Kansas
LTAP Fact Sheet

What Should Local Governments Be Doing to Prepare for Automated Vehicles in Kansas?

By Connor Mountford and Lisa Harris-Frydman, Kansas LTAP

Vehicle automation is rapidly changing the transportation landscape. By 2021, 11 of the largest auto manufacturers plan to have some level of autonomous vehicle on the road. Automation technology has the potential to provide significant societal benefits ranging from reduced traffic fatalities to making to easier to find a parking spot. However, the pace at which this technology is evolving poses planning challenges for local governments. The purpose of this article is to provide basic information about the future use of automated vehicles in Kansas and what your audience needs to be doing (or thinking about) to prepare for them.

Automation 101

University research centers, transportation agencies, and automotive companies have been researching automation technology since the 1980s. By the early 2000s, research teams were able to build vehicles capable of completing a 60-mile urban course. Today, automation technology has gone commercial with 11 major auto manufactures planning to have some form of autonomous vehicle available by 2021.

Automated vehicle technology uses a "sense-plan-act" design that incorporates a variety of cameras and sensors that gather data on the vehicle's environment such as lane markings, vehicle behavior, and pedestrian activity. This data is then interpreted by software algorithms that plan the vehicles actions. The software converts the plans into commands in the vehicle's control system – brakes, steering, etc. This process operates on varying loops and frequencies for different functions. For example, a data loop connected to the emergency braking system would run at a much higher frequency than a loop used for navigation.

The Society of Automotive Engineers classifies automation technology into five categories ranging from no automation to fully autonomous. While advanced automation technology is being piloted by companies like Google and Tesla, most vehicles today utilize partial automation technology such as parking assistance, collision detection, or lane correction. Figure 1 shows the evolution of autonomous vehicles.

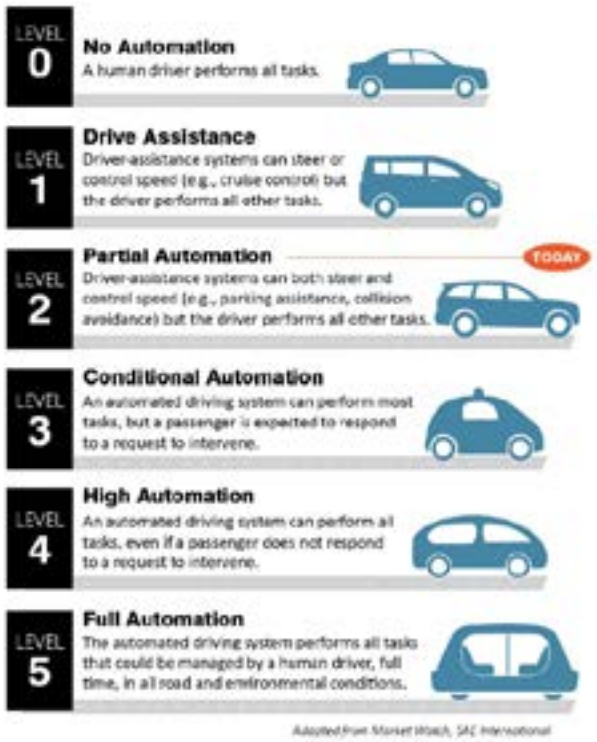

Figure 1. The Evolution of Autonomous Vehicles

Planning for automation in Kansas

Although the widespread use of highly or fully automated vehicles is years away, the right time for local governments to start planning is now. The Mid-America Regional Council (MARC), based in the Kansas City metro area, has identified seven policy areas that local governments should focus on when planning for autonomous vehicles. MARC identified questions to drive movement in each policy area and made recommendations for planning actions for local

governments. The following are the seven policy areas and the driving questions:

- **Travel Demand Management and System Performance** — How can we anticipate changes in travel demand and maximize the safety benefits that AVs promise?
- **Infrastructure, Planning and Investment** — What new infrastructure systems and standards are needed to support AV deployment? What impacts are AVs likely to have on traditional transportation funding sources and what new revenue opportunities might they create?
- **Data Management and Cybersecurity** — What new partnerships, capacities and strategies will the public and private sectors need to securely manage and share AV-related data?
- **Environment and Land Use** — How might changes in travel behavior lead to changes in development patterns? Can AV technology support compact, efficient development and reduce the negative environmental impacts of transportation?
- **Equitable Access and Mobility Services** — How can AVs be deployed to equitably serve the needs of people and communities with transportation disadvantages?
- **Economic and Workforce Opportunity** — What opportunities and risks might AVs create for regional industry clusters, our workforce and the region's economic competitiveness?
- **Certification, Liability and Insurance** — How might AVs impact these issues, particularly for area local governments?

See "Driving Change: A Policy and Planning Framework for Autonomous and Connected Vehicles in Greater Kansas City" for more information on actions local governments can take to prepare for autonomous vehicles. https://www.marc.org/Transportation/Plans-Studies/pdfs/Driving-Change-AV-White-Paper.aspx

Rural considerations

Autonomous vehicles are not new to rural areas – they have been used for years in farming operations. But those vehicles do not interact routinely with traffic on roads.

We talked with Mike Floberg, Director of KDOT's Innovative Technologies Division, about how counties and rural communities should be preparing for autonomous vehicles on their road systems.

Floberg said the strategy for using autonomous vehicles in Kansas will be stepped -- depending on the size of the jurisdiction. Connected vehicles will likely come first, he said, and these would start on the interstate system and then eventually the state and local systems. These would function like trains, reducing the space needed between a system of vehicles. These are anticipated for use on major highways and also in local areas to get goods from factories to interstates. Another application for autonomous vehicles might be automated transit buses within a community that would visit common destinations. To use automation technology, vehicles will need reliable infrastructure to delineate the roadway, and this would likely be on main roads and major freight routes.

In local areas, Floberg anticipates that an autonomous vehicle would still be "manned," and the attendant would help with loading and unloading and any trouble-shooting needed en route. It would be like flying a plane on auto-pilot. You still need the pilot.

Some places in other states are testing driverless vehicles, but they are geofenced and in very controlled environments.

Cities and counties will have the most time to prepare, Floberg said. "They should be thinking about getting main roads up to standard with pavement markings and signing," he said. Floberg would like to see KDOT and local governments cooperate more on pavement marking projects. Local agencies could contract with the same pavement marking vendor, for example, to stripe the state and local roads in the same general area and create some cost efficiencies. Floberg said Clay County approximately 5 years ago went in with KDOT on a pavement marking project.

"Cities and Counties should be thinking about getting main roads up to standard with pavement markings and signing."
- Mike Floberg

Floberg also said it will be important to keep roads and roadsides clean, and to plan for that in maintenance schedules. And to get a public information campaign together for residents about autonomous vehicles.

There have been bills in the Kansas Legislature in the past to test semi-truck automation on interstate highways, but there were challenges and didn't move forward. Policy, sensitivity and thorough understanding can cause delays. "We've got time. No need to panic," Floberg said.

