Texas Department of Transportation

Innovative Intersections Program

Fact Sheets

SEPTEMBER 2024

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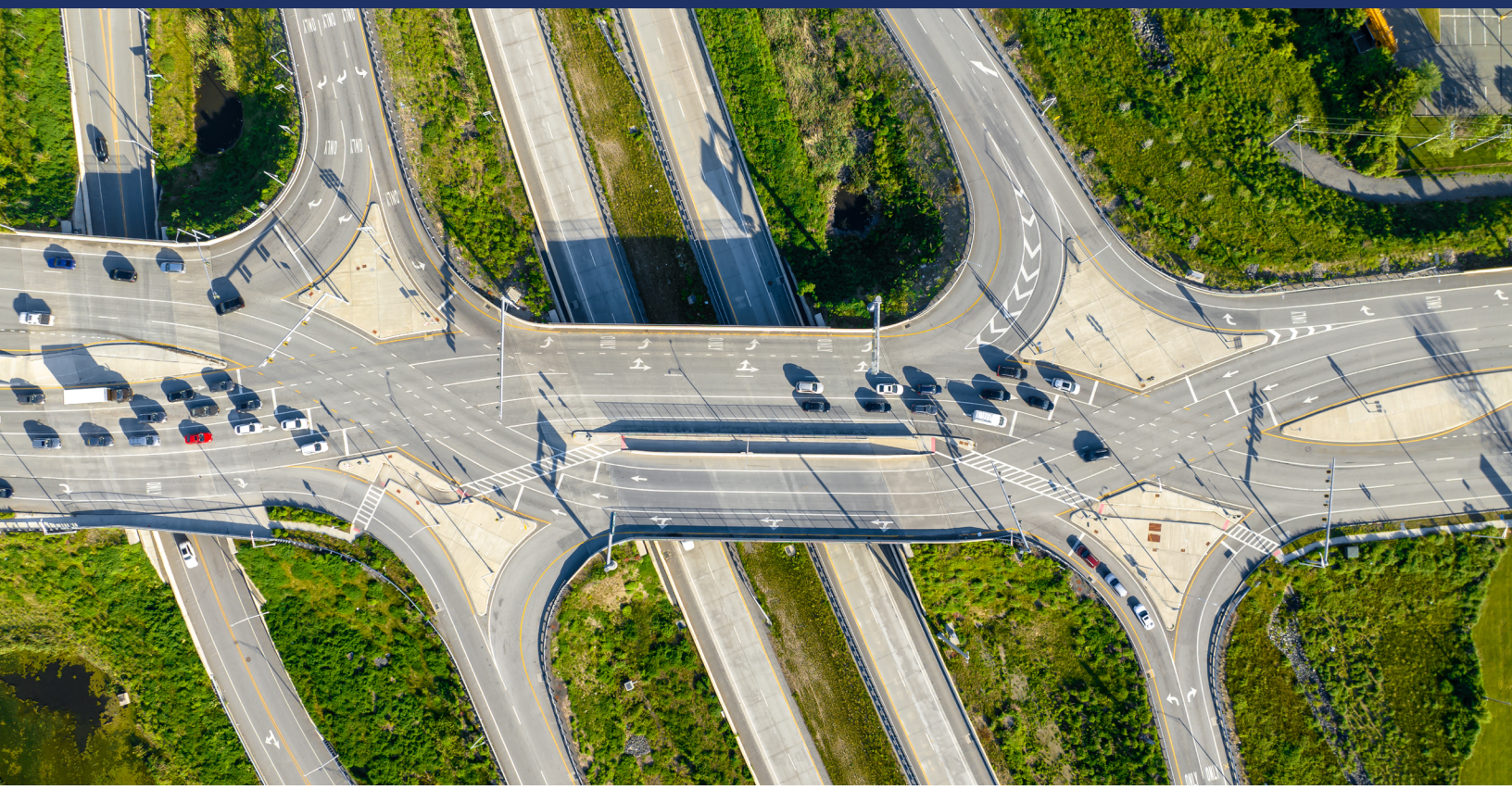
INNOVATIVE INTERSECTIONS PROGRAM



INTRODUCTION

When transportation planners and engineers make plans to deploy innovative intersection or interchange designs, it is likely that they will be required to introduce these designs to members of the public that may be unfamiliar or resistant to the changes. Because of these challenges, effective and intentional public involvement is a necessary component of projects utilizing alternative designs.

