

Quality Matters

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from the Quality Assurance Branch (QAB) of Highway Design



The Importance of Follow Through

I love it when a plan comes together, even if it takes two times to get it right.

In 2011, the Quality Matters Newsletter reported about the importance of avoiding designs that have superelevation transitions out of sags and excessive K values (rate of vertical curve) in sag conditions. For those of you that aren't hardcore design buffs, when these two elements are combined, it can result in a large, flat area where water may not drain quickly enough, leading to conditions where vehicles may hydroplane.

Okay, that's the background. What's interesting is the story of the project that inspired the [original article](#). That same year, a section of interstate had just been widened and reconstructed. Shortly after completion, an unusual vehicle crash with a guardrail end treatment led a group of the design team to investigate. Upon a chance conversation with a local deputy at the site, they learned that the sheriff would dispatch an officer to that specific location every time it rained.

That tidbit of information sparked an investigation of a seemingly bigger problem. First, they took a look at the crash records and found in this specific location (0.7 mile), there was an uncommonly high crash rate for a normal stretch of interstate. Digging deeper

showed a high percentage of these crashes happened when the pavement was wet.

The team then developed a hypothesis that the vertical curve at the bottom of the hill (sag) may be too flat and water is not draining fast enough from the pavement. If this was the case, then conditions could be ripe for vehicles to hydroplane and lose control. To test this theory, a survey team was dispatched to map the road.

The survey results indicated that the cross slope of the road was originally not built according to the plans. Indeed, throughout the bottom section of the sag, the road was nearly flat.

To address this issue, pavement was milled out across all three lanes to the proper cross slope and a new surface coat of even thickness was placed. Problem solved! Right?

Before I answer, think about this. Of the highway projects you've planned, designed or built, how many have you gone back to check on their performance? If it was to fix a traffic congestion problem, did it get resolved after it was constructed? How much better did it actually get? How long are the traffic queues? What is the travel time through the corridor?

What was the delay at each intersection? Did the performance match what was predicted during the design? I would wager a guess that other than driving through a project or watching traffic flow from the roadside, you have measured the performance post-construction on very few.

So, back to our interstate fix. This year, the latest crash data was examined. The before and after shows the total number of crashes dropped from 59 to just 15; crashes on wet pavement went down by 97% (33 to 1)! This examination shows that the hypothesis was correct and the applied solution made a significant difference.

Measuring the performance of our highway projects is something that we should undertake more frequently. Not only can we determine if the problem of a specific project was addressed, over time, we can learn more about what types of improvements are most effective as well as see where we missed the mark or could have done better.

If you have a project where you went back and measured its performance, let us know. We'd love to share some of these examples with others!

by: [Brent Sweger](#)

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Median Intersection Design for Rural High-Speed Divided Highways

While rural high-speed divided highways can increase accessibility by offering at-grade intersections and at a lower price point than freeways, the trade-off is a higher number of vehicular conflict points.

Dr. Reginald Souleyerette, currently the Commonwealth Chair of Transportation Engineering at UK, and the research team set out to understand the causes of common crashes in the vicinity of at-grade intersections on the rural high-speed divided highways and to explore safety improvements at those locations. Their research showed that because of the hybrid nature of the rural high-speed divided highway, a dedicated chapter had not been developed for this kind of expressway in the Green Book or the Manual on Uniform Traffic Control Devices (MUTCD).

The group determined the most common and severe crash type for two-way stop controlled (TWSC) intersections are right-angle crashes. Crash records at TWSC intersections in multiple states were reviewed to understand the cause of the crashes. The research team initially suspected traffic on the minor approach did not realize they had encountered an intersection and did not stop for mainline traffic; however, the records revealed that most crashes were attributed to the motorist on the minor approaches misjudging safe gaps in mainline traffic on the far side of the intersection.