A recent Federal Highway Administration (FHWA) tour for knowledge exchange in automated and connected systems specifically in local agencies. The report has not yet been released. We will let you know when they publish it. This may contain more ideas and examples to learn from as automated technology is rolled out across the country.

Another opportunity to learn more about autonomous vehicles and local governments will be to attend a seminar titled Autonomous Vehicle Transportation in Rural and Urban Settings (Seminar 4 of 4). This will be a free 2.5 hour presentation on the topic, hosted by Wichita State University. A date has not yet been set for this seminar, but you can check this website for more information (and also for presentations from previous seminars on the topic). https://www.wichita.edu/research/WSUInitiatives/technology-takes-the-wheel/PPT-Recording-Download-Page.php

Conclusion

Autonomous vehicles will eventually come to the transportation system in Kansas. Local governments have time to get ready for them. To prepare, it would be helpful to learn how the technology works and initiate conversations with your business owners and elected officials to plan ahead for investments you might need to make (and maintain) in your jurisdiction's infrastructure to facilitate their use on routes that would serve your community's needs.

ADDITIONAL RESOURCES

- The FHWA has a variety of resources on automated vehicles: https://www.transportation.gov/AV
- A detailed primer on connected and autonomous vehicles is here: https://ops.fhwa.dot.gov/publications/fhwahop17001/ch1.htm
- If you have questions about your local Kansas government's steps in preparing for autonomous vehicles, reach out to Mike Floberg at Mike.Floberg@ks.gov.

Source:
Interview with Mike Floberg on April 27, 2020.

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A New Pavement Management System for County Roads

By Nikhila Gunda, Kansas LTAP

This article mainly focuses on the results of a research study that developed an innovative and efficient pavement management system (PMS) which uses a new optimization methodology for managing local paved roads in Wyoming.

What does a pavement management system do?

A PMS is a set of tools that assists decision-makers in finding optimum strategies for providing and maintaining pavements in a serviceable condition over a given period. The main function of a PMS is to provide objective information and useful data to help managers to make more clear, cost-effective, consistent and defensible decisions for preserving and maintaining a pavement network.

Components of a PMS

There are three primary tasks performed by a PMS – data collection, analyses and feedback. Each of these tasks helps provide a basic understanding of the possible consequences of alternative options for maintenance.

Data collection. This includes an *inventory* (physical pavement features like number of lanes, length, surface type, functional classification), *history* (past project dates and types of construction, reconstruction, preventive maintenance, and rehabilitation), a *condition survey* (roughness or ride, pavement distress, rutting and surface friction), *traffic information* (volume, vehicle types, and load), *costs,* and a *database* (compilation of all data files used in the PMS).

Analyses. These create output useful for making decisions. Analyses include pavement condition analysis, priority assessment models, and optimization models.

Feedback. This process includes ongoing field observations to improve the reliability of the PMS analysis.

Pavement management systems in Kansas

Kansas has a statewide PMS managing the state highway system and it is used for optimally allocating funds. More information on the Kansas PMS can be found on the KDOT website. The 2019 KDOT Transportation Asset Management Plan (TAMP) sets out a performance-based process to manage physical assets like bridges and pavement while meeting federal requirements. Some local agencies in Kansas also have a PMS, such as the City of Burlington and the City of Eudora. There is no standard PMS for local road systems in Kansas.

Block cracking plagues county roads. Above is an example of a low distress road from Iowa's Department of Transportation.

Wyoming LTAP's new Optimization Model for managing paved county roads

In Wyoming, WYDOT's PMS is used for managing a total of 6,844 miles of state highways and interstates, while county governments manage their roads use engineering judgement, without any PMS. Most optimization models in the literature and in practice

focus on characteristics of state highways and interstate systems and don't translate well to county paved roads – because county roads have lower standards, carry lower traffic volumes and generally do not receive adequate funding for their maintenance. Drivers also have different perceptions about what looks and feels like a serviceable road on the local system vs. the state system. To address these issues, the Wyoming Technology Transfer Center (WYT^2/LTAP) developed a new optimization methodology for managing county roads (many of which were built decades ago) using data they collected in 2014. This data included roadway inventory data, pavement condition data, and roadway thicknesses.

The research investigated three main issues related to county roads management: 1) serviceability prediction, 2) the cost of measuring pavement roughness, and 3) optimizing budgets for pavement management. The following are the results of the study:

A Pavement Serviceability Index Model Developed. A ride quality survey was conducted to develop new serviceability prediction models (models that can predict the level of service a pavement provides to the users) suitable for county paved roads. Based on the perceptions of Wyoming residents, a Pavement Serviceability Index (PSI) model was developed for county paved roads that was statistically valid and better represents county road conditions when compared with the current state model.

Predicting IRI Values. Besides PSI, the International Roughness Index (IRI) is another pavement performance indicator commonly used around the world for evaluating and managing road systems. In simple terms, pavement roughness is defined as the irregularities seen on the road surface that affect user comfort and safety. Due to the limited funds available to local governments to collect pavement condition data, this study evaluated the ability of smartphones to measure IRI as part of PMS, as a cost-effective solution. Using IRI values measured from smartphones and reference IRI values measured using a standard profiler, two models were developed to predict IRI values. It was found that there was no statistically significant difference between the predicted and measured IRI.

A New Methodology for Counties. This research project also developed a new risk-based PMS methodology (risks related to minimizing life-cycle costs, increasing traffic, truck loading, and budget constraints) to identify and manage the best mix of road maintenance and preservation projects for limited available resources. This innovative methodology is tailored specifically for the county paved roads and is flexible for analyzing different scenarios, such as determining minimum budgets, developing a five-year CIP within a limited budget and maximizing benefit to the public. It was concluded that the new methodology can be implemented in all 23 Wyoming counties and can be used by other states for developing a PMS for their county paved roads.

Conclusion

The Wyoming Technology Transfer Center (WYT^2/LTAP) developed an optimization methodology tailored for county paved roads. This new model can help decision-makers allocate funding for maintenance by identifying priorities among all their jurisdiction's paved roads. The new methodology can be used to develop multi-year pavement maintenance plans that would aim for specific performance targets within maintenance policies and budget levels. Smartphone applications can easily predict the IRI directly. However, more research is required to identify and address different variables for county roads that may affect IRI measurement using smartphones. More detailed information on this new PMS methodology for local roads can be found online at https://www.ugpti.org/resources/reports/downloads/mpc19-397.pdf.

For more information

For more information on the 2019 Transportation Asset Management Plan by KDOT, visit this free web-based resources at http://www.tamptemplate.org/wp-content/uploads/tamps/042_kansasdot.pdf.

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Parking Restrictions for On-Street Parking

By Anna Cohen and Lisa Koch, Kansas LTAP

Parking restrictions are tools used by cities to allocate parking to specific areas. Restrictions are often put in place to avoid overcrowding streets with parked cars and to ensure that emergency vehicles can access streets.

