

Engineering Guide

Diverging Diamond Interchange (DDI)

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Benefits, Limitations and Design Guides

Motorists drive through the Diverging Diamond Interchanges (DDI) on the left side of the road, which converts all turns into reduced conflict curbside turns.

Curbside left turns result in more capacity and better safety performance at locations with heavy traffic compared to traditional diamond interchanges.

This guide provides background, benefits, limitations, design guidelines, and further resources for designing DDIs.

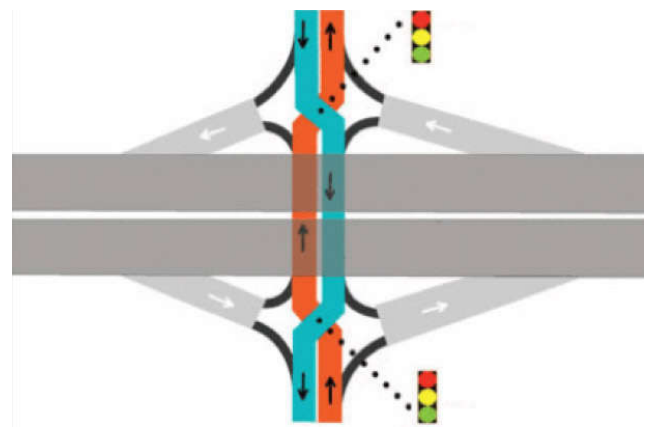
Background Of Diverging Diamond Interchanges

A DDI is a relatively new concept where motorists cross-over from driving on the right side of the road to the left as they go through an interchange. The crossing roads then switch back to standard right side driving on the other side of the interchange. Reverse this for countries that have left side driving.

The Missouri Department of Transportation built the first DDI in the United States in Spring Field, Missouri in 2009. DDI's are rapidly gaining in popularity because they improve safety by reducing conflict points, places where vehicles could collide. They also reduce road construction costs by allowing a skinnier bridge deck since multiple turn lanes are not needed. The capacity at a DDI is significantly higher than a traditional interchange if

there are heavy left turn volumes.

Initial data suggests that DDIs are working just as expected, with fewer crashes and better operations. A performance evaluation of the Interstate 44 and Route 13 DDI in Missouri found a 46% reduction in all crashes and a 72% reduction in left turn related crashes.¹ The public also perceived the DDI as



¹ Diverging Diamond Interchange Performance Evaluation (I-44 and Route 13), Missouri DOT Report No. OR11-012, February 2011

being safer and operating better than a standard diamond interchange. While the initial studies are good, more research is needed to confirm DDIs are a safety enhancement.

With fewer turn lanes to cross and simple two-phase signal timing, bicyclists and pedestrians appear to be accommodated better at DDIs than traditional interchanges. These benefits to non-motorized traffic may be offset by the free flowing nature of the turn lanes at the DDI. More study of the impact of DDIs on nonmotorized traffic is needed.

Since the DDI is a new concept, engineers are still working out a few issues in their operation and what the best practice should be for signing and striping. Optimal traffic signal timing is also being debated, such as whether they should operate with one or two controllers and if they should be interconnected with other adjacent signals or allowed for free-flow operations (no priority to any approach). Another discussion is whether there is a need to signalize or use yield control for the left and right turn movements. Of course ensuring that all users, including drivers and walkers, understand the movement of traffic and where to look for conflicting traffic is also being reviewed and evaluated.

Design guidelines for diverging diamond interchanges

Currently, there are no official standards for this type of interchange. Based on the growing information about DDI operations, here are current

design guidelines:

Crossover angles should be between 40-50 degrees to minimize the likelihood of wrong way driving. This angle also accommodates larger trucks with their higher center of gravity.

The length of the road approaching and following the crossover should be between 10 and 15 feet to allow for a straight cross through the intersection. Similar to roundabout design.

BENEFITS OF DIVERGING DIAMOND INTERCHANGES OVER TRADITIONAL INTERCHANGES

- Fewer conflict points than traditional interchanges.
- Higher capacity for left turning traffic.
- Slower speeds and calmer traffic thanks to the curved design of the DDI.
- Decreased delays and vehicle stacking with simple two-phase traffic signal operation.
- Easier U-turns for the freeway drivers who missed their exit.
- Potentially safer use for road bicyclists because of lower vehicle speeds.
- Potentially safer use for pedestrians and bicyclists due to narrower lane crossings.
- Lower construction costs due to the narrower bridge deck.

LIMITATIONS OF DIVERGING DIAMOND INTERCHANGES COMPARED TO TRADITIONAL INTERCHANGES

- Less efficient for through traffic.
- Less efficient for lower volume interchanges.
- Potential confusion in the area due to driving on the “wrong-side” of the road.
- Less efficient for drivers who have taken the wrong exit and need to get back on the freeway.
- Potentially poorer operations at intersections adjacent to the interchange because of the complexity of traffic signal timing coordination.
- Potentially less safe for pedestrians and bicyclists due to more free flowing vehicular crossings.
- Transit stops cannot be inside the DDI.
- More right-of-way is required on the bridge approaches to accommodate the cross-over maneuvers.



Resources

- [Missouri's Experience with a Diverging Diamond Interchange](#)
- [Driver's Evaluation of the Diverging Diamond Interchange](#)
- [FHWA Double Crossover Diamond Interchange Guide](#)
- [Diverging Diamond Interchange Performance Evaluation](#)
- [Website of the Gilbert Chlewicki, the researcher who brought the DDI concept to the US](#)