet	120 feet
50 to 60 mph	701 to 1,250 feet	160 feet
More than 60 mph	More than 1,250 feet	200 feet

Note: The relationship between the curve radius and the advisory speed shown in this table should not be used to determine the advisory speed.

Intersections

Intersection signs may be used where engineering judgment indicates a need to inform the road user in advance of an intersection. Intersection signs should show the general configuration of the intersecting roadway, such as cross road, side road, t-intersection, y-intersection, or curvilinear alignment. Where side roads are not opposite each other, the symbol for the intersection should indicate a slight offset. The relative traffic volume of the intersecting roadways may be shown by different widths of lines on the symbol.

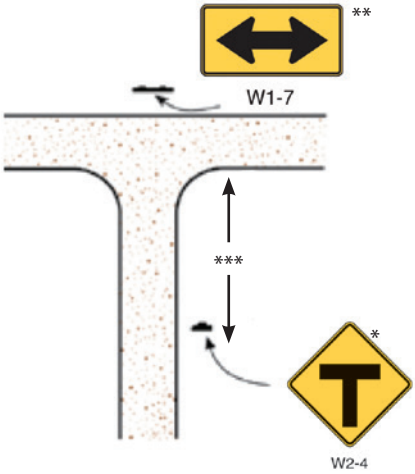
Intersection Sight Triangle

The driver of a vehicle approaching an intersection needs a view of vehicles approaching the intersection from the intersecting roads. 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. Long sight triangles provide better safety. Many times sight distance can be improved by mowing, tree removal, flattening backslopes, and lowering hills.

T-Intersections

Figure 15 shows typical signing at a T intersection with no STOP or YIELD signs. On low volume rural roads refer to the LVR Guide for need for signs based on road type.

Figure 15: Example of location of signs at T intersections



Notes:
**See LVR Guide for need for T-SYMBOL sign on low volume rural roads.*

***A LARGE ARROW sign is an optional sign that may be used in any situation, and may be used in lieu of the T-SYMBOL sign if the LARGE ARROW sign can be seen far enough in advance to allow a stop at the intersection. See Table 3 for guidance (495 feet for 55 mph).*

****Distance in advance based from Table 1 based on stop condition. (325 feet minimum for 55 mph)*

Table 3: Stopping Sight Distance (Table 6C-2 of the MUTCD)

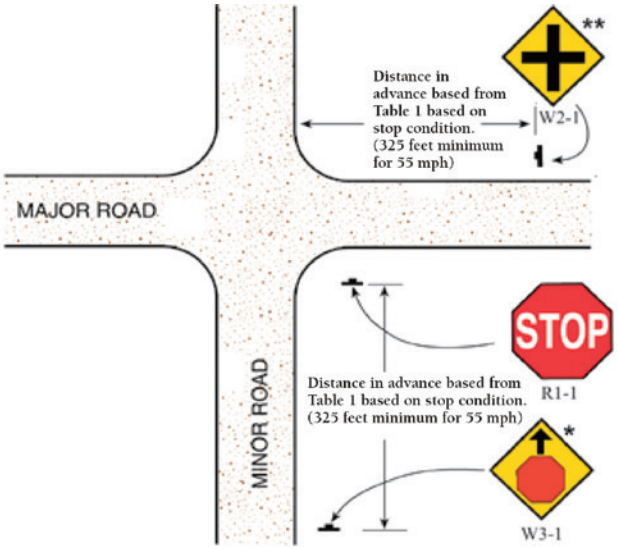
Speed*	Distance
20 mph	115 feet
25 mph	155 feet
30 mph	200 feet
35 mph	250 feet
40 mph	305 feet
45 mph	360 feet
50 mph	425 feet
55 mph	495 feet
60 mph	570 feet
65 mph	645 feet
70 mph	730 feet
75 mph	820 feet

**Posted speed, off-peak 85th percentile speed prior to work starting, or the anticipated operating speed.*

4-Way Intersections

Figure 16 shows typical signing at a 4-way intersection with STOP control on the minor road.

Figure 16: Example location of signs at 4-way intersection



4-Way Intersection

Notes:
**Install STOP/YIELD ahead sign when the STOP or YIELD sign cannot be seen an adequate distance ahead of the intersection to stop. (495 ft. minimum at 55 mph)*

***Intersection warning sign may be installed if sight distance is restricted or if large volume of entering vehicles.*

Many low volume rural road intersections are uncontrolled (no STOP or YIELD signs). Right-of-way at uncontrolled intersections is based on state law. The law states that when two vehicles approach or enter an intersection from different roads at approximately the same time, the driver of the vehicle on the left shall yield the right-of-way to the vehicle on the right (KSA 8-1526). If the sight triangle is restricted, it may be appropriate to install YIELD or STOP signs. The decision to install regulatory signs is normally based on an engineering study, then followed with a resolution by the county commission or city council. Since these kind of decisions are made by management, field personnel should report sight distance issues and citizen concerns to supervision.

Railroad Crossings

Crashes involving railroads are severe and often result in fatalities. Traffic control devices at a grade crossing include the crossbuck assembly, advance warning signs, and pavement markings on paved roads. Additionally, on some roads, there are flashing light signals and gates. The crossbuck assembly, flashing lights and gates are the responsibility of the railroad. Advance warning signs as well as pavement markings on paved roads are the responsibility of the agency that maintains the road. This guide covers the most common crossing situations; for a more detailed discussion refer to the LVR Guide and Chapter 8 of the MUTCD.