This article will focus on parking restrictions for on-street parking, including state standards for on-street parking, local examples of restrictions, and methods of enforcement/implementation.

On-street versus off-street parking

Space for parking can be made available in two forms, on-street parking and off-street parking. On-street parking provides space on the road for cars to parallel park, or to park at an angle forward-in or back-in. On-street parking is found on collector and local streets due to their lower speed limits and traffic volume. Off-street parking is land provided by a municipality, business, or residential unit that provides space for a vehicle off the street. Off-street parking can be large surface lots, parking garages, and driveways.

Street standards for on-street parking

Not all streets can handle on-street parking and also remain safe to all users. Streets need to be wide enough to support the flow of traffic on the street, provide enough space for emergency access, and provide enough space between moving traffic and parked cars. Streets also need a low enough speed for pedestrians to access their parked vehicle in the roadway.

A standard vehicle is six feet wide. A widely accepted width of eight feet is provided for on-street parking, giving enough room for a passenger to safely step out of the vehicle and for cars to pass without hitting another car.

Currently, there is no consensus for on-street width minimums for providing on-street parking. Some cities allow on street parking for streets that are 29 feet wide curb to curb. This provides 20 feet for emergency access vehicles which is a commonly accepted minimum. The spacing for each car on the road is 7.3 feet, giving each car 1.3 feet between other vehicles. Other cities prefer on-street parking for streets that are 35-39 feet wide from curb to curb which then gives vehicles 2.8-3.8 feet between each vehicle. An illustration of varying residential street widths that provide on-street parking is provided in Figure 1.

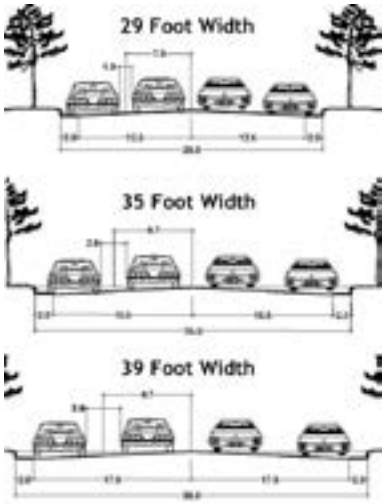

Figure 1 illustrates street widths for on-street parking.

On-street parking should be on streets with lower speed limits. Slower driving gives drivers more time to react to parked vehicles and pedestrians. Many cities suggest speed limits of 25mph-30mph for streets that provide parking.

Safety of bicyclists should be considered when designing on-street parking. On-street parking should be on streets that provide enough distance between vehicles for riders to feel comfortable. When designing bike lanes adjacent to on-street parking, the length of the driver's side door must be taken into account. The open door must remain in the parking zone and not in the bicycle lane.

Kansas on-street parking restrictions

The state of Kansas has standard restrictions for on-street parking. These restrictions can be modified within local jurisdictions to provide more safety on streets. Below are some of the on-street parking restrictions for residential streets.

Parking is not allowed:

- Within 15 feet of a fire hydrant
- Within 30 feet of a crosswalk at an intersection
- Within 30 feet of a stop sign or traffic signal
- Within 20 feet of a fire station or 75 feet if posted by the fire department
- Within 50 feet of a railroad crossing
- In front of a public or private driveway

At the local level, some cities use development codes to reduce on-street parking. For example, the City of DeSoto requires that developers of single family homes provide 2 off-street parking spaces per dwelling unit, and multi-family homes require 1.5 off-street parking spaces per bedroom. An added parking restriction in DeSoto prevents residents from parking in the bulb of the cul-de-sac to allow more space for emergency vehicle access.

Methods for Restricting On-street Parking

On-street parking can be restricted using a variety of methods, ranging from placing signs restricting the amount of time a vehicle can remain parked to physically altering the street and making it too narrow for parking. Permit parking restricts parking to those who have paid for a permit to park in the area. This is typical in residential neighborhoods with little off-street parking available for residents.

Metered on-street parking is a method for reducing the amount of time one vehicle remains parked on a street. Not only is the driver forced to pay to park on the street, meters can have maximum time limits. Creating time limits will encourage the driver to leave after their time has maxed out or require them to pay an additional amount to remain parked. A barrier to non-metered time limit parking is determining how long a vehicle has been parked. Some cities like Lawrence use a chalk system in which a city employee marks the tires of cars at certain time intervals to indicate how long cars are parking in time-limited spots.

Implementing Parking Restrictions

Parking restrictions can be implemented in varying ways depending on how much funding is allocated to enforcement. Using signs to inform drivers of restrictions is a common method for implementing parking restrictions. Signs can give detailed information as to when a vehicle can park on the street, for how long, where they can park, and the consequences of violating the parking rules. The Federal Highway Administration publishes the Manual on Urban Traffic Control Devices, which provides the national standard for road signage and traffic control devices. See sign examples in Figure 2.

Enforcing Parking Restrictions

Signs and meters alone may not be enough to enforce parking restrictions. Drivers need to be aware of the consequences they face should they choose to violate the rules.

A common method to enforce parking restrictions is to hire parking enforcement officers. The officers are tasked with walking around the city to enforce parking restrictions by writing citations for those who are parked illegally. Before a city hires parking officers to enforce parking fines, punishments need to be established and apparent to all drivers. Cities need to

Figure 2: Example of signs restricting on-street parking. Images taken from the Manual on Uniform Traffic Control Devices.

make certain that fines are high enough to discourage drivers from breaking the rules. Low fines may not prevent drivers from following restrictions if fines are comparable to paying for parking in a metered spot. Parking fines should not be used as a revenue source; it is a tool used to discourage people from parking in restricted areas.

Keeping detailed records of violators will help in dealing with repeat offenders. Cities can set higher fines for those who have been caught parking illegally more than once. Additional consequences for repeat offenders may include having the car booted or towed by a third-party company. This causes an inconvenience to the owner of the vehicle since they have to call the third party to remove the boot or retrieve their car; there is also a fee the owner will have to pay to get their car back. The benefit of using a third-party towing company is that it removes the cost from the City to hold the vehicles own tow trucks. It also removes any conflict between the car owner and parking officer.

Conclusion

Parking is a highly contested topic as some feel cities should provide parking everywhere while others feel it's wasted space or make streets unsafe. On-street parking is used when not enough off-street parking is provided in commercial and residential areas. While there is no clear standard for on-street parking, there is some consensus on street standards cities can use to frame their own parking situation.

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Seeding: An Effective Erosion Control Measure

By Nikhila Gunda, Kansas LTAP

This factsheet will present information on seeding, including types of seed, machinery used, common practices, and its maintenance practices that comply with Kansas state regulations.

Seeding helps prevent erosion

Seeding is the process of planting seeds of annual grasses, legumes, or small grains to establish perennial vegetation cover on disturbed areas, helping to reduce erosion. It is one of the less costly and most effective erosion prevention practices. When done successfully, seeding counteracts the erosive influences of rain, snowmelt runoff, and wind on exposed soil. Planted vegetation holds soil particles in place and reduces sediment and runoff to downstream areas. It also filters sediments, helps the soil absorb water, and improves and enhances the aesthetics of the land area.

