

Motorists, pedestrians, and bicyclists face greater mobility challenges and safety risks at interchanges as traffic volumes grow and congestion worsens. Agencies need safer, more balanced designs that keep people moving. Innovative intersection designs represent a solution, and are being built more often because they can deliver more for less.

## WHAT IS A DIVERGING DIAMOND INTERCHANGE?

A DDI is sometimes referred to as a **Double Crossover Diamond (DCD)**

The Diverging Diamond Interchange (DDI) is a simple design innovation that improves safety and mobility, often at a much lower cost, compared to conventional interchange designs. The key to what makes a DDI work so well is how left turns are handled.

The DDI resembles a conventional diamond interchange, which is the most common form in the United States. Drivers make right turns at a DDI just as they would at a regular diamond interchange.

The crossover intersections are what make DDIs different, and they are very intuitive for the driver. The crossovers gently transition – or diverge – traffic from the right side of the road to the left side of the road and then back again. Because traffic is on the left hand side between the crossovers, all left turns occur without having to cross opposing traffic. The road geometry, signs, and pavement markings all work together to make this very simple. In cities where DDIs have been built, drivers say they don't even notice the crossover intersections.

Diverging Diamond Interchanges are almost always worth considering as an alternative, but particularly if a location has any of the following characteristics:

- Heavy volumes of left turns on to and off of freeway ramps.
- Moderate but unbalanced crossroad traffic volumes through the interchange.
- Left turn related safety concerns at the interchange intersections.
- A need for additional capacity without widening the roadway and bridge(s);<sup>1</sup>

## IMPROVING SAFETY WHILE INCREASING THROUGHPUT

A potential conflict exists each time a vehicle, pedestrian, or bicycle crosses or turns across the path of another direction of traffic. Compared to a conventional diamond interchange, the DDI reduces vehicle-to-vehicle conflict points by nearly 50 percent and eliminates many of the most severe crash types. An evaluation of the Springfield (Missouri) DDI compared crashes

from the first year after construction to the 5-year average before the DDI, and found the following:

- Left turn crashes were totally eliminated.
- Right angle crashes were reduced 72 percent.
- Rear end crashes were reduced 29 percent.
- Total crashes were reduced 46 percent.<sup>2</sup>

A separate study comparing DDI designs to conventional diamond interchange designs modeled a range of high and low traffic volume combinations.<sup>3</sup> For higher traffic volumes, the DDI designs demonstrated better overall performance, reducing delay by 15-60 percent and increasing throughput by 10-30 percent. The DDI was able to accommodate twice the left turn traffic as the conventional design.

Opened in 2009, the DDI in Springfield (Missouri) was the first in the United States. Since then, dozens more have been built in several states, and they have quickly become a popular interchange design option. Where they have been built, travelers save time, agencies saved money, and communities will benefit from safer facilities for many years.



Springfield, MO DDI  
Source: DDI Video FHWA-SA-14-019

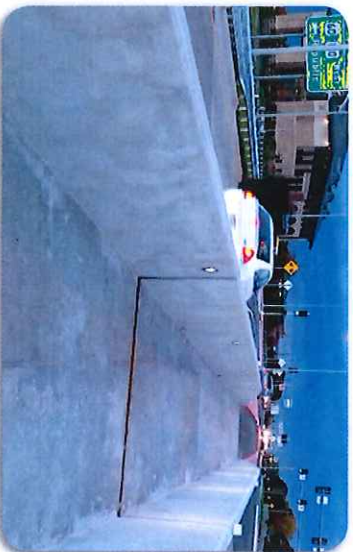
## A TIMELY, COST-EFFECTIVE SOLUTION

A DDI can cost less – in some cases as much as 75 percent less – than an equivalent conventional diamond or single point urban interchange.<sup>4</sup> DDIs often require fewer lanes than a conventional design to handle the same amount of traffic. A smaller project footprint means less right-of-way is needed, resulting in fewer impacts to adjacent areas. All of this makes a DDI alternative cheaper, easier, and quicker to construct.

## INTEGRATING ALL USERS

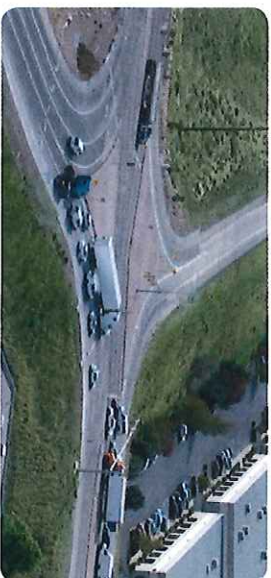
The benefits of a DDI are not limited to just vehicle traffic – safe and convenient pedestrian walkways and crossings are important components of any well-designed interchange. At a DDI, pedestrian walkways are located either through the median or along the sides of the crossroad, while bicycle lanes are placed in the customary location to the right of traffic. Crosswalks are simpler and involve crossing fewer lanes at a time.

Given the importance of freight movement through interchanges, a DDI also is designed to accommodate large commercial vehicles. The



Center Pedestrian Refuge, Springfield, MO DDI  
Source: DDI Video FHWA-SA-14-019

ability of trucks to turn on to and off of the ramps and navigate along the crossroad is not inhibited with a DDI. In surveys of commercial drivers using the Springfield (Missouri) DDI, 83 percent of respondents felt that maneuvering a large truck through the interchange was easy and no different from other interchange types.<sup>5</sup>



Trucks Using a DDI in Salt Lake County, UT  
Source: DDI Video FHWA-SA-14-019

## SOURCES

- <sup>1</sup> FHWA, *Techbrief: Double Crossover Diamond Interchange*, FHWA-HRT-09-054 (Washington, DC: 2009). Available at: <http://www.fhwa.dot.gov/publications/research/safety/09054/index.cfm>
- <sup>2</sup> Missouri DOT, *Diverging Diamond Interchange Performance Evaluation (I-44 and Route 13)*, OR11-012 (2011). Available at: <http://library.modot.mo.gov/RDT/reports/TTY1013/or11012.pdf>
- <sup>3</sup> Praveen Edara, Joe Bared, and Ram Jagannathan, "Diverging Diamond Interchange and Double Crossover Intersection – Vehicle and Pedestrian Performance," *Transportation Research Record* 1912 (2005):31-38
- <sup>4</sup> The Official Website of the DDI - "A Diamond Interchange With a Twist." Available at: <http://divergingdiamond.com/benefits.html> (accessed December 5, 2013).
- <sup>5</sup> Missouri DOT, *Diverging Diamond Interchange Performance Evaluation (I-44 and Route 13)*, OR11-012 (2011). Available at: <http://library.modot.mo.gov/RDT/reports/TTY1013/or11012.pdf>

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FHWA-SA-14-039



## DIVERGING DIAMOND INTERCHANGE



Atlanta, GA DDI  
Source: Google Earth

AN INNOVATIVE,  
PROVEN SOLUTION FOR  
IMPROVING SAFETY AND  
MOBILITY AT INTERCHANGES



U.S. Department of Transportation  
Federal Highway Administration

Safe Roads for a Safer Future  
Investment in reducing safety issues  
<https://safety.fhwa.dot.gov>