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Lone Star Roads™

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In This Issue

Deliberate Design for Traffic Safety

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Traffic safety has been a major concern among highway officials, law enforcement, and road users for decades. Per TxDOT's statewide crash statistics, Texas suffered 3,534 traffic fatalities and 17,152 incapacitating injuries during 2014, so it lingers as an important matter for Texans. Over the decades many approaches have been pursued: better enforcement, safer vehicles, better driver behavior, quicker emergency responses, and improved roadways. Progress has certainly been made along all of these fronts, but traffic volumes continue to grow and society continues to face a serious crash toll. The on-going questions are: can more be done, and, if so, what? Despite generally good roads, a pertinent question remains: can still more be done to make roadways safer? According to the Federal Highway Administration (FHWA), the answer is YES, through Predictive Safety Analysis (1) processes in roadway design.

Safety In Design Processes

Agencies have responded to the need to make roads safer in a number of ways. As problems have become understood, countermeasures have been incorporated into design processes. Features such as continuous highway shoulders, sloped end treatments for roadside culverts, and break-a-way sign supports have become commonplace. These and a long list of features is now incorporated into new or redevelopment roadway projects. These are systemic changes, features incorporated on a system-wide basis without respect to a particular crash history in the limits of any project.

Special safety improvement programs have been developed to address facilities not scheduled for expansion or complete redevelopment. Funding is set aside for dealing with parts of the road system where specific problems persist, essentially retrofitting special countermeasure treatments. Examples include: adding shoulders, placing cable barriers in narrow medians, improving intersections, and addition of left turn lanes on high speed rural routes. Generally, such improvements are made based on crash history data at specific locations or along specific reaches of a route. Due to limited safety improvement funding, crash-prone locations have been compared through cost-benefit analysis to determine which to treat first, leaving some to await future funding. Sophisticated analyses are used to make determinations about alternative treatments and among competing problem locations.

Crash History Data and Perplexing Variables

One reality officials face is the many variables involved in traffic crashes. Most crashes can be traced directly to driver error or misbehavior, often complicated by weather or nighttime conditions. As a result, remedies may not reduce the number of crashes but may reduce their severity. For example, high-tension cable barriers in a median do not affect driver behavior so are not likely to keep an errant driver from leaving the travelway; however, these barriers will decrease severe head-on crashes with traffic in opposing lanes. Due to many variables, most safety improvements have traditionally been driven largely by the severity of the problem depicted with crash history data at specific locations. The goal has been to address safety issues as much as possible with available funding, so spending is influenced by historical site-specific data; completely logical approach absent any better technology.

Implementing roadway safety countermeasures at specific locations is an attempt to reduce the types of crashes that have occurred in the past at that location. Using predictive safety analysis to forecast the safety effectiveness of alternative designs for a major project is a very different approach.

Difficult Design Trade-Offs

Roadway designers must juggle numerous variables: principle among these are traffic carrying capacity, construction cost, right-of-way (ROW) limitations, constructability, storm drainage, and traffic safety. Many significant projects commonly involve comprehensive analyses of these matters and topics like pavement design, geotechnical characteristics, and environmental assessment.

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The Local Technical Assistance Program (LTAP) is a nationwide effort financed by the Federal Highway Administration and individual state departments of transportation. Its purpose is to translate into understandable terms the best available technology for roadways, bridges, bicycle and pedestrian facilities, and public transportation for city and county roadway and transportation personnel.

The Lone Star LTAP center, operated by the Texas A&M Engineering Extension Service, is sponsored by the Texas Department of Transportation (TxDOT) and the Federal Highway Administration. This newsletter is designed to keep you informed about new publications, techniques, and training opportunities that may be helpful to you and your community.

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Many of these factors involve specific reports detailing the analyses and findings, and each is completed fairly early in the design process in order to inform final design work. Designers must attempt to satisfy all of the demands placed on a project by these factors, and invariably must make trade-offs in one or more factors in order to meet important needs in other factors.