Seeding can be an easy and efficient erosion prevention practice on all local projects, from large construction projects to routine maintenance work. For many years, seeding practices were left up to the jurisdiction, and effectiveness varied from place to place. With more stringent rules regarding erosion control and water quality for construction and maintenance projects, it is more important than ever that local agencies proactively establish good ground cover for their local projects.

Types of seeding - temporary and permanent

Temporary seeding is used when a disturbed area is inactive or will not be brought to the final grade for an extended period. This practice controls runoff and erosion until permanent vegetation or other erosion control measures can be established. It also reduces problems associated with mud and dust from exposed soil surfaces during construction. Permanent seeding is appropriate for large areas of exposed soil or for any final graded and exposed area of land that has not been otherwise stabilized. Different practices are recommended for temporary vs permanent seeding.

Seeding in Kansas

In the state of Kansas, all temporary and permanent seeding procedures must be carried out in accordance with the Kansas Department of Transportation's (KDOT) Temporary Erosion and Pollution Control Manual (Division 900) and Materials for Roadside Improvements Manual (Division 2100). According to KDOT's Division 900 manual, temporary seeding is to be used only if the project has less than 1 acre of erodible or exposed surface; otherwise, permanent seeding is preferred. Typically, local governments and agencies have seed mixes corresponding with the seasons in their respective jurisdictions. It is recommended to check with your local government requirements for seeding and other erosion control measures for any given project. This factsheet includes limited information on seed mix, soil preparation, and seeding and mulching recommendations by KDOT that comply with Kansas State regulations. The KDOT's Division 900 manual contains detailed seeding methods, construction, and preparation requirements, while the Division 2100 manual provides detailed material requirements for fertilizers, seeding, and mulching.

Process of seeding

A well-established seeded area requires proper preparation and fertilization of the seedbed, appropriate selection of the seed mixture and seeding equipment, and protection with mulch. Unless shown otherwise in contract documents (the documents that confirm the agreement to a particular seeding process, materials, requirements and any extra specifications between the local agency and the seeding contractor), the following steps for seeding are carried out within the right-of-way and construction easements.

Preparation of seedbed

Before seeding, the disturbed areas should be repaired by leveling the grade to the elevations of any abutting sidewalks and removing rocks and other debris. In developed urban and residential areas, the seedbed is commonly prepared by using rotary tillers or similar equipment; however, tractor-mounted equipment is permitted if the area is large enough to accommodate it. To prepare a firm, friable, and weed-free seedbed, tillage implements like disks and harrows

that drill 2 to 3 inches of the seedbed should be used. If impractical, then hand methods will suffice.

The following are a few things to remember when preparing the seedbed:

- No damage should be done to the trees and native grasses if planning to keep intact.
- If encountered, areas of annual grasses like cheat, crabgrass, or triple-awn should be eradicated by disking
- If existing or temporary grasses provide stability with no erosion, those areas do not need to be graded.

Application of Fertilizers

Fertilizers should be applied to the prepared seedbed by using a fertilizer attachment on the seed drill or a broadcast spreader. Hand methods can be used to spread fertilizer uniformly where it is impractical to use a seed drill. Fertilizers that can be used on KDOT and local projects must comply with the applicable sections of the 'Kansas Commercial Fertilizer Law' as administered by the Kansas State Board of Agriculture. The commercial fertilizers that are used on KDOT projects/ local projects have a varied composition of Nitrogen (N), Phosphoric acid (P2O5), and Soluble Potash (K2O), and are packaged individually, in bulk, or liquid form.

Materials Requirements for Seed Mix

The seeds used for seeding must comply with the seed and noxious weed laws of the State of Kansas and applicable Kansas Department of Agriculture Rules and Regulations, except when specifically mentioned. Sericea Lespedeza and Multiflora Rose should not be provided or mixed with any seed.

- Before seed drilling, seed analyses must be conducted by the rules and regulations prescribed by the Association of Official Seed Analysts (AOSA) and Kansas Seed Law. The Kansas Seed Law specifies the following: the type and amount of weed seed permitted; the requirement for a current analysis report; labeling of all seed to show its purity, germination, date of last germination test, and weed seed content (Division 2100, Section 2103.2). (Note: Local agencies purchase the seed mix which has been already analyzed and in some cases KDOT conducts test before its use on KDOT projects)
- The seed should be cleaned and conditioned, resulting in a product that meets or exceeds minimum standards, which can then be planted without further cleaning and processing.
- Minimum Pure Live Seed (PLS) requirements, as shown in the table 2103.1 and 2103.2 (found in Division 2100), should be met. Seed PLS (%) can be computed by using the following formula:

What is pure live seed?

The amount of living seed in the total quantity of seed when non-viable seed or non-seed material is exclused. (Division II, Section 2400 KC Metro Chapter of APWA)

$$\%\ \text{PLS} = \frac{(\%\ \text{Germ} + \%\ \text{Firm or Hard Seed})}{\%\ \text{Purity}100}$$

- There are two types of seeds used: Grass seeds and wildflower seeds. Grass seeds are used most often as they cost less than wildflower seeds. Wildflower seeds are planted at designated locations for the beautification of the surrounding areas. All the grass and wildflower seeds that can be used in the State of Kansas are listed in Tables 2103-1 and 2103-2 of DIVISION 2100.
- If seeds fail to comply with PLS requirements, it is permitted to use them under the following conditions:
- The Contractor can provide suitable evidence to the Engineer that seeds that comply with Table 2103-1 and 2103-2 (Division 2100) are not readily available.
- The Contractor is willing to increase the number of seeds, at no additional cost to KDOT or the Local Public Authority (LPA), to provide the minimum quantity of PLS required.
- It is permissible to use seed from native stands if the seed is harvested within range of its planting location. This is not to exceed 300 miles south, 150 miles north or west, and 1500 feet in elevation. To certify location and elevation, native seed sources are identified by state and county where the seed was harvested. Local agencies are responsible for gathering the native seeds (or the contractor as agreed in the contract documents).

Seed Drilling Equipment

In rural areas, a seed drill is the most commonly used machinery for seeding. A broadcast seeder is used when it is impractical to operate a seed drill. On steep slopes or other areas inaccessible with a seed drill or broadcast seeder, a hydroseeder may be used. In developed urban areas, suitable equipment for the size of the lawn and small areas should be used. When appropriate, manually operated equipment like drop-seeders, cyclone spreaders, or other similar equipment can be used. The drill used for seeding can accommodate the seed sizes and weight of seed using as many compartments as required. Seeds of compatible size and weight may be mixed and placed in the same compartment.

Drilling Procedure

The maximum depth for drilling grass seeds and wildflower seeds is 1/2 inch and 1/8 inch, respectively. If both the seeds are used in the same area, grasses are drilled first. Once the disturbed area is fertilized and seeded, the soil should be firmed using a cultipacker or smooth roller. The seeds should be drilled at the rate and in the locations as mentioned in the project contract documents.