The leading treatment recommended by the report to address the right-angle crashes is called a J-turn intersection (see diagram) that eliminates the right-angle conflict points by forcing drivers to accomplish through or left turn movements from the minor approach in steps. A J-turn intersection allows traffic on the minor road needing to continue on the minor road or turn left onto the mainline to use turn lanes built in the median near the intersection to make U-turns.

This type of intersection prevents the most severe type of conflict point by forcing the minor road traffic to merge with mainline traffic rather than cross it perpendicularly. A J-turn also goes by other names such as Restricted Crossing U-Turn (RCUT) or Superstreet intersection.

Another benefit of the J-turn intersection is the offset left-turn lanes are introduced. The offset left-turn lanes greatly improve the sight distance caused by opposing left turn vehicles and reduces left-turn leaving type crashes.

Based on J-turn intersection case studies the research team observed intersections most likely to benefit from a conversion to J-turn intersections have:

1. A history of far-side right-angle collisions, collisions within the median, and/or 'left-turn leaving' collisions;
2. High volumes of traffic on the mainline creating infrequent safe gaps for direct

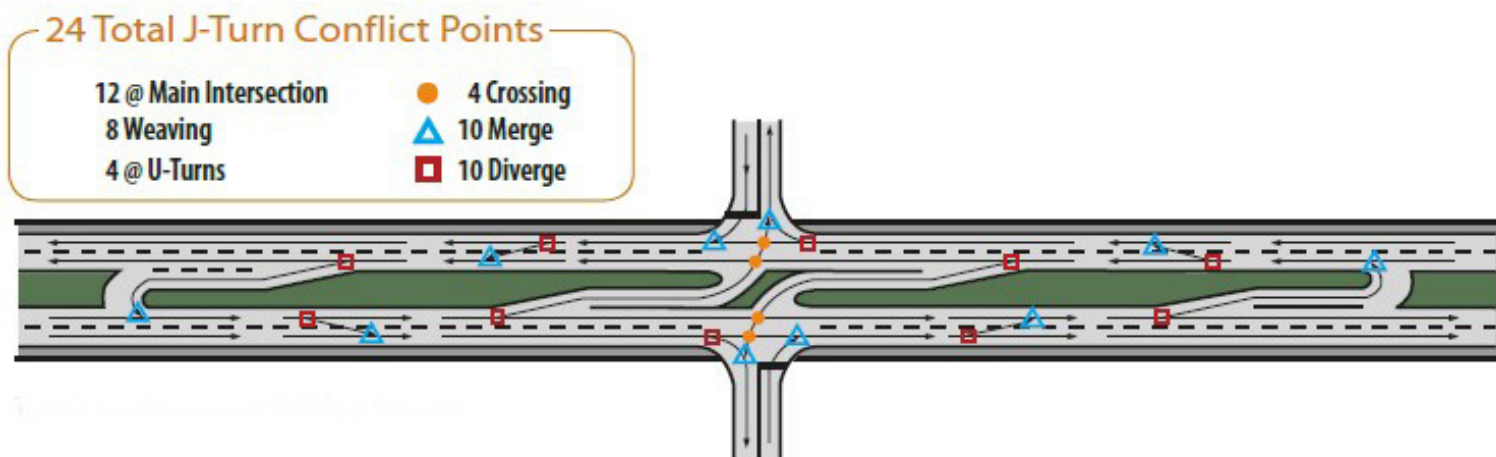
crossing or left-turn maneuvers, while still having frequent enough gaps for safe right-turn entry; and

3. Relatively low volumes of traffic crossing or turning left from the minor roads.

The [NCHRP Report 650](#), developed to aid designers in their design of rural high-speed divided highways, notes that the Green Book does not include guidance exclusively for J-turn intersections. To date, there are none in Kentucky; however, the Central Office Highway Safety Improvement Program (HSIP) group is an advocate of this type of innovative intersection because of its high potential for preventing serious angle crashes.

The HSIP group, who is responsible for finding cost-effective solutions to address high crash rates on Kentucky roadways, is seeking locations where the J-turn will be beneficial as part of a pilot program. Please contact [Jarrod Stanley](#) if you are interested in using a J-turn intersection on your project. Based on accident severity and frequency the pilot program will allow the group to determine the benefit to cost ratio of these intersections allowing them to determine the value of using the J-turn intersection to replace traditional median intersection for rural high-speed divided highways. If you have a potential location for a J-turn you are encouraged to contact the HSIP group.

by: [Shawn Russell](#)



Surveying Accuracy

“Plans can only be as accurate as the survey they are based on. Plans may be worse than the survey, but never better.” – William S. Gulick

During recent Post Construction Reviews (PCR), survey accuracy was noted as a recurring issue. If mapping inaccuracies are not identified and corrected to reflect actual field conditions, change orders for earthwork and other construction items will likely be necessary. Examination of the survey prior to letting can avoid major issues later on. Two of the major issues noticed are:

Mapping during certain times of the year can reduce mapping accuracy especially when tree foliage is at its thickest. At these times, mapping may not accurately reflect the ground surface as it exists in the field. Mapping areas that have heavy tree cover are prone to error when produced by aerial surveying

and sometimes LIDAR when ground points cannot be accurately located. The best time for either method is in the colder months when leaves are off the trees. Project managers should look for places marked as “obscured area” from the survey consultant and pass that along to the designers. In addition, possibly have the obscured area survey from the ground.

The greater the length of time that passes between the survey and construction letting the more likely the area within the project limits may have changed. It isn't uncommon to have a project design sit on the shelf for five or ten years prior to going to construction. Typically, ground line changes happen as a

result of site development, farming, utility work, or coal mining.

When possible, the project team should verify existing topographic conditions on the plans are accurate by noting any changes since the survey. For example, changed drainage conditions may cause a field design revision, change in material types and quantities, or additional drainage easements. Checks by survey crews and even drones equipped with cameras to verify accuracy of control points may be warranted. Substantial survey accuracy issues can often be addressed before they become more costly and time consuming to fix during construction.

by: [Bob Jones](#)

Upcoming Training:

■ **2016 ACEC-KY/FHWA/KYTC Partnering Conference**
9/6/2016 » 9/8/2016
Louisville

■ **Highway Capacity Analysis using HCM 2010 and HCS 2010**
9/27/2016 » 9/29/2016
Frankfort From 9:00 am until 4:00 pm

■ **Somerset One Day Fall Seminar**
9/28/2016
Somerset From 8:00 am to 4:30 pm

■ **Ashland One Day Seminar**
10/5/2016
Catlettsburg From 8:00 am to 4:30 pm

■ **Bowling Green One Day Fall Seminar**
10/7/2016
Bowling Green From 8:00 am to 4:30 pm

■ **Paducah One Day Fall Seminar**
10/19/2016
Paducah From 8:00 am to 4:30 pm

■ **Madisonville One Day Seminar**
11/9/2016
Madisonville From 8:00 am to 4:30 pm

■ **Prestonsburg One Day Seminar**
11/16/2016
Prestonsburg From 8:00 am to 4:30 pm

■ **Lexington One Day Seminar**
12/7/2016
Lexington From 8:00 am to 4:30 pm

■ **KRS 322 MTS Code of Conduct & Expert Witness**
12/7/2016
Lexington From 8:00 am to 4:30 pm

■ **Louisville One Day Seminar**
12/16/2016
Louisville From 8:00 am to 4:30 pm

*KYTC employees should register through **Kevin Martin** for all classes.*

*Consultants will only need to register through **Kevin Martin** if the class is held at KYTC. Otherwise consultants should contact the [Kentucky Engineering Center](#).*

All times are local.

Limits of Flowable Fill

Section 701.03.06 of KY Standard Specifications states “When the top of the pipe is within one pipe diameter of the subgrade, backfill with flowable fill to an elevation of one foot above the pipe from the outside edge of shoulder or back of curb to outside edge of shoulder or back of curb as applicable. When installing under existing pavement, backfill with flowable fill to the subgrade elevation.”

The limits for flowable fill should be shown in the plan set, preferably on the pipe sheets. Since flowable fill is incidental to the pipe pay item, this offers a simple reminder to the contractors bidding on that project. The contractors use this information to estimate the quantity required to develop a more accurate unit bid price for the associated pipe.

by: [Mike Spain](#)

Cross Drains

Transverse perforated pipe underdrains, aka cross drains, are routinely used in highway construction and are extremely effective in the collection of subsurface drainage. Subsurface drainage not properly addressed can lead to perpetual and costly highway maintenance problems. Cross drain installation are a well-accepted practice as depicted in KYTC Standard Drawing RDP-005-05.

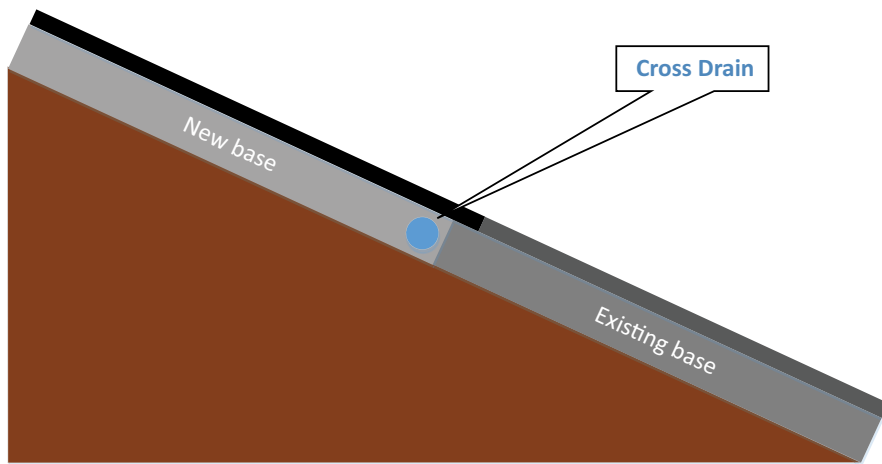
During a recent Post Construction Review (PCR) at District 10, construction personnel recommended installing cross drains at the subsurface interface between the new and old roadbed sections when on downhill grade (see diagram).

District 10 has observed that potholes routinely develop at the interface between new and old roadbed section on a downhill

grade location where no cross drains exist. District personnel believe that subsurface drainage is not able to flow laterally quick enough to reach the roadside ditches or daylight points. Therefore, there is a buildup of subsurface drainage in the roadway base causing pressure on the pavement and also saturating the soil. This condition ultimately creates base and pavement failures.

To solve this, District 10 suggests installing a cross drain in advance of the interface to collect subsurface drainage and daylight it laterally. This is beneficial even if rock must be removed to place the cross drain. Removing the underground water flow allows the subgrade to keep its strength thereby preventing potholing and other asphalt pavement problems.

by: [Bob Jones](#)



Profile view

2016 Standards Drawings are [here](#) effective as of June 24, 2016 letting. As a result the Sepia List just got significantly shorter! Be sure to update plans accordingly.

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Safeloading vs. Pipe Removal

In most scenarios, an existing pipe can be easily removed and discarded at a minimal cost to the project; however, there are two scenarios where safeloading the existing pipe (filling it with flowable fill) to make it a permanent part of the fill may be beneficial.

- Widening of an existing roadway where traffic must be maintained complicates removal of existing pipe. In this case, leaving the pipe in place may be easier than trying to remove it. In fact, based on 2015 average bid unit prices, the cost for safeloading a pipe is less than the cost of pipe removal for pipes less than 24 inches in diameter.
- The depth of pipe can also make safeloading a better option. Pipe removal of pipe well below the existing and new roadway template can invite future settlement issues at that location. Safeloading can minimize those concerns significantly.

by: [Mike Spain](#)

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