Innovative intersections use non-traditional methods, including the reduction of conflict points, to improve traffic flow at crossroads, leading to enhanced safety, operational performance, and resiliency. As a result, they are becoming more common in Texas and on TxDOT facilities.

The Innovative Intersections Fact Sheets contain valuable descriptions, facts, scenarios and benefits associated with commonly used innovative intersection types.

CONFLICT POINTS

Here are some useful safety facts and concepts to keep in mind when discussing conflict points.

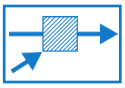
WHAT ARE CONFLICT POINTS?

A conflict point is a location where the paths of two or more road users (for example, vehicles, pedestrians and cyclists) interact with one another, such as at road intersections. There is a strong correlation between the number of collisions that occur at an intersection and the number and severity of conflict points it contains.

WHAT ARE THE DIFFERENT TYPES OF CONFLICT POINTS?

There are three distinct types of conflict points for road intersections. The diagram below compares conflict points at a traditional intersection and a roundabout.

1. **Crossing** conflicts occur when road users cross paths with one another. Collisions that occur at crossing conflict points are commonly known as right-angle crashes and are typically the most severe.



2. **Merging** is a conflict point type scenario in which road users are traveling in the same direction in different lanes simultaneously merge into the same lane. These crashes are typically referred to as sideswipes and are less severe than crossing conflicts.

3. **Diverging** conflicts occur when a road user diverges from one path to another. These diverging crashes often involve rear end crashes as the front vehicle slows to turn.

Figure 1 illustrates conflict point locations and types for both traditional and roundabout intersections.