Seeding Seasons

It is important to seed the project during the proper seeding season to protect the finished grading. There are two types of seasons based on different grass and wildflower seeds – Cool-season (February 15 through April 20 and August 15 through September 15) and Warm-season (November 15 through June 1). When the seeding area is less than 1 acre, the seeding is done during the seeding seasons specified for either cool or warm-season grasses. Seeding mix is based on the season type, cool and warm seasons. If wrong seeds are planted in a wrong season, then the rate of germination decreases resulting in the lower chances of survival of the vegetation.

Mulch

To promote the effective establishment of vegetation, the seeded areas should be covered with mulch immediately after fertilizing and seeding operations. The mulch should be applied uniformly over the area at the rates mentioned in the contract documents. Mulch is punched into the ground by approximately 2 inches, using a mulch puncher. If needed, weights can be used on the mulch puncher to punch the mulching material into the soil. When the sloped area is too steep to use a mulch puncher, the mulch should be patted with the forks as it is placed on the slope. On the lawn and small areas in urban areas, mulch is applied using hand methods. It is recommended to hand spread a light application of soil or sand over the mulched area to reduce any wind loss. Other types of mulches like wood cellulose fiber and hydro-mulching are also preferred depending on the budget, size, and location of the seeded area. To ensure that no bare spots are left, mulch tacking slurry can be applied over the mulched area.

Maintenance Tips

The following are some of the recommended steps that are practiced for the maintenance of the seeded area:

- Seeded areas should be monitored and observed to identify poor growth or areas that fail to germinate. In those identified areas, reseeding and mulching should be done, as needed.
- Repairing eroded areas and irrigating seeded areas, particularly during extended dry periods, may also be necessary.
- Mowing is not required until 4 inches of growth occurs. It should not remove more than 1/3 of the grass height during the first 4 months.
- For a successful establishment of permanent seeding, the seeded areas should be repaired and reseeded for the complete first year.
- Inspection should be done at regular intervals and within 48 hours after every rain event that causes stormwater runoff to occur on-site.
- Though mulching is expensive and optional, it is highly recommended for well-established vegetation.

Conclusion

Seeding is a cost-effective and immediate measure to prevent and reduce soil erosion caused by disturbed areas due to on-site construction activities. Seeding is the application of temporary or perennial vegetative cover on disturbed areas by planting seeds or plants with appropriate rapidly growing annual or perennial plant types. The type of seed mixtures used for seeding must comply with the rules and regulations of Kansas weed law and Kansas Department of Agriculture. A well-established seeded area requires proper preparation and fertilization of the seedbed, appropriate selection of the seed mixture and seeding equipment, and protection with mulch within the right-of-way and construction easements. Some of the best procedures for the maintenance of established seeding include regular inspection, repairing and reseeding damaged areas, and mowing the grass only when necessary. Though it is not required for local agencies to follow the KDOT seeding requirements, it is highly recommended to follow KDOT manuals and procedures for the long term and good yield of vegetation which requires less maintenance over the period of time and saves money.

Acknowledgements

Special thanks to Mike Perkins who provided his expertise advice and invaluable input for this article from his experience in the field.

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Kansas
LTAP Newsletter

The Use of Drones by Road and Bridge Agencies in Kansas - Now and in the Future

By Lisa Koch, Kansas LTAP

In recent years, unmanned aerial systems (UASs), or drones, equipped with auxiliary technologies have been used to gather photography and data for numerous industries including the military, agriculture, and forestry. Some in the transportation sector have begun to adopt the use of drones for the purpose of reducing staff time in the field. The use of drones in the transportation field is still new, research results on efficiencies is inconsistent, and use of the technology for data collection is rarely taught in engineering programs; therefore it is up to the agency to invest in education on this topic.

To assist local agencies, the University of Kansas Transportation Center, through a State Transportation Innovation Council grant by the Federal Highway Administration, has spent the past year understanding the state of the practice related to the use of drones in road and bridge agencies and how drones are currently used by practitioners in Kansas. The goal of the research is to create educational programming to increase the use of drones where results are most likely to improve efficiencies for road and bridge agencies.

As part of the research, a survey was conducted on the use of drones in Kansas by road and bridge professionals currently -- and the interest in future use of this technology. This article will focus on the results of the survey and outline plans for training in Kansas on this topic.

A survey of 12 questions was sent to the Kansas LTAP mailing list, which included 631 individuals. Of those invitations, there were 55 responses, or a response rate of 8.7 percent. We appreciate those who took the time to respond to respond to this survey.

The initial question asked about drone usage. Of those who responded to the survey, only 20% stated that their agencies used drones for agency work. We then asked those who do use drones at their agency about the purpose, the following were the main responses:

- Bridge inspection
- Land surveying and mapping
- Emergency response
- Flooding issues
- Infrastructure inspection

Two-thirds of agency respondents who use drones use in-house resources, with the reaminder using contractors to provide drone services. Of those that use in-house resources, 77% assist other departments in their jurisdiction with their drone needs. The respondents were asked about the frequency of their use of drones. The majority of respondents who use drones use them between 1-20 times per year.

Respondents were asked to describe their experience of using drones as part of their work. Those who provided answers where positive. The work that they did with the drones (aerial photography for communications, updating construction progress, or measuring stockpiles) was not generally data-intensive. There was an interest in learning more about the capabilities of data collection and management using drone tools so that data from drones could be integrated into day to day operations.

The final questions of the survey asked respondents about interest in coursework related to drones for road and bridge professionals. 51% of respondents said that they would be interested in training in this area, with the following topics being of the most interest:

- Land surveying and mapping
- Infrastructure inspection
- Bridge inspection
- Traffic data collection

The information gathered from the survey was helpful in identifying the market for potential coursework and the areas of interest for study. The KUTC is considering the following framework for a future class for local agencies on UAS:

An initial webinar that providers an overview of the use of UAS for local road and bridge professionals (this webinar is being piloted on August 20, 2020)

Those interested in receiving operator licensure should do so. The KUTC recommends K-State's Polytechnic Drone Operator Training in Salina as the training of choice in Kansas.

The KUTC will partner with industry experts to provide additional content for specific topics, such as those listed above, that mixes classroom time and field time, to provide students with experience in specific UAS methodology.

The KUTC will also work with KU faculty to discuss methods for including UAS education in the civil engineering curriculum so that future engineers learn these techniques while in school. Education, both through bachelor's and master's degree programs and through LTAP, is essential for adopting drones as a regular piece of an engineer's and agency's toolkit.

Do you have ideas for how to increase drone usage or interesting stories of your use of drones on the job? Let us know. Contact Lisa Koch at kolisach@ku.edu.

