



A FORUM8 Case Study

North Carolina State University (NCSU), Raleigh, North Carolina, USA

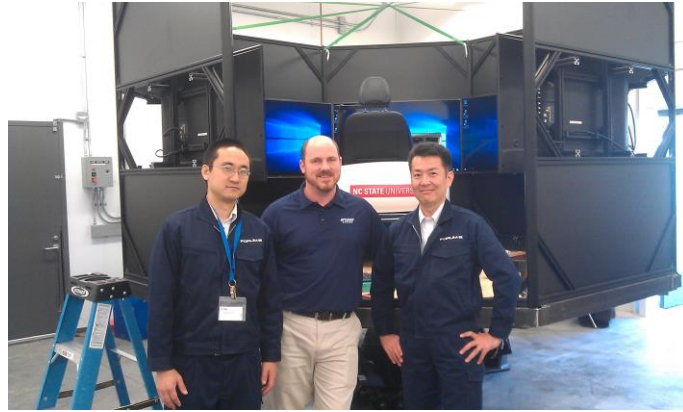
An Assessment of Safety and Geometric Design Criteria for Diverging Diamond Interchanges

NCSU has recently invested in a FORUM8 Driving Simulator along with VR-Design Studio DS (formerly UC-win/Road DS) as part of this Transport Research Board funded project. The aim of the project is to investigate certain features of driver behaviour when confronted by a Diverging Diamond Interchange.

Chris Cunningham, the Director of the Highway Systems Group at the Institute for Transportation Research and Education at NCSU commented *“We are going to use the FORUM8 driving simulator to look at various unique geometric design components of these Diverging Diamond Interchanges, such as the crossover design and the right and left turn movements at the off ramp, we believe that this is where drivers must look down an approach which may not be intuitive.”*

PROJECT BACKGROUND

The use of Diverging Diamond Interchanges (DDI), also referred to as Double Crossover Diamonds (DCD), has become more prevalent throughout the United States over the past 3 to 5 years. Overall, DDIs are gaining momentum within the interchange design community. However, only a limited amount of guidance on the design of these types of interchanges exists. The first DDI in the US was constructed in 2009 by the Missouri Department of Transportation (MoDOT). The DDI design accommodates left-turning movements at signalized, grade-separated interchanges of arterials and limited-access highways, while eliminating the need for left-turn phasing. On the arterial, two-phase traffic signals are installed at the ramp terminal intersections to shift traffic over to the left side of the roadway between the nodes of the interchange. Once on the left side of the arterial roadway, vehicles can turn left onto limited-access ramps without stopping and without conflicting with through traffic.



Currently, there are no existing guidelines/standards for design of this type of interchange. The design is extremely dependent on site-specific conditions which are demonstrated by the variations in the design elements of the DDIs constructed to date. Additionally, there is relatively little accident history available as no DDIs existed in North America prior to 2009. Analysis of the actual safety and operational performance of DDIs has been limited to a handful of in-service DDIs. An assessment of the current design process and safety analysis is needed to ensure that recent advances and emerging issues are appropriately leveraged and/or reflected in design practices, guidelines, and policies.

PROJECT OBJECTIVE

The research objective is to identify, review, and evaluate the geometric design features and the associated safety and operational performance of in-service DDIs across the US. This information will then be utilized to develop recommendations for the AASHTO Technical Committee on Geometric Design for consideration as future geometric policy and guidelines. Two basic questions will be addressed: (1) What are the essential design characteristics of a DDI and how should an engineer utilize this information in the design of a DDI and (2) What are the safety and operational benefits of utilizing a DDI and how might the designer utilize this information in their design?



FORUM8 Driving Simulators

FORUM8 offer customers a very wide range of Driving Simulator hardware units subject to the application and customer budget. However whatever hardware system is chosen the customer can benefit from the FORUM8 interactive 3D VR driving simulation & modelling software VR-Design Studio (*formerly UC-win/Road*).

VR-Design Studio offers drivers a highly realistic driving experience on or off-road either left or right hand driving. The software is also offered with an optional pre-built driver training environment & a range of different scenarios and emergency events.

The software enables any number of human factors research and driver training scenarios can be produced using the user-friendly scenario editor.

Weather effects, time of day, smoke / fire particle & geo-location
Vehicle Dynamics, including CarSim Math Model plug-in & Wheel Noise Simulation

Driver Diagnosis, Data Log-Export & Reply plug-ins

- Vehicle to Vehicle & Vehicle to Infrastructure communications
- Autonomous & Connected Vehicle simulation & research
- Advanced Driver Assistance Systems (ADAS) simulation

- Eye Tracking systems – calculation of screen coordinates possible
- Eco-Drive / Carbon Footprint calculations & Force Feedback
- Seamlessly Import Point Cloud data, Road networks & Photo-logs

- Database of over 4000 3D models of street furniture etc...
- Software Development Kit (SDK) & scenario development software



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