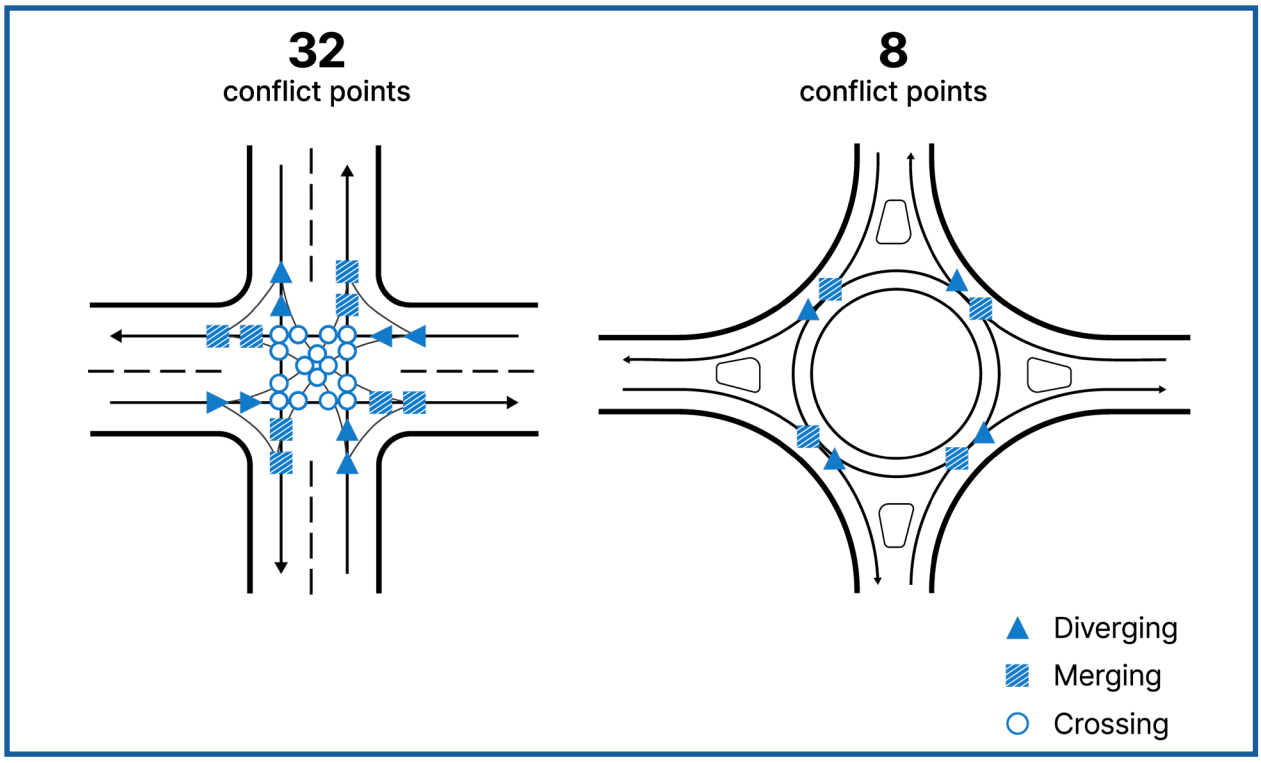


FIGURE 1 - TRADITIONAL (LEFT) AND ROUNDABOUT (RIGHT) INTERSECTION CONFLICT POINTS

HOW MANY CONFLICT POINTS EXIST AT INNOVATIVE INTERSECTIONS?

Innovative intersections (Table 1) and interchanges (Table 2) contain fewer conflict points than are found at traditional intersections or interchanges.

TYPE OF INTERSECTION	CROSSING	MERGING	DIVERGING	TOTAL
CONVENTIONAL INTERSECTION (FOUR-LEG INTERSECTION)	16	8	8	32
ROUNDABOUT	0	4	4	8
DISPLACED LEFT TURN (FULL)	12	8	8	28
DISPLACED LEFT TURN (PARTIAL)	14	8	8	30
MEDIAN U-TURN (FULL)	4	6	6	16
MEDIAN U-TURN (PARTIAL)	6	8	8	22
RESTRICTED CROSSING U-TURN	2	6	6	14
QUADRANT ROADWAY / SINGLE LOOP	6	8	8	22
CONVENTIONAL INTERSECTION (THREE-LEG INTERSECTION)	3	3	3	9
CONTINUOUS GREEN-T	3	3	3	9

TABLE 1 - CONFLICT POINTS (BY INTERSECTION DESIGN)

TYPE OF INTERCHANGE	CROSSING	MERGING	DIVERGING	TOTAL
CONVENTIONAL DIAMOND	10	8	8	26
SINGLE POINT URBAN	8	8	8	24
ROUNDABOUT	0	6	6	12
TWO ROUNDABOUTS (ONE AT EACH RAMP TERMINAL)	0	8	8	16
CLOVERLEAF	0	8	8	16
DIVERGING DIAMOND	2	8	8	14
PARTIAL CLOVERLEAF (PARCLO A4)	2	4	6	12
PARTIAL CLOVERLEAF (PARCLO B4)	2	6	4	12
DISPLACED LEFT TURN	6	8	8	22

TABLE 2 - CONFLICT POINTS (BY INTERCHANGE DESIGN)

CONTINUOUS GREEN-T

Here are some useful facts and concepts to keep in mind when discussing continuous green-T (CGT) intersections.

WHAT IS A CGT INTERSECTION?

A CGT (also known as a Turbo-T, High-T or Seagull) is a major road-cross street intersection, with the major road experiencing higher rates of vehicle through movement than the intersecting cross street.

WHAT ARE THE TYPICAL DESIGN CHARACTERISTICS OF A CGT INTERSECTION?

CGT intersections are ideal for use at three-legged intersections of heavily trafficked major roads and a lower-trafficked side street (Figure 2). Traditional CGT designs use a channelized lane to control left-turn road user movement from the side street onto the major street. These intersections use traffic signals at the intersection to control this movement.

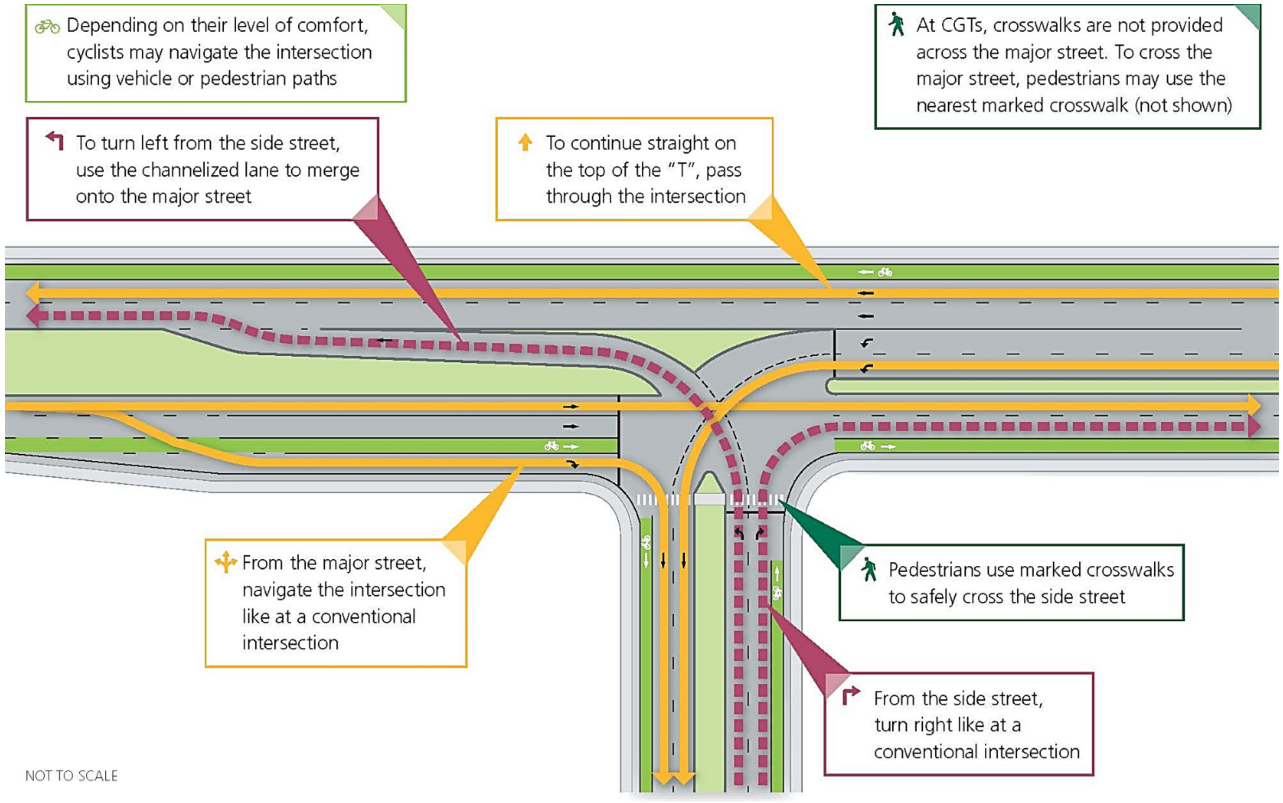


FIGURE 2 - CGT INTERSECTION (THREE-LEGGED DESIGN)

WHAT ARE THE BENEFITS OF USING CGT INTERSECTIONS?

The CGT design improves the safety of an intersection by reducing the number of conflict points it contains. These designs also support roadway operational efficiencies by allowing side-street-to-major-street left turns without stopping major street traffic in both directions.

DISPLACED LEFT TURN

Here are some key points to emphasize when discussing displaced left turn (DLT) intersections and interchanges.

WHAT IS A DLT INTERSECTION?

Also known as a continuous flow intersection, a DLT intersection facilitates steady road user movement for both users who turn left or pass through the intersection. A DLT design does this by relocating, or displacing, left-turn lanes for road users who turn left from a more heavily trafficked road onto a lower-volume cross street. A DLT design is ideal for intersections that experience both heavy through traffic and heavy left-turn traffic.

WHAT ARE THE TYPICAL DESIGN CHARACTERISTICS OF A DLT INTERSECTION?