Kansas
LTAP Newsletter

How to Use Pneumatic Road Tube Counters

By Hemin Mohammed, Kansas LTAP

Traffic volumes, speed, and vehicle classifications are essential information for all areas of transportation planning. These data shape everyday decisions on how to design, operate, and maintain local infrastructure. The pneumatic road tube counter is by far the most commonly used sensor for automatically collecting highly accurate traffic data such as the speed of vehicular traffic passing along a roadway, traffic volume (counts), and vehicle classifications (1). This article will describe how pneumatic road tube counters work, and the pros and cons of using them, and how to obtain them through Kansas LTAP's Equipment Loan Program.

A pneumatic road tube counter is a temporary electronic traffic recording device. The collected traffic data can be used by local agencies and traffic professionals to identify traffic patterns and for traffic studies to improve roads or provide alternatives. For instance, traffic counts, often collected by pneumatic road tube counters, provide the source data used to calculate the Annual Average Daily Traffic (AADT), to compare two or more roadways, or to determine different zones such as a central business district (CBD) in an urban area. Another example of collected data is speed, which is usually used for defining peak speeding periods and speed limit enforcement efforts.

Applications

A pneumatic road tube is an on-roadway technology that involves rubber tubes laid on top of paved road lane(s). There is a difference between pneumatic road tubes and other traffic counting devices like piezoelectric sensors, which are embedded in paved roadways, and inductive loops, which are cut into paved roadways. Pneumatic road tubes are generally used for temporary studies to collect a short-term count, while piezoelectric sensors and inductive loops are used for ongoing data collection. Piezoelectric sensors and inductive loops detect traffic patterns and are often used for monitoring traffic congestion on major roads to improve the operational efficiency of traffic signals in the intersections (1).

How do I install pneumatic road tubes?

Selecting the installation location is the first step of the process. To do so, place tubes exactly perpendicular to the flow of traffic and install them on a straight stretch of road so vehicles are not hitting the tubes on an angle. Installation should be away from locations where traffic will be queueing up and stopping on the tubes, or in locations where vehicles will turn or pass over the tubes on an angle.

The second step is the tube layout or installation configuration. This step varies depending on the type and manufacturer of the equipment and the type of data to be collected. Figure 1 shows an example of pneumatic road tube layouts provided by a manufacturer. Reading and understanding the user's manual for the device is very important because the internal calculations depend on those layouts to calculate speed, vehicle length, headway, and other traffic parameters. If the specified layouts are not followed, the device will generate erroneous data. For instance, the spacing between tubes in a two-tube setup is a function of the posted speed limit for the segment

Figure 1. Kansas LTAP Team Installing Pneumatic Road Tube Counter in Republic County, Kansas.

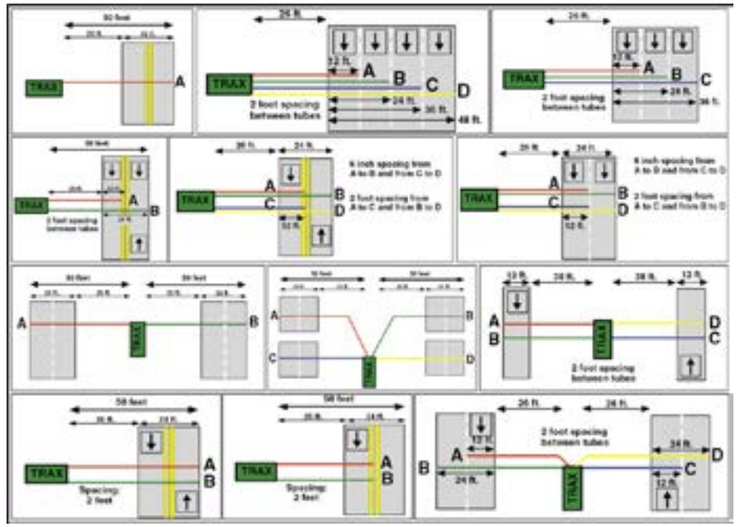

Figure 2. Pneumatic Road Tube Layout Samples (2)

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of the road in question. When the posted speed limit of a segment is high, it is recommended to increase the distance between the tubes to allow for a more precise measurement of the collected speed. Once the location and layout are specified, the installation process can be started. The equipment required for installation depends on the type of device and road tubes used, but generally includes tubes, a hammer and PK nails, mastic tape in 6-inch strips, a clamp, a utility knife, a tape measure, and end plugs.

After measuring the proposed distance between the tubes, the tubes are stretched by an additional 10 percent of their length across the desired lane(s), sealed at one end, taped in the middle by mastic tapes, and then attached to the collection device at the other end. When a vehicle passes over a tube, the wheels pinch off that section of the tube, sending air pulsing back to the counter. The counter then records this pulse and converts it into a vehicle count. Using a single tube records the time between individual vehicles and axle counts, which must be converted to vehicle counts using factors related to assumed vehicle classification in the area (3).

The last step of the installation process is observing the traffic as it is being recorded to ensure the setup is working correctly. Checking the tubes periodically during the traffic study is important to ensure they have not been damaged and data is being recorded as programmed.

Where do pneumatic road tubes work most effectively?

Ideally, the use of road tubes would be exclusively on paved segments of roadways to minimize the risk of damage to the equipment from sharp gravel and to avoid erroneous data caused by irregularities in the road surface (3).

Which types of data do pneumatic road tubes collect?

Pneumatic road tubes provide individual detection; that is, the traffic parameters in each row of the data table represent an individual vehicle detected on the road. The data can then be downloaded as a Microsoft Excel file, which displays various details about the location and time of data collection and several parameters of a detected vehicle in different columns. These traffic parameters include date and time of detection, travel lane, number of vehicle axles, space between axles, class of vehicles (see Figure 3), length of vehicles, and travel speed. (1). Some of the recent versions of pneumatic road tube counters have been upgraded to count bicycles. Kansas LTAP has five counters with upgrades that count bicycles for loan.

Advantages and disadvantages of using pneumatic road tubes

The FHWA has identified the following advantages and disadvantages of pneumatic road tube counters (5).

Advantages

- Quick installation for permanent and temporary recording of data,
- Low power usage,
- Low cost,
- Simple to maintain,
- Manufacturers often supply software packages to assist with data analysis.

Disadvantages

- Inaccurate axle counting when truck and bus volumes are high,
- Temperature sensitivity of the air switch,
- Tubes can be cut from vandalism and truck tire wear.