Crossbuck Assembly

The railroad is responsible for installing and maintaining the crossbuck assembly, which includes the crossbuck, number of tracks plaque (if more than one track), and a 2 inch white reflective strip on the back of each crossbuck blade. Additionally, at passive grade crossings, a STOP or YIELD sign plus a 2 inch white reflective strip on each side of the crossbuck post is required (the strip in front of the post may be red in color). State law (KS.A. 66-2,121) requires the railroad to place and maintain a crossbuck assembly on the right side of the roadway at each approach to a grade crossing. Missing or damaged crossbucks and signals should be reported to the railroad using the emergency notification phone number posted at the crossing.

Pavement Markings

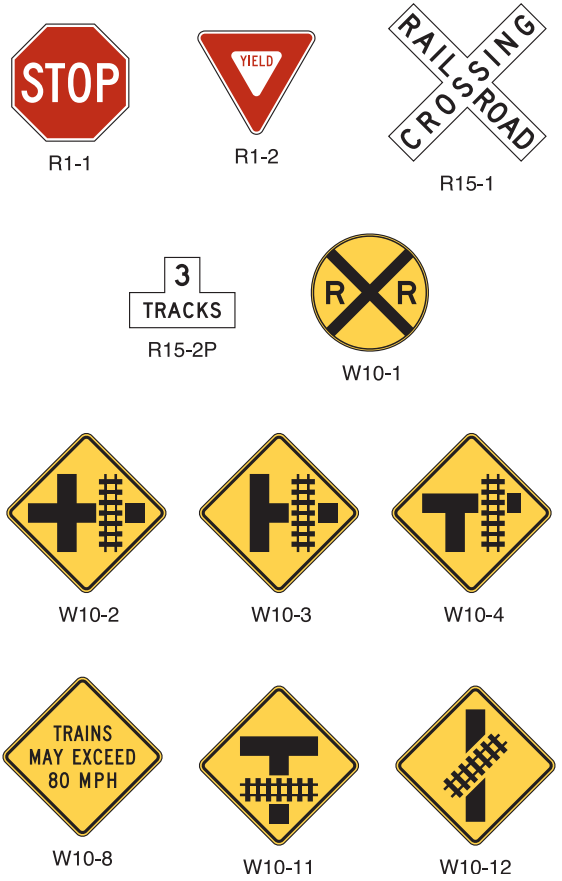
On paved roads, the pavement markings in advance of the grade crossing consist of an X, the letters RR, certain transverse lines, and centerline no-passing lines if the centerline is marked. Also, stop bars are required at active signals. Pavement markings are required in rural areas where the speed limit is more than 40 MPH, except on low volume rural roads. Guidance on which grade crossings on low-volume rural paved roads should have pavement markings is in Section 5F.05 of the MUTCD:

"Guidance:
01 Pavement markings at highway-rail grade crossings should be used on paved low-volume roads, particularly if they are already deployed at most other highway-rail grade crossings within the immediate vicinity, or when the roadway has center line markings."

Railroad Advance Warning Signs (W10 Series)

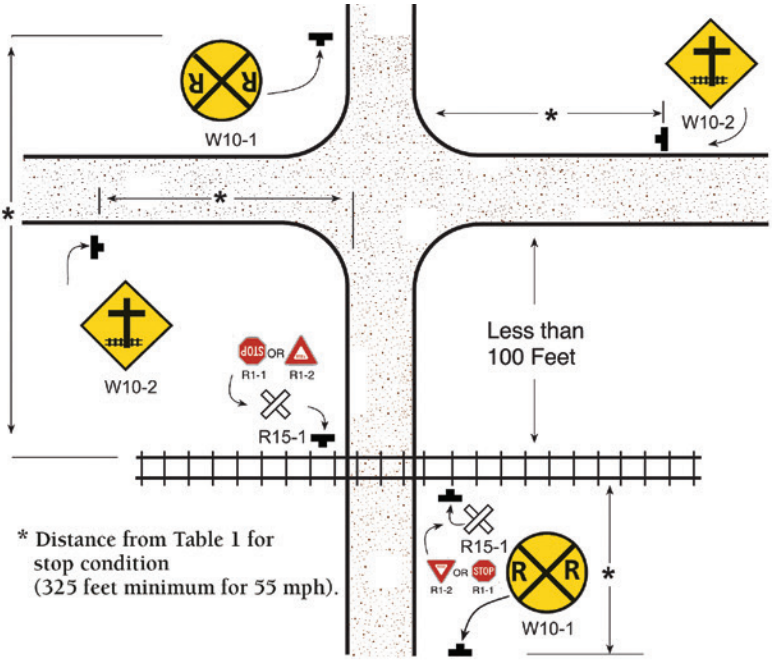
The MUTCD requires advance warning signs at all grade crossings. The round W10-1 railroad advance warning sign is required on the approach to a grade crossing. The advance placement of the W10-1 sign shall be located in accordance with Table 1 for a stop condition.

Figure 17: Highway-rail crossing signs and plaques (Figure 5F-1 of the MUTCD)