What has been missing from this traditional process is a way to assess how any or all of the trade-offs may affect traffic safety. Experienced designers realize that traffic safety may be impacted by some trade-offs, but have lacked the means by which to quantify those effects in order to permit traffic safety to compete among the tradeoffs; those usually associated with the project budget. For example, a wider median on a new four-lane roadway certainly improves traffic safety over the life of the facility, but it also involves more expense for ROW, and may well involve greater construction cost. The question is whether that safety benefit outweighs the additional costs. Heretofore, direct quantitative comparisons of this type have been impractical, if not impossible, due to the lack of reliable models for forecasting traffic crashes that might be expected with any particular design. FHWA's "Data-Driven Safety Analysis Initiative" argues that Predictive Safety Analysis techniques will eliminate this shortcoming; that such techniques will provide better understanding of tradeoffs and result in safer facilities, thus helping reduce crashes.

FHWA's "Data-Driven Safety Analysis Initiative" argues that better understanding and application of traffic safety among the many tradeoffs in roadway project design can result in safer facilities and help reduce traffic crashes.

Predictive Safety Analyses

It is important that decision makers be able to assess the safety performance of proposed facility designs in order to be sure traffic safety plays a higher role in those decisions; that traffic safety is not unintentionally traded-off for short term benefits in other aspects of a project. This is especially important over the long run, since most facilities are called on to perform many years beyond the design year for which they were constructed. Excessive volume tends to result in greater risk of crashes.

Traffic safety has always been a factor in roadway design. Safety criteria are at the heart of the basic criteria of horizontal and vertical design, so the traditional approach has been to tacitly assume that by following agency or FHWA geometric design guidelines, traffic safety has been adequately addressed for any one project. The problem is that for the same project two alternative designs can be prepared to completely satisfy established geometric design criteria but yet not offer comparative safety performance, especially on a long-term basis. Until recent times this reality could not be quantitatively assessed due to lack of reliable predictive models. FHWA argues that this unfortunate condition no long exists; that tools are now available for this work.

Intentional Safety Design

In their Every Day Counts 3 Program, FHWA cites tools useful for designing a project to intentionally optimize traffic safety. Several are listed below. At the very minimum, such tools offer the opportunity for decision makers to understand and assess the effects of traffic safety tradeoffs as related to other project factors. Also, it could be argued that deploying the best available methods to improve traffic safety on each project, is justified in order to fulfill the public trust placed in any agency.

- **AASHTO's Highway Safety Manual (HSM)**
- **AASHTOWare Safety Analyst**
- **FHWA's Interactive Highway Safety Design Model (IHSDM)**
- **NCHRP's Enhanced Interchange Safety Analysis Tool (ISATe)**
- **FHWA's Crash Modification Factors Clearinghouse**

One point of caution is important to understanding use of these tools. They cannot be depended on to forecast the number and type of crashes that will actually occur when a project is deployed, simply because there are so many non-roadway variables at play. Rather, these tools are designed to allow reasonable forecasting of the traffic safety characteristics of alternative design options for projects. The purpose is to raise traffic safety to a more understandable and quantifiable status in project development processes and result in safer facility designs.

Benefits of Deliberate Traffic Safety Design

A number of recent studies have reported about the positive effects of the Predictive Safety Analysis approach to project development processes. FHWA cites a study by Wu, K.F., Himes, S.C., and Pictrucha, M.T., Transportation Research Board, 2013; which states: "Development of advanced methods on all projects and acquisition of high quality data may explain why Colorado outperformed the rest of the country in reduction of fatal crashes."

According to the FHWA, the benefits of data-driven Predictive Safety Analysis can be summed up in three main points:
1. Informed Decision-Making: Quantifying the safety impacts in roadway planning and design helps policy makers and the general public better able to weigh traffic safety against other project factors.
2. Optimized Investment: Use of the most current analytical methods makes it possible for agencies to maximize the safety benefit of every project.
3. Improved Safety: Intentionally designing safety into every project as a special priority promises to curtail the high toll of traffic crashes in a jurisdiction over the long term. ★

Notes:
(1) Term developed in materials presented by the Federal Highway Administration in their Every Day Counts 3 webinar – "EDC-3 Data-Driven Safety Analysis Initiative"; materials from which parts of this article are drawn as cited in the text.

State Law Requires Professional Engineer Oversight of Public Works Projects

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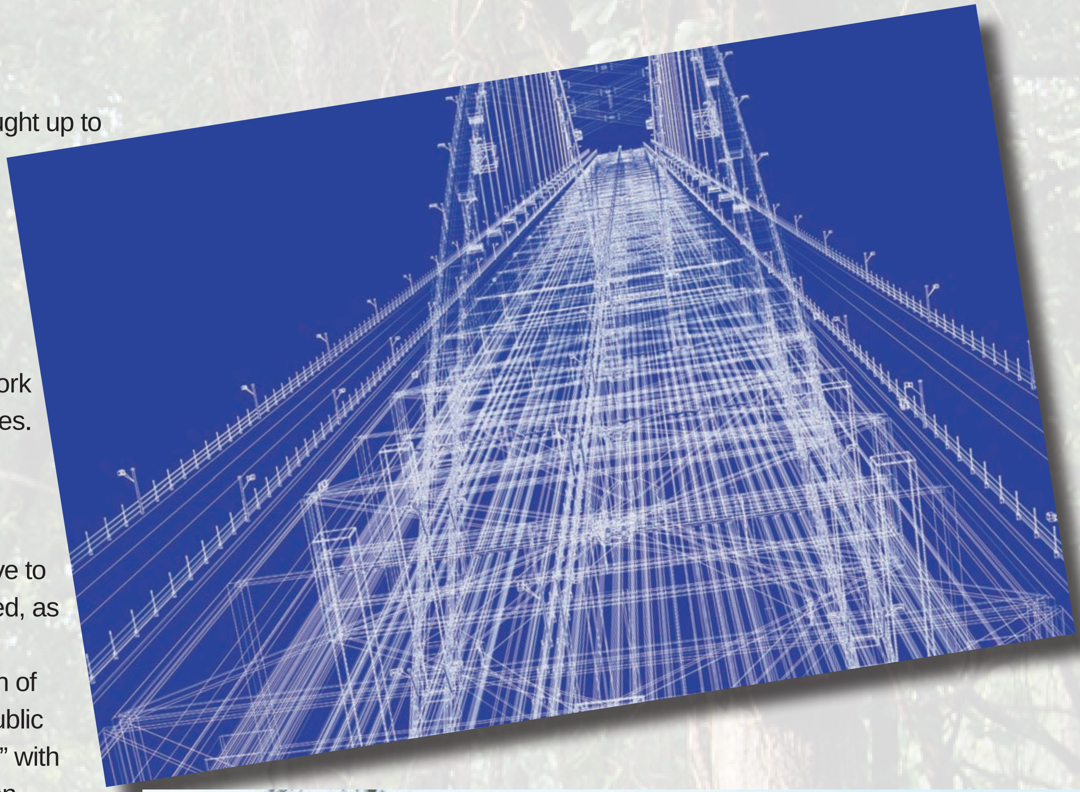
There are over 230,000 centerline miles of county roads and city streets in Texas, with these routes being under the jurisdiction of Cities and Counties. These routes not only include many types of roadway pavements and surfacing, but approximately 18,000 bridge class structures and even many times more than that of non-bridge classified culvert structures. Of course, in addition to these fixtures proper, a great many signs, and other appurtenances, are also included.

So, in order to keep the “traffic moving” smoothly and safely on all these roads and streets, the scope of public work is huge, not only in great numbers but in terms of the amounts and varieties in types of work, as well.

For instance, roadways sometimes have to be realigned horizontally and/or vertically, with pavements being re-constructed and/or replaced. And, eventually these pavements typically require maintenance, including patching and resurfacing; or improvement.

Bridges typically need to be maintained, repaired, reconstructed or replaced, and sometimes widened. And, for stream-channel bridges, there is also often the need for drift and brush removal, and channel and channel-protection work.

And, sometimes bridges and culverts even have to be added to the inventory where



the overall route in the area is being re-constructed or brought up to standards for increased traffic load.

Non-bridge classified culvert structures are of many types, including those with conduits of steel, which can corrode and maybe even collapse over time, requiring their replacement. Also, channel, and drift and brush removal work are often needed around these structures.

And also, approach and barrier rails, signs, object and warning markers, pavement striping and markings, and roadway illumination systems, often have to be maintained, replaced and/or improved, as well.