Interested in using pneumatic road tubes? Kansas LTAP can help

A pneumatic road tube counter costs approximately $1,700 without the tubes and installation tools identified in this article. However, Kansas LTAP has

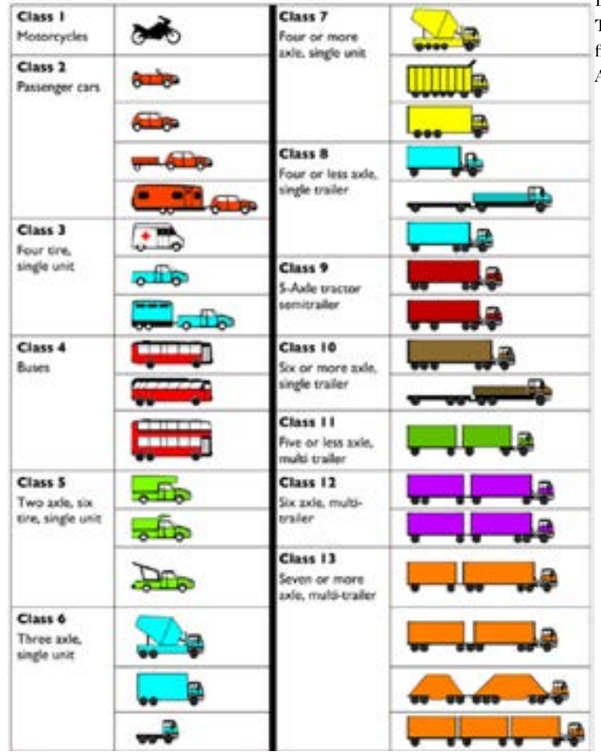

Figure 3. FHWA 13 Vehicle Category Classification (4)

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18 pneumatic road tube counters with the installation tools and offers them to public agencies for free through its Equipment Loan Program. Learn more at http://kutc.ku.edu/equipment-loan-program.
Kansas LTAP also provides hands-on training for using the pneumatic road tubes (and many of the other devices available through the loan program) and will analyze the collected data for no cost, if needed. For further information on the proper devices for your needs, please contact Kansas LTAP at hemin@ku.edu.

Endnotes

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Kansas
LTAP Newsletter

Decorative Crosswalks

By Lisa Harris-Frydman, Kansas LTAP

Some communities are fielding requests from citizens for decorative crosswalks. Can art co-exist with traffic safety? If done carefully and thoughtfully, the answer is yes. This article will discuss the pros and cons of decorative crosswalk treatments, review regulations for their use, and provide some practical food for thought for traffic engineers.

Why use decorative crosswalks?

Communities use decorative crosswalks to make an area look more attractive, feel more historic, or to communicate something about the character of the community. For example, in Watkins Glen, NY, home of a road race through its city streets, some crosswalks have a checkerboard design like a racing flag. Other communities have used a brick pattern in crosswalks in historic districts. Or a rainbow design to celebrate diversity. Or an art deco pattern to indicate the era the neighborhood was built. These are just a few examples.

Above photo taken in Watkins Glen, NY.

Regulations pertaining to design of decorative crosswalks

The Manual on Uniform Traffic Control Devices (MUTCD) is the national standard for design and placement of traffic control devices, including pavement markings. Kansas adopts the MUTCD as its state standard as well.

Above photo taken in Gevena, NY.

Chapter 3G, Section 3G.01 of the 2009 MUTCD contains standards and guidance for the use of colored pavements, reprinted below. (Note that the MUTCD addresses colored pavements separately from colored pavement markings. Markings are addressed in Chapter 3A, Section 3A.05.)

Very little is mentioned about decorative crosswalks in the section below – the last paragraph specifically mentions them.

CHAPTER 3G. COLORED PAVEMENTS
Section 3G.01 General

Support:
Colored pavements consist of different colored road paving materials, such as colored asphalt or concrete, or paint or other marking materials applied to the surface of a road or island to simulate a colored pavement. If non-retroreflective colored pavement, including bricks and other types of patterned surfaces, is used as a purely aesthetic treatment and is not intended to communicate a regulatory, warning, or guidance message to road users, the colored pavement is not considered to be a traffic control device, even if it is located between the

lines of a crosswalk.

Standard:

If colored pavement is used within the traveled way, on flush or raised islands, or on shoulders to regulate, warn, or guide traffic or if retroreflective colored pavement is used, the colored pavement is considered to be a traffic control device and shall be limited to the following colors and applications:

A. Yellow pavement color shall be used only for flush or raised median islands separating traffic flows in opposite directions or for left-hand shoulders of roadways of divided highways or one-way streets or ramps.

B. White pavement color shall be used for flush or raised channelizing islands where traffic passes on both sides in the same general direction or for right-hand shoulders.

Colored pavements shall not be used as a traffic control device, unless the device is applicable at all times.

Guidance:

Colored pavements used as traffic control devices should be used only where they contrast significantly with adjoining paved areas.

Colored pavement located between crosswalk lines should not use colors or patterns that degrade the contrast of white crosswalk lines, or that might be mistaken by road users as a traffic control application.

The FHWA has provided subsequent, more detailed guidance about decorative crosswalks in an official ruling dated August 15, 2013 titled Interpretation Letter 3(09)-24(I) – Application of Colored Pavement. https://mutcd.fhwa.dot.gov/resources/interpretations/3_09_24.htm

The letter addresses the "considerable ambiguity [that] continues regarding how colored pavement can be used, especially between the white transverse lines of a legally marked crosswalk." The letter provides more detail about what design elements are considered by the FHWA to be a distraction to safety. The letter also reviews prior FHWA rulings on the topic.

The gist is that the pavement marking used for traffic control at a crossing (such as the white transverse crosswalk lines) must be prominent, and the decorative design should not compete with it. The design should be uniform and repetitive as opposed to freeform, which could be a distraction to drivers. Colors should be muted, nonreflective, and not the same colors of pavement markings used for traffic control. A buffer gap between the design and the outside white crosswalk lines is recommended.

The FHWA has asked some cities to remove decorative crossings that do not meet their guidelines. For example, St. Louis has leaf designs in a crosswalk near the city's botanical garden that the city is letting fade away, as they do not comply with the MUTCD.

The FHWA allowed 3-D crosswalks as an experiment in the past, but no longer does. For more information, see https://mutcd.fhwa.dot.gov/knowledge/faqs/faq_part3.htm At one location it was reported that drivers were confused and swerved to avoid what they thought were obstacles in the road.

Some cities that are installing decorative crosswalks

Decorative crosswalks in larger cities like Austin and Seattle have been featured in national publications, and requests for them are growing across the country. Several cities actively promote decorative crosswalks.

Seattle has a program is called "Community Crosswalks," intended to depict neighborhood character. More information is at this link: https://www.seattle.gov/transportation/projects-and-programs/programs/pedestrian-program/community-crosswalks.

Above photo from Iceland.

Milwaukee, WI has a decorative sidewalk program. (https://city.milwaukee.gov/mpw/infrastructure/Decorative-Crosswalks.htm)

Austin, TX has a program called Creative Crosswalks, but that program is currently paused for review, per their website.

Closer to home, Olathe, KS, has a decorative crosswalk downtown across from the Johnson Administration Building. We spoke with Cheryl Lambrecht, Senior Traffic Engineer with the City of Olathe, about her thoughts about decorative crosswalks.

Lambrecht said her supervisor thought the 3-D design "looked really cool," and they decided to try one. Lambrecht said their pavement marking contractor is also an artist, so it was relatively easy for him to create.

3-D crosswalks originated in Iceland, India, and China, and were intended to slow down drivers who were speeding. They have gained traction worldwide, with applications in Mozambique, Montreal, and New Delhi, to name a few.

. Lambrecht said they have not had swerving problems at the Olathe installation. "The reason we didn't see any drivers swerving or stopping abruptly is that drivers don't see the 3D effect," she said. The concept of a single point perspective drawing works when standing still, like looking at a painting hanging on a wall. For a crosswalk, drivers cross the vanishing point in fractions

Above photo taken in St. Louis, Missouri.

of a second. They see flat, colored paint on a street. For pedestrians using the crosswalk, they don't experience 3D because they aren't aligned to view the vanishing point. They see traditional crosswalk markings with some extra geometric shapes of color.

She said although the idea is that a 3-D crosswalk will slow people down, in her experience, it doesn't. "The main benefit is that you can take really nice photos when people cross." Lambrecht said She said Olathe residents have been generally underwhelmed with the crosswalk.

When considering installing a decorative crosswalk in your community, besides following FHWA guidance about the design, Lambrecht said you need to think about skid resistance for walkers and bicycles and motorcycles. "For me, as a traffic engineer, you have to be careful about what you are doing, and where," she said. She said the best location for decorative crosswalk would be on low speed, low volume road.

Another important aspect of decorative crosswalks is maintenance. "Maintenance is the life of a street," Lambrecht said. "Cracks need to be sealed. Holes need to be patched. Paint will go away after a while—sometimes sooner than you expect. There are a lot of everyday issues." So, when it comes to maintenance, decorative crosswalks "can be a pain in the.... neck," she said.

Lambrecht shared with us the photo below of 10th and Locust Streets in downtown Des Moines from October 3, 2019. She said this image illustrates the challenges – "the hole, the patch, the spray-painted lines from a utility locator."

From a maintenance perspective, Lambrecht said there are two paths a city can follow. She said: "The first path is that the decorative crosswalk is temporary. When street maintenance occurs and as traffic wears away the paint, that's okay. The other path is that the artwork has to be maintained until a new design is applied or until a decision is made to remove the artwork. In this case, someone has to touch up the artwork every time a utility locator marks a line, a utility digs a hole, a crack is sealed, and a snowplow scrapes the pavement. Who does that work depends on whether city staff is available or if the city has to hire a contractor. In my opinion, it doesn't make sense to try to maintain the artwork to its original condition. A decorated crosswalk is a different type of public art. It's intended to be temporary. The priority is maintaining the white crosswalk markings."

Conclusion

Decorative crosswalks are allowed by the MUTCD, but there are conditions on the design to preserve roadway safety. 3-D designs are no longer allowed. If you choose to install a decorative crosswalk, be sure to consult the 2009 MUTCD and subsequent guidance/rulings to learn what regulations and guidance you need to follow. And also important: consider what it will take to maintain the crosswalk once it is in place. The FHWA has asked some cities to remove decorative crossings that do not meet their guidelines. For example, St. Louis has leaf designs in a crosswalk near the city's botanical garden that the city is letting fade away, as they do not comply with the MUTCD.

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Kansas
LTAP Newsletter

Three Helpful Guides Are Heading Your Way

By Lisa Harris-Frydman, Kansas LTAP

Norm Bowers may be retired from the Kansas Association of Counties (KAC), but is still helping local agencies as an author. This article will describe three guides written or updated by Norm -- under development by Kansas LTAP in partnership with the Kansas Association of Counties. These will be helpful resources for rural local agencies.

Three guides and their target audiences

Field Guide for Rural Roads. This glovebox guide update helps agencies reduce run-off-the-road crashes and other types of crashes in rural areas. The existing guide, written for public works field staff, is out-of-date with the current Manual on Uniform Traffic Control Devices (MUTCD). The revision will update the guide to current standards and to complement the Kansas Handbook of Traffic Control Guidance for Low-Volume Rural Roads (aka the LVR Handbook). The update of this field guide was requested by members of the Kansas County Highway Association. It is a key safety resource for the Kansas LTAP Local Field Liaisons to share with rural agencies as they meet with them.

Field Guide for Guardrail Maintenance. The second guide is targeted at individuals who make decisions about installation, repair, or removal of guardrails, such as county engineers, consulting engineers, and road supervisors. It is intended as a reference guide for office use. Advisors for this publication were Tod Salfrank and Mike Perkins. Salfrank, Assistant Bureau Chief of KDOT's Bureau of Local Projects, has conducted research on guardrails. Perkins, a Kansas LTAP Local Field Liaison, teaches LTAP's Guardrail Maintenance course.

About the guardrail guide, Bowers said "This guide is about one of the most difficult issues we have on rural roads – whether to remove, replace in kind, or upgrade existing guardrails – and whether to install new crashworthy bridge rail and approach guardrail on new bridges."

Field Guide for Motorgrader Operators. This new guide is aimed at a different audience than FHWA's popular "Gravel Road Maintenance and Design Manual." The FHWA manual covers the entire United States and is a reference book for managers. It is more technical than what will be covered in the new field guide, which is intended to be used in the field and carried in a motor grader. The new guide will be tailored to the conditions and laws of Kansas and is written for grader operators and their supervisors.

Ryan Durst and Dale Dorsch were the official reviewers for content for the motor grader guide. Durst is Assistant Road Supervisor for Coffey County and Dorsch is Kansas LTAP's Gravel Roads Maintenance Instructor.

Where to obtain the guides

The guides will be available on the Kansas LTAP website and in print. LTAP will distribute a hard copy to each county, and extra hard copies will be available upon request . Look for a notice in an upcoming biweekly Kansas LTAP Update about the release of these guides. They should be ready to distribute a few months from now.

Questions? Reach out to Lisa Harris-Frydman at lharris@ku.edu.

Kansas LTAP Newsletter

Welcome Emily Wilder as New Kansas LTAP Director

By Emily Wilder, Kansas LTAP

Kansas LTAP would like to congratulate Lisa Harris-Frydman on over 20 years of dedicated service to the LTAP program! Lisa began phased retirement in mid-June and will remain an active part of the center, focusing on special projects and mentorship. Lisa has passed the baton of LTAP director to a familiar face at KUTC, Emily Wilder.

Emily served as the center's education program manager before transitioning to the role of LTAP director. Emily holds a M.S. in Management and Leadership, is a teacher with the Kansas Leadership Center, and in the process of becoming a leadership coach. In addition to acting as the Kansas LTAP director, she is also the associate director for business operations at KUTC, the National LTAP Association's (NLTAPA) liaison to the American Public Works Association, and co-chair for the NLTAPA Partnership Workgroup. Emily is excited to continue to serve Kansas public works agencies.

As always, it is our goal to provide you with the technical skills needed to do your job. This fall, many classes will move to a virtual format as LTAP adapts to COVID-19 restrictions. We will continue to share information through our Kansas LTAP Update bi-weekly emails, quarterly newsletters, and Facebook page. If you have content suggestions, special requests, or need assistance, please email Emily Wilder at eaross@ku.edu.

Thank you all for all that you do!