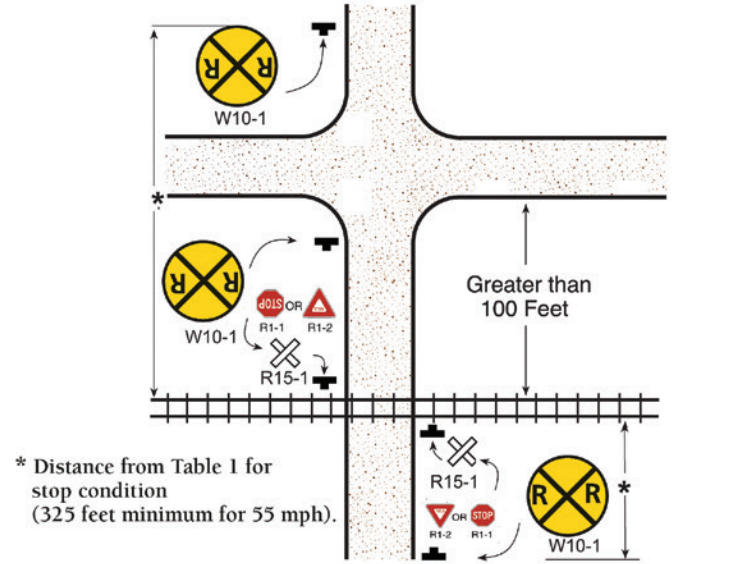


On a road parallel with the railroad, if the distance between the tracks and the parallel road is less than 100 feet, the W10-2, W10-3, or W10-4 signs shall be installed on each approach of the parallel road. When the W10-2, W10-3, or W10-4 signs are installed on the parallel road, the W10-1 sign is not required between the tracks and the parallel road. On low volume parallel roads the W10-2, W10-3, or W10-4 signs are optional.

Figure 18: Typical railroad crossing signing



Sign placement when parallel road is under 100 feet from unsignalized crossing.



Sign placement when parallel road is over 100 feet from unsignalized crossing.

Object Markers

Types of Object Markers

The purpose of object markers is to mark obstructions located within or adjacent to the roadway, such as bridge abutments, drainage structures, and other physical objects.

Type 2 Object Markers (OM2) are used to mark obstructions adjacent to the roadway. The most commonly used option is the 6" x 12" yellow sheeting.

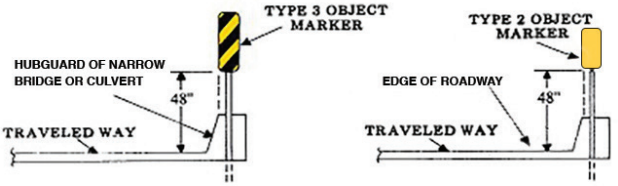
Type 3 Object Markers (OM3) are used to mark obstructions in or adjacent to the roadway. The OM3 is a 12" x 36" black and yellow striped panel with the stripes sloping downward toward the side of the obstruction on which traffic is to pass.

Type 4 Object Markers (OM4) are used to mark the end of a roadway. The most commonly used option is the 18" x 18" red sheeting.

To provide required retroreflectivity, high intensity sheeting is required on all object markers.

The edge of the OM2 or OM3 closest to the road user shall be installed in line with the closest edge of the obstruction. The typical mounting height to the bottom of the object marker should be 4 feet above the near edge of the traveled way. When the marker is placed down the foreslope, the mounting height to the bottom of the object marker should be at least 4 feet above the ground.

Figure 19: Example mounting of object markers



On low volume roads where wide farm equipment damages normal object markers there is an optional OM-2 consisting of a flexible delineator with 24" of reflective sheeting.

Figure 20: Flexible OM-2 for low volume roads with wide farm equipment

Bridges and Culverts

Bridges and culverts that are narrower than the approach roadway, and obstacles at the edge or adjacent to the roadway, may be unexpected conditions not readily apparent. The options available to advise the road user of narrow and one-lane structures as well as roadside obstacles include:

1. Object markers
2. Advance warning signs
3. Tapering to provide positive guidance, and
4. Delineators.

Bridges and culverts as wide or wider than the approach travel lanes are just marked with object markers.

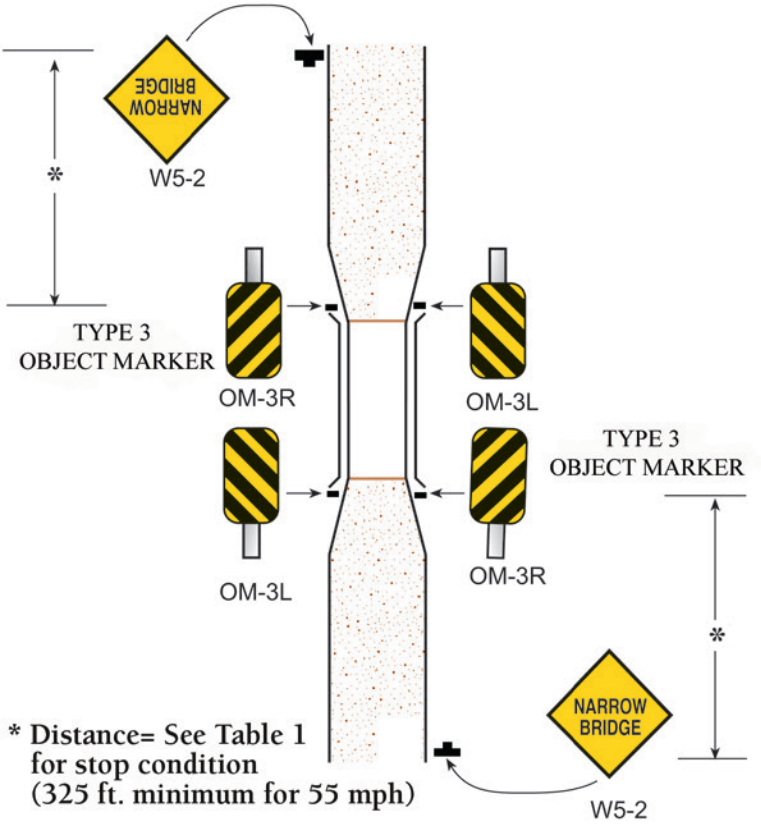
Narrow Bridge

The standard signing for narrow bridges on roads with greater than 400 average daily traffic (ADT) is show on Figure 21.

1. The narrow bridge (W5-2) sign should be placed in advance of any bridge or culvert having a width narrower than the approach travel lanes (usually 24 feet) and greater than 18 feet. If the width is less than 18 feet wide a one lane bridge (W5-3) sign should be used instead of the narrow bridge sign. On low-volume rural roads the narrow bridge sign and one lane bridge sign are normally installed only where there is limited approach sight distance. (See the LVR Guide for more details.)

2. Type 3 object markers (OM-3) should be set at the four corners of the bridges with a width less than approach travel lanes. Type 2 object markers (OM-2) are used if the bridge width is wider than the approach travel lanes.
3. If approach guardrail is present, the end of the guardrail is marked by an OM-3 or OM-2 depending on the location of the end shoe.
4. Delineators may be used on the approach to provide better guidance.
5. Approaches to the structure on unpaved roads could be tapered.

Figure 21: Typical narrow bridge signing



Notes:

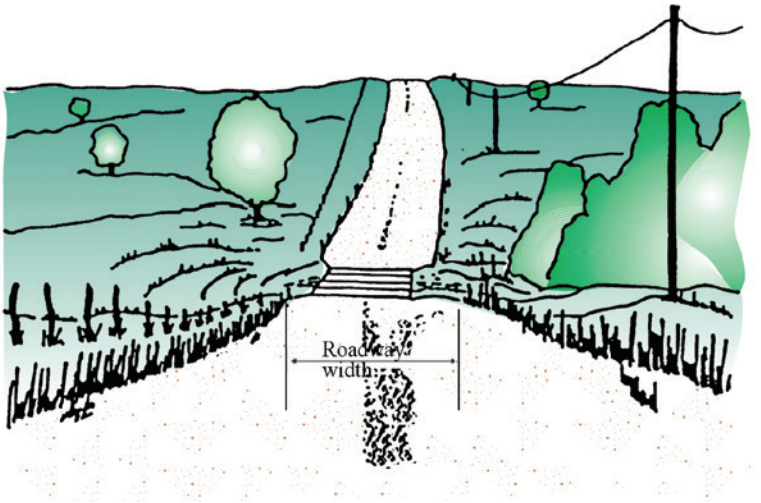
1. *For widths less than 18 feet use One Lane Bridge signs.*
2. *On low-volume roads advance warning signs are normally installed only where there is limited approach sight distance.*
3. *On low volume roads with wide farm equipment object markers can be lowered or staggered as described in the LVR Guide.*
4. *On low-volume roads if the approach is tapered OM-2s can be used in lieu of OM-3s.*

Tapering

Positive guidance is the concept that there is a safety benefit when drivers are given sufficient information where they need it and in a form they can best use it to avoid an obstacle. Positive guidance can be given to the driver through combinations of signs, object markers, advisory speed signs, and probably most important of all, the view of the road ahead. Studies have shown the edge of the roadway ahead is among the most important guidance information the driver uses. Using the edge of the roadway in this manner provides an easy and effective way of providing positive guidance at narrow bridges and culverts.

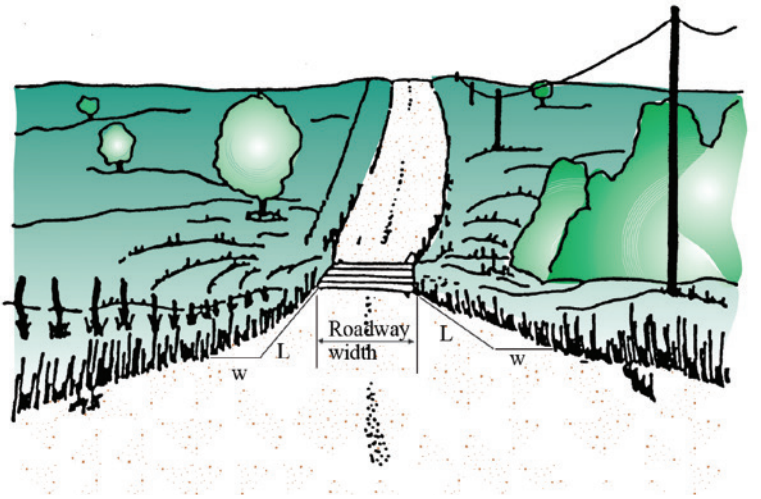
"Tapering" is a simple technique in which the traveled way (the maintained part of the road) is gradually narrowed (tapered) some distance ahead of, say, a narrow culvert. If tapering is not used, drivers may not see the end of the short culvert and if they continue to follow the edge of roadway they may drop a wheel off the end of the culvert. This is illustrated in Figure 22A. If tapering is used, drivers simply follow, as usual, the edge of roadway and thus are guided away from the roadside obstacle (See Figure 22B).

Figure 22A: Before tapering road



Note: Roadway wider than structure (e.g. culvert or bridge) with Edges leading into culvert headwall, bridge railing or ditch.

Figure 22B: After tapering road



Note: Tapered Section – Roadway width is gradually reduced to width of structure with edges leading away from ditch or culvert ends.

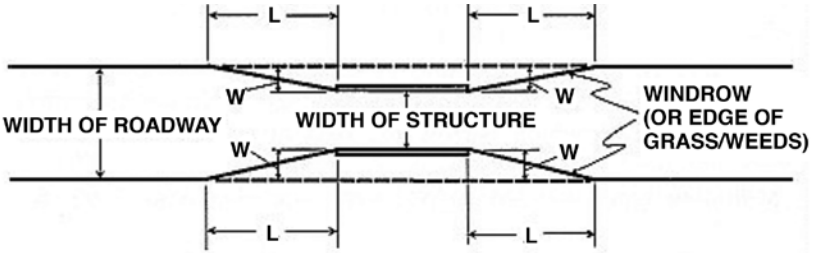
Tapering Technique

A tapered roadway edge may be used to guide the driver away from hazardous obstacles ahead, such as bridge abutments, edge drop-offs, culverts or other objects that narrow the roadway. The grader operator forms the taper by gradually narrowing the roadway. Minimum recommended taper lengths are shown in Table 4, with a graphic depiction of L and W in Figure 23.

Table 4: Minimum Taper Length for Narrow Structures, L (feet)

Offset W (feet)	Speed Limit or Prevailing Speed		
	Less than 30 mph	30-40 mph	Over 40 mph
2	30'	50'	100'
3	45'	75'	150'
4	60'	100'	200'
5	75'	125'	250'
6	90'	150'	300'

Figure 23:Taper details for narrow structures



Object markers should be used at the narrow structure. If a taper is constructed, an OM-2 can be used in lieu of an OM-3.

Temporary Traffic Control

General Guidance

The MUTCD provides guidance for the use of traffic control devices at construction and maintenance zones. The current term for these devices is, "Temporary Traffic Control," abbreviated in this section as "TTC." This section of the handbook is very abbreviated; more detailed information is available in Chapter 10 of the LVR Guide and Chapter 5G and Part 6 of the MUTCD. Traffic control in temporary traffic control zones should be designed on the assumption that road users will only reduce their speeds if they clearly perceive a need to do so, and then only in small increments of speed. Temporary traffic control zones should not present a surprise to the road user. Frequent and/ or abrupt changes in geometrics and other features should be avoided. Transitions should be well delineated and long enough to accommodate driving conditions at the speeds vehicles are realistically expected to travel.

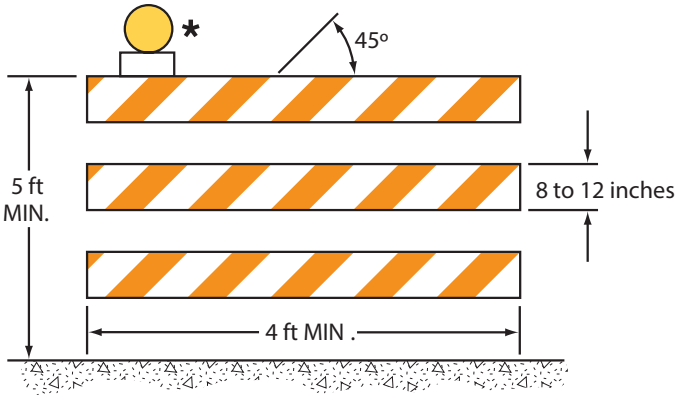
High-Visibility Safety Apparel

The MUTCD requires that all workers within the right-of-way, including emergency responders, wear high visibility apparel. The apparel requirement is ANSI/ISEA Class 2 for daytime and Class 3 for nighttime. This requirement applies to flaggers as well as other workers when outside their equipment or vehicle.

Type 3 Barricade

Type 3 Barricades should be used to close or partially close a road. When used at a road closure, they may be placed completely across a roadway. When a highway is legally closed but access must still be allowed for local road users, barricades usually are not extended completely across the roadway; they are staggered. Where barricades extend entirely across a roadway, the stripes should slope downward in the direction toward which road users must turn to detour.

Figure 24: Type 3 barricade (Source: MUTCD Figure 6F-7)



TYPE 3 BARRICADE

*Warning lights (optional)

Temporary Traffic Control Signs

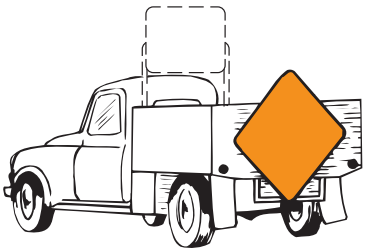
TTC warning signs are orange and black with high intensity sheeting.

Figure 25: Temporary traffic control signs and plaques (Source: MUTCD Figure 5G-1)

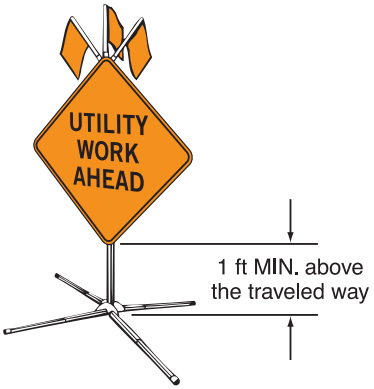
Mounting of Temporary Traffic Control Signs

Temporary traffic control signs that will be in place for long periods of time are usually mounted on crashworthy posts or a barricade. For signs that will be in place for a short period of time they may be mounted on a barricade, tripod, sign stand or on the back of a truck. The bottom of signs on barricades and stands should be a minimum of 1 foot above the road surface.

Figure 26: Method of mounting signs other than on posts (Source: MUTCD Figure 6F-2)



PORTABLE AND TEMPORARY MOUNTINGS



Typical Applications General Items

TTC involves many variables such as type and location of the work, work duration, phasing of the work, roadway type and geometry, vertical and horizontal alignment, intersections, interchanges, traffic volumes, vehicle mix, and traffic speeds. The MUTCD has many Typical Applications (TA) for various scenarios. The TA may need to be adjusted to fit field conditions. This field guide addresses just a few typical applications that cover most common situations encountered on low-volume rural roads. The LVR Guide and Part 6 of the MUTCD have more extensive illustrations of typical applications that should be consulted if the typical applications in this field guide are not applicable.

Position of Advance Warning Signs in Work Zones

Table 6H-3 of the MUTCD provides distances for the advance placement of warning signs shown in typical applications. For rural roads the advance placement distance and the distance between advance warning signs (A, B & C) is 500 ft. On low-volume roadways with speeds of 30 miles per hour or less, the MUTCD's Section 5G.02 allows 100 feet advance placement distance and 100 feet between advance warning signs.