Our State law recognizes that certain of such roadway and street work, in the public interest should be properly "engineered" with "engineering supervision" of construction. Consequently, Texas Civil Statute Sec. 1001.407 requires that ……"The state or a political subdivision of the state may not construct a public work involving engineering in which the public health, welfare, or safety is involved, unless:
(1) the engineering plans, specifications, and estimates have been prepared by an engineer; and
(2) the engineering construction is to be performed under the direct supervision of an engineer."
An "engineer" in this instance is further defined in the statute as being "a person licensed to engage in the practice engineering in this state".
However, Sec. 1001.053, exempts from having the oversight of a qualified licensed professional engineer;
(1) a public work that involves electrical or mechanical engineering, if the contemplated expense for the completed project is $8,000 or less;
(2) a public work that does not involve electrical or mechanical engineering, if the contemplated expense for the completed project is $20,000 or less; or
(3) road maintenance or improvement undertaken by the commissioners court of a county. ★

REFERENCES:

1. TEXAS CIVIL STATUTES, Occupations Code, Title 6-Regulations of Engineering, Architecture, Land Surveying and Related Practices, Apr 2015.

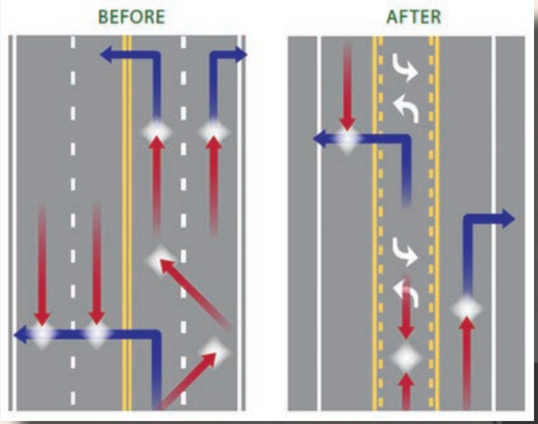
2. "Report on Texas Bridges", Texas Department of Transportation (TxDOT) Bridge Division, Austin, TX, Sep 2012.

3. Email Correspondence, Texas County Road/City Street Mileage, Texas Department of Transportation (TxDOT), Apr 2015.

4. Email Correspondence, Texas Board of Professional Engineers (TBPE), Mar 2015.

Putting a Road on a "Diet" Helps Improve Operation and Overall Safety

Many four-lane undivided highways have high crash rates as traffic volumes increase and the inside lane is shared by both higher speed traffic and left-turning vehicles. This is especially true in areas where new development has resulted in numerous intersecting streets and driveways. In an effort to make this cross section of roadway safer, the Federal Highway Administration (FHWA) is promoting a "Road Diet". A Road Diet involves converting the existing four-lane undivided roadway cross section to a three-lane segment consisting of two through lanes and a center two-way left-turn lane.

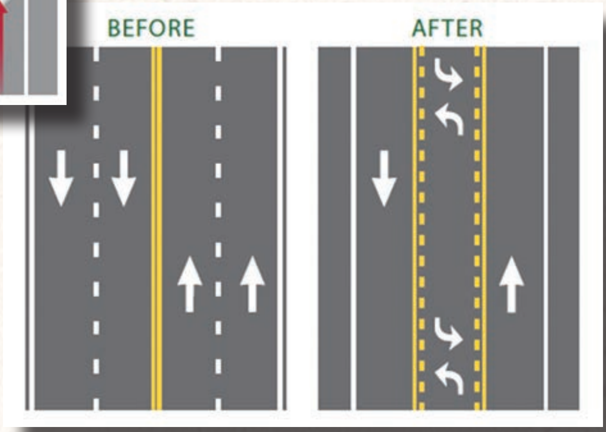


Benefits of Road Diet application may include:

- An overall crash reduction
- Reduction of rear-end and left-turn crashes through the use of a dedicated left-turn lane
- Fewer lanes for pedestrians to cross
- The opportunity to install bicycle lanes when the cross-section width is reallocated
- Reduced right-angle crashes as cross street drivers must only cross three lanes of traffic instead of four
- Simplifying safe gap selection for motorists (especially older and younger driver) when making left turns from or onto the primary roadway.

What about Capacity?

There is often concern that by reducing the number of lanes will reduce the volume of vehicles flowing through the corridor. However, operationally, repeat through drivers know the areas where left turning traffic is prevalent. As a result, they will remain in the right lane in these areas. So in reality, the effective capacity reduction is much less than the reduction assumed before implementation.



A Road Diet can be a low-cost safety solution, particularly where only pavement marking modifications are required to make the traffic control improvement. In most cases, the transition to a Road Diet may be planned in conjunction with a roadway resurfacing project. ★

For more information, the FHWA Road Diet Information Guide can be found at http://safety.fhwa.dot.gov/road_diets/info_guide/rdig.pdf

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