The DLT can be designed as a partial displaced left turn with crossovers for left turns on the major street, or a full displaced left turn on both the major and crossing road (Figure 3). It also accounts for multimodal transportation, placing pedestrian and bicyclist crossing points at the main intersection. Planning for a DLT requires moderate amounts of added right-of-way to support this design.

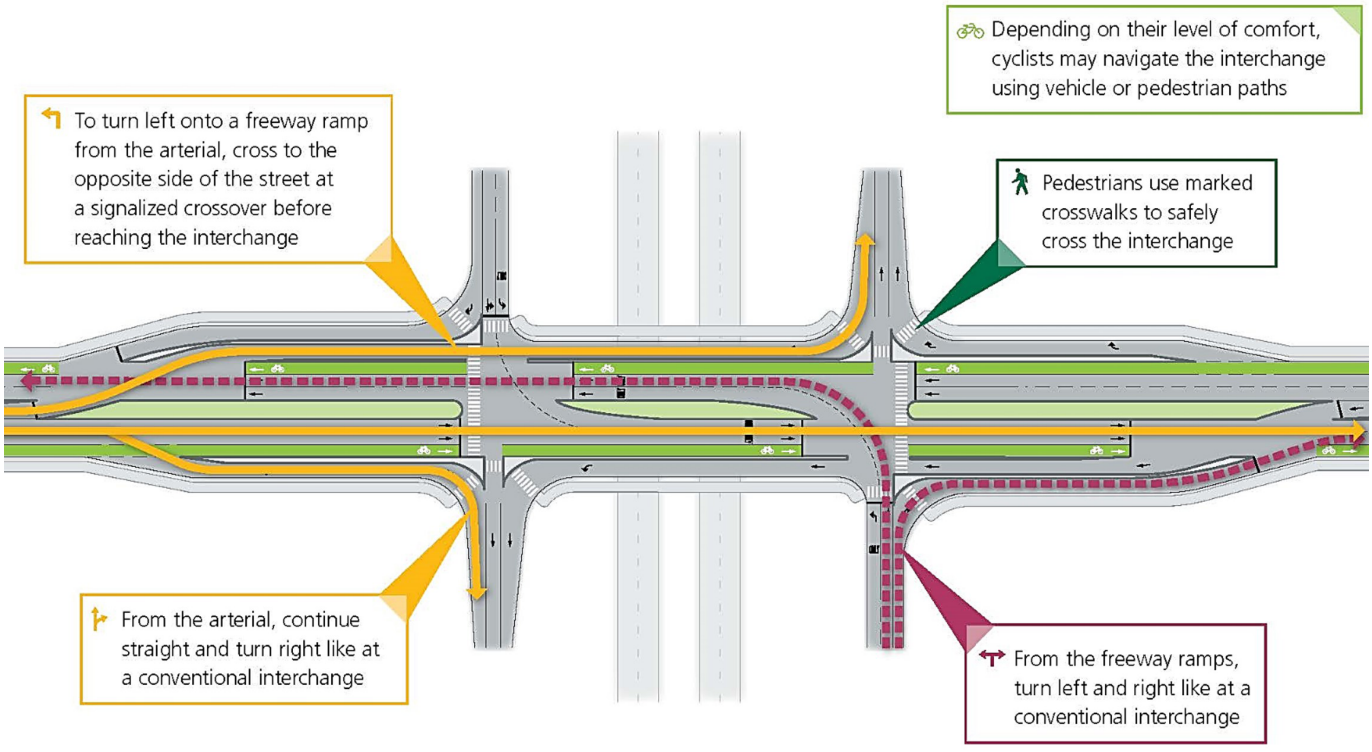


FIGURE 3 - DISPLACED LEFT TURN INTERCHANGE

WHAT ARE THE BENEFITS OF USING DLT INTERSECTIONS?

The DLT design improves road user safety by lowering the number of conflict points located at the intersection. It also improves the intersection's operational efficiency by decreasing the number of traffic signal phases (from four to two) required to pass through the intersection, enhancing signal synchronization.

DIVERGING DIAMOND INTERCHANGE

Here are some key points to emphasize when discussing the Diverging Diamond Interchange (DDI).

WHAT IS A DDI INTERCHANGE?

A DDI is a grade-separated interchange that allows crossroad traffic traