



Issues Related to Design of At-Grade Intersections near Highway-Railroad Grade Crossings

Texas leads the nation in both the number of at-grade crossings and the number of incidents at those crossings. As shown in [Figure 1](#), a large number of design and operational elements intended to provide information to the driver or control the driver's behavior are present. For this reason, at-grade intersections near highway-railroad grade crossings can cause driver confusion and add to traffic safety concerns.

Current design guidelines address at-grade intersection design and highway-railroad grade crossings, but generally do not address the case where the two are in close proximity.

Texas Department of Transportation (TxDOT) Project O-1845 was initiated to identify items that should be considered in designing at-grade intersections near highway-railroad grade crossings. The



Figure 1. An at-grade crossing and intersection

first year's activities focused on developing an understanding of the problems encountered by designers and engineers through the use of a survey, following up that survey with site visits and discussions, and reviewing the literature to examine published reports relating previously encountered issues and answers. The second year's activities focused on developing guidelines for problematic issues related to the at-grade intersections near

highway-railroad grade crossings.

What We Did . . .

In the first year of the project, researchers surveyed engineers and designers in the TxDOT districts and in urban areas of Texas. In this survey, information was obtained regarding commonly encountered problems such as high-profile crossings ("hump" crossings), storage distance requirements,



design vehicles, etc. Follow-up visits or telephone calls were made to expand upon the survey and examine field conditions.

In the second year of the project, researchers developed guidelines that sought to resolve or ameliorate problems predicted from the literature or reported through the survey process. Specific recommendations were developed regarding traffic control devices, the interconnection of traffic signals with highway-railroad grade crossing warning systems, channelization, high-profile crossings, and illumination.

What We Found . . .

The review found a number of common issues from discussions with engineers in the field. A commonly expressed concern regarded high-profile crossings and an inability to predict when problems might be encountered due to vehicles “bottoming-out” at those crossings. The selection of an appropriate design vehicle was problematic, as was the availability of a design tool to evaluate specific roadway designs. The review reported problems with high-profile crossings when roadways were widened towards railroad tracks, resulting in more severe grades and



Figure 2. Visual adaptation to brighter areas can mask objects or design features that appear in shadowed areas

profiles. Illumination was typically not provided or considered at railroad grade crossings, regardless of the illumination of nearby intersections. The design and layout of the at-grade highway intersection was cited as being influenced by the presence of the railroad grade crossing, although specific concerns were generally not expressed.

Issues determined to be problematic from the literature included a difficulty predicting queues that might result from traffic signal operations. Traffic signals are required to be interconnected with active railroad grade crossings when the separation between the two is less than 200 ft; however, if queues are expected that exceed 200 ft, interconnection should be

considered for those locations with greater separations.

Another issue that appears to be problematic is the provision of adequate channelization islands to accommodate expected traffic queues and railroad grade crossing equipment. Traffic islands frequently serve two purposes: a location for control devices (i.e., gates or lights) and the prevention of vehicles from avoiding gates at active crossings. Their design should typically consider both concerns, while meeting basic design standards for the construction of traffic islands.

Illumination was another issue reported as a potential concern. Visual adaptation to brighter areas can mask objects or design features that appear



in shadowed areas (see Figure 2).

Illumination can also be provided to highlight the crossing and the sides of trains, providing a safety benefit.

The Researchers Recommend . . .

Based on the project findings, researchers developed a set of guidelines that includes recommendations for the following elements of designing at-grade intersections near highway-railroad grade crossings:

Traffic control devices. The *Manual on Uniform Traffic Control Devices* (MUTCD) is recognized as the predominant design tool for the selection of traffic control devices. Because not all roadway designers may be familiar with the MUTCD, a brief discussion of its recommendations and requirements for roadway signing and traffic signal interconnection is provided in the guidelines.

Traffic signal interconnection with active grade crossings. A methodology useful for predicting queues that may develop from traffic signal operation was developed and is provided in the guidelines as a tool for examining the need for signal interconnection. Because queues may develop that are longer



than 200 ft, the methodology provides a means of testing to see whether interconnection should be included in the signal design in cases of greater separation.

Traffic channelization. The need for and use of channelizing islands at railroad grade crossings and highway intersections is discussed, with suitable references provided for general design. The guidelines include recommendations regarding minimum widths and lengths necessary to provide a satisfactory design suitable for gate crossing installation and control of traffic queues.

High-profile or “hump” crossings. A design tool has been located that provides designers with a means of evaluating grade crossings to determine whether low vehicles are likely to “bottom-out” as they travel

over the crossing. Several potential design vehicles are presented for use, depending upon local circumstances and conditions.

Illumination. The need for the provision of illumination at railroad grade crossings is reviewed, and recommendations are provided in the guidelines for its use to enhance the visibility of grade crossings and trains. A discussion is also included that will enable the designer to evaluate local site conditions in a qualitative manner.

Although some of the material will be familiar to experienced designers, review of the guidelines will help ensure that these locations are designed appropriately. The recommended guidelines on hump crossings, queue length estimation procedures, and illumination may be of particular use to the designer.



For More Details . . .

The research is documented in the following reports:

Report 1845-2, At-Grade Intersections near Highway-Railroad Grade Crossings, unpublished

Report 1845-3, Design Guidelines for At-Grade Intersections near Highway-Railroad Grade Crossings

Research Supervisors: Daniel B. Fambro, TTI
Mark D. Wooldridge, TTI, m-wooldridge@tamu.edu, (979) 845-9902

Researchers: Marcus A. Brewer, TTI, m-brewer@tamu.edu, (979) 845-2640
Roelof J. Engelbrecht, TTI, r-engelbrecht@tamu.edu, (979) 862-3559
Scott R. Harry, TTI
Hanseon Cho, TTI, h-cho@ttimail.tamu.edu, (979) 847-9271

TxDOT Project Directors: Mario Medina, mmedina@dot.state.tx.us, (512) 416-2675
Thomas Beeman, tbeeman@dot.state.tx.us, (512) 416-2277

To obtain copies of the report, contact Dolores Hott, Texas Transportation Institute, Information & Technology Exchange Center, (979) 845-4853, or e-mail d-hott@tamu.edu. See our on-line catalog at <http://tti.tamu.edu>.

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The research developed improved geometric design guidelines for enhancing at-grade intersections near highway-railroad grade crossings. The guidelines are being evaluated for incorporation into TxDOT's *Roadway Design Manual*. Upon approval, the guidelines will be incorporated into TxDOT's *Roadway Design Manual* as an appendix.

For more information, please contact: Bill Knowles, P.E., RTI Research Engineer, (512) 465-7648 or e-mail wknowle@dot.state.tx.us.

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