Typical Application - Gravel Road Maintenance (Dragging)

This application is typical maintenance (dragging of unpaved roads). A motor grader shall be equipped with a slow moving vehicle emblem, flashing lights,

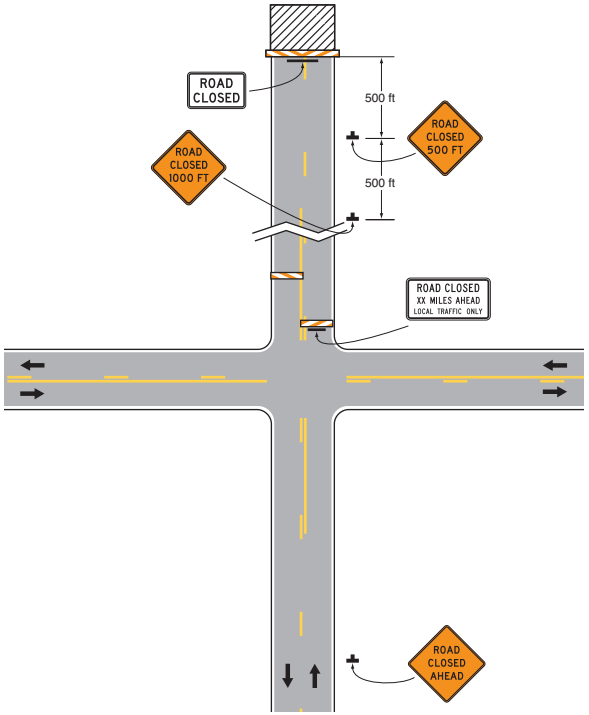
and a beacon. Flags at the ends of the moldboard are optional. Windrows should begin where they can be seen from a distance. Large windrows should not extend across intersections. Consider optional ROAD WORK AHEAD signs on main roads with poor visibility of the grader.

Typical Application - Road Closure

This application is a typical road closure of a mile of road.

1. Wing barricades with ROAD CLOSED TO THRU TRAFFIC are set near the intersection on the mile that is closed.
2. For main roads install a ROAD CLOSED AHEAD (or 500 FT) in advance of the wing barricade at the intersections.
3. If roadway is closed for the day or for a short-term project, the signs may be placed on temporary mountings.

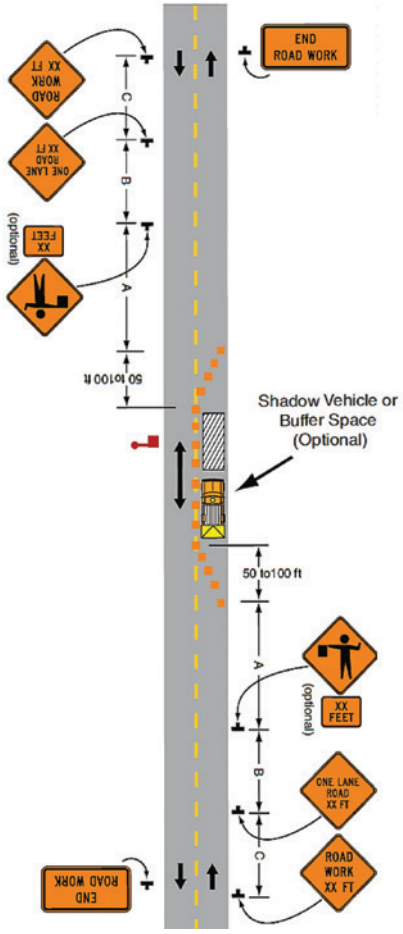
Figure 27: Road closure of a low-volume rural road



Typical Application - Lane Closure Using Flagger

1. Two flaggers are typically required for this application. A single flagger may be used for low-volume situations with short work zones on straight roadways where the flagger is positioned to be visible to road users approaching from both directions.
2. The ROAD WORK AHEAD and the END ROAD WORK signs may be omitted for short-duration operations.
3. Where there are hills or curves, the buffer space should be extended so that the two-way traffic taper is placed before a horizontal or vertical curve to provide adequate sight distance for the flagger and a queue of stopped vehicles.

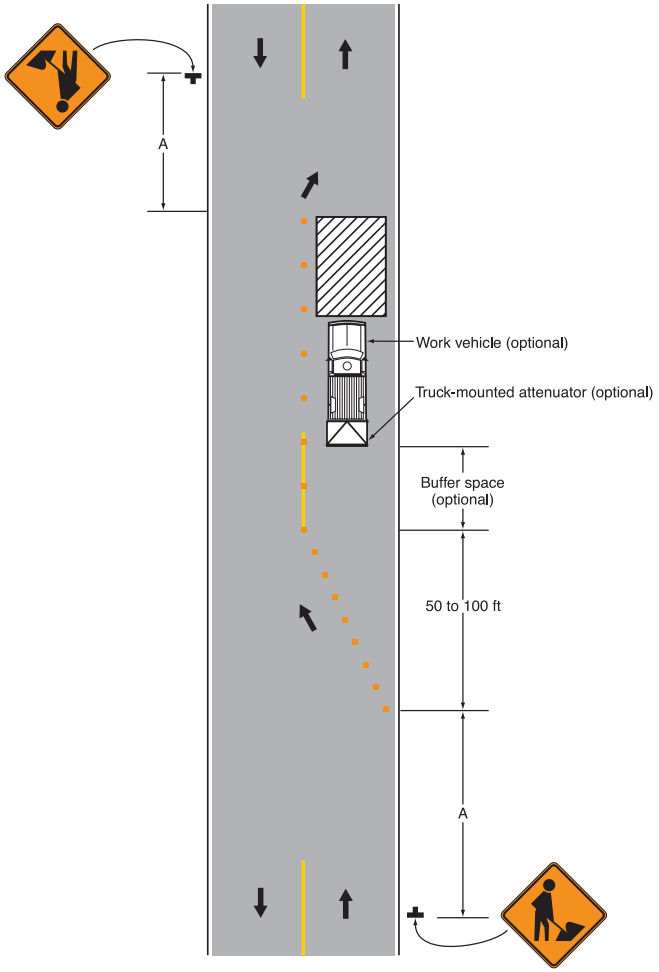
Figure 28: Lane closure using flaggers
(Source: Work Zone Safety Consortium adapted from MUTCD TA-10)



Typical Application - Lane Closure on Minor Road

1. Use this application only for low-speed, low-volume roads that are typical of gravel and dirt local roads.
2. Use this application where the work space is short and where road users can see the roadway beyond.
3. Vehicles and major equipment shall operate flashers and beacons.

Figure 29: Lane closure on dirt or minor gravel road (Adapted from TA 18 of the MUTCD)



SECTION 4
W-BEAM GUARDRAIL AND HANDRAIL

W-Beam Guardrail Repair

Guardrail along slopes and at bridge approaches is intended to protect a vehicle from hitting a more hazardous object. However, guardrail itself can cause serious damage to vehicles and injury when struck. Guardrail standards have changed many times over the years, which has resulted in many different configurations in the field. When guardrail is damaged or deteriorated it is typically repaired to bring it back to the original configuration to function as originally designed. The repair work usually consists of replacing damaged W-beam and damaged or rotten posts. If an old end shoe is damaged many agencies replace the end shoe with a buffer end shoe as shown in Figure 30, which is more visible and reduces the chance of spearing. The standard height for W-Beam guardrail is 27 inches to the top of the rail; for newer Midwest Guardrail System the height is 31 inches to the top of the rail.

Figure 30: A buffer end shoe reduces chance of spearing

W-Beam Guardrail Removal

Before there were rational warrants for guardrail the decision on where to place guardrail was rather arbitrary. Sometimes guardrail was placed where it was more of a risk than the object it was shielding, or was not cost effective. Typical locations where guardrail is counter productive is at low fills and culverts ends less than 8 feet high. In situations where existing guardrail may no longer be warranted, it is best to seek assistance from Kansas LTAP or an engineer to see if the guardrail can just be removed. Figures 31 and 32 show locations where guardrail removal may be appropriate.

Figure 31: Guardrail is just ornamental and is a spearing risk which could be removed.

Figure 32: Old guardrail is probably more of a risk than trees and could be removed.

W-Beam Guardrail Upgrade

Because guardrail warrants and standards are complicated, upgrading existing guardrail should not be considered without consulting an engineer. The engineer will determine if the guardrail is warranted, and design the slopes, rail and crashworthy end section to current standards so it will function properly.

Ornamental Handrail On Culverts

Prior to 1950 it was standard to construct ornamental handrail to delineate culvert ends. As traffic speeds increased it was found that if hit by a vehicle the ornamental handrails caused more damage and injury than if there were no handrail. Ornamental handrail on narrow culverts also restricts passage of wide farm equipment. Pipe, angle iron, and other shapes of steel handrails on culverts can spear an errant vehicle and enter the cab of a vehicle. Since steel handrails are not crashworthy and will not redirect an errant vehicle, it is almost always a safety improvement to remove the handrail and install an object marker. A study by Kansas State University in 1997 found that if the depth from road edge to the channel was less than 8 feet, removing the concrete handrail was a safety improvement. It is now a common safety practice in Kansas to remove ornamental concrete handrail on culverts and mark the culvert end with an object marker. A flexible object marker may be used if wide farm equipment may damage a standard marker. Removal of ornamental handrail on culverts is normally authorized by a supervisor.

Figure 33: Pipe handrail will not redirect an errant vehicle and is a spearing risk; it may be cut off to improve safety.

Figure 34: Ornamental concrete handrail may be removed to improve safety if the depth to the channel is less than 8 feet.

ADDITIONAL RESOURCES

Conversion factors

Length 1 sta. = 100 ft. 1 mile = 5280 ft. 1 ft. = 12 inches	Area 1 s.y. = 9 s.f. 1 acre = 43,560 s.f.
Volume 1 c.y. = 27 c.f. 1.c.f. = 7.485 gallons	Weight 1 lb. = 16 oz. 1 ton = 2000 lbs.

Waterway openings for culvert pipe

Round Pipe

Pipe Diameter In.	Nominal W.W. Area Sq. Ft.
12	0.8
15	1.2
18	1.8
24	3.1
30	4.9
36	7.1
42	9.6
48	12.5
54	15.9
60	19.6
66	23.7
72	28.3
78	33.2

Arched Pipe

KDOT Bid Designation Sq. Ft.	Nominal W.W. Area Sq. Ft.	Pipe Arch Span & Rise
1.0	1.1	17" x 13"
1.5	1.6	21" x 15"
2.0	2.2	24" x 18"
2.5	2.9	28" x 20"
3.0 or 4.0	4.5	35" x 24"
5.0 or 6.0	6.5	42" x 29"
7.0 or 8.5	8.9	49" x 33"
10.0 or 11.0	11.7	53" x 41"
10.0 or 11.0	11.6	57" x 38"
12.5 or 14.0	15.6	60" x 46"
12.5 or 14.0	14.7	64" x 43"
16.5	19.3	66" x 51"
16.5	18.1	71" x 47"
21.0	23.2	73" x 55"
21.0	21.9	77" x 52"
25.0	27.4	81" x 59"
25.0	26.0	83" x 57"
32.0	32.1	87" x 63"
36.0	37.0	95" x 67"
42.0	42.4	103" x 71"
47.0	48.0	112" x 75"

Typical Material Weights

Material	Statewide Average	Comments
Concrete	150 lbs per c.f.	In place
Hotmix	145 lbs per c.f.	Compacted
Coldmix	140 lbs per c.f.	Compacted
Aggregates		
AB-3(dry wt.)(KDOT)	140 lbs per c.f.	Compacted
AB-3(wet wt)(KDOT)	156 lbs per c.f.	Compacted
AS-1(dry wt.)(KDOT)	135 lbs per c.f.	Compacted
AS-1(wet wt.)(KDOT)	150 lbs per c.f.	Compacted
Road Rock(dry wt.)*	125 lbs per c.f.	Compacted
Road Rock(wet wt.)*	135 lbs per c.f.	Compacted
Screened rock 3/8"	96 lbs per c.f.	In stockpile
Screened rock 3/4"	100 lbs per c.f.	In stockpile
AB-3(pile-wet)	105 lbs per c.f.	In stockpile
Sand(dry)	95 lbs per c.f.	In stockpile
Sand(damp)	101 lbs per c.f.	In stockpile
Soil	110 lbs per c.f.	Compacted
Road Salt	80 lbs per c.f.	In stockpile
Liquids		
Asphalt (AC)	8.33 lbs per gal	
Asphalt cutback	7.81 lbs per gal	
Asphalt-emulsion	8.24 lbs per gal	
Water	8.435 lbs per gal	
Water	62.43 lbs per c.f.	
MGCL(summer)(30%)	10.8 lbs per gal.	
CACL (winter)(32%)	11.0 lbs per gal.	
CACL(summer)(38%)	11.5 lbs per gal.	

**Road Rock is good crusher run or screened limestone with no more than 12% passing the 200 sieve.*

SUGGESTED RESOURCES AND REFERENCES

1. National Center for Rural Road Safety: ruralsafetycenter.org

2. Federal Highway Administration, Office of Safety: safety.fhwa.dot.gov

3. FHWA: Training, Tools, Guidance and Countermeasures for Locals safety.fhwa.dot.gov/local_rural/training/

4. Gravel Roads Construction & Maintenance Guide, FHWA, August 2017. https://www.fhwa.dot.gov/construction/pubs/ots15002.pdf

5. Kansas Handbook of Traffic Control Guidance for Low Volume Rural Roads, Kansas LTAP, 2017. https://kutc.ku.edu/sites/kutc.ku.edu/files/docs/ltap-news/LVR%20guide%202017_interactive.pdf

6. Manual on Uniform Traffic Control Devices for Streets and Highways, FHWA, 2009 Edition with Revisions 1 and 2: mutcd.fhwa.dot.gov

7. Kansas Local Road Management Handbook, Kansas LTAP, 2015 https://kutc.ku.edu/sites/kutc.ku.edu/files/docs/ltap-news/LRMH-2015.pdf

8. Maintenance of Drainage Features for Safety—A Guide for Local Highway and Street Maintenance Personnel, FHWA, FHWA-SA-09-024, July 2009. https://safety.fhwa.dot.gov/local_rural/training/fhwasa09024/

9. Maintenance of Signs and Sign Supports—A Guide for Local Highway and Street Maintenance Personnel, FHWA, FHWA-SA-09-025, January 2010.3. https://safety.fhwa.dot.gov/local_rural/training/fhwasa09025/

10. A Guide for Erecting Mailboxes on Highways, AASHTO, Roadside Design Guide, 4th Edition, 2011 (Chapter 11).

11. Guidelines for Geometric Design of Very Low-Volume Local Roads, Second Edition (ADT<= 2000), AASHTO, 2019.

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LTAP
KANSAS LOCAL TECHNICAL ASSISTANCE PROGRAM

Kansas Local Technical Assistance Program

Kansas LTAP serves road and bridge and public works officials through training, information-sharing, and technology transfer activities. Kansas LTAP also provides both one-on-one problem solving and wider outreach at state, regional and national professional meetings. Services include

Newsletters. Each year four issues of the KS LTAP e-newsletter are provided without charge to city, county, state, and township highway agencies across Kansas. The newsletter covers a broad range of technical topics and policy news of interest to road and bridge officials. Updates on training and resources available to local agencies in Kansas are available by email every other week

Training. Each year Kansas LTAP holds dozens of workshops across the state. Common topics include road maintenance (asphalt, concrete, gravel), culverts and drainage, snow and ice control, work zone signing, workplace safety, roadway safety, and leadership topics. Visit our website at www.ksltap.org and click on "Training Calendar" to view a list of upcoming training opportunities

Kansas Roads Scholar Program. This program provides a curriculum of training to increase knowledge of road maintenance operations and improve technical, supervisory, and managerial/administrative skills. Kansas LTAP administers this program for the Kansas County Highway Association and the American Public Works Association's Kansas Chapter. Other partners are the Kansas Association of Counties and the Kansas DOT. All Kansas public works and road and bridge employees are welcome to participate in the program. More information is available through KS LTAP at (785) 864-2594 and at ksroadsscholar.org

Technical Resources. Online and print resource offerings are available in a searchable format on the Kansas LTAP website

On-Site Assistance. LTAP's Local Liaisons visit agencies on-site with technical assistance related to roadway safety and operations

Equipment for Loan. LTAP loans equipment for no charge for traffic studies and will analyze the data if needed. Other equipment is also for loan. Visit the KS LTAP website to learn more.

Website. Visit ksltap.org to learn more about LTAP and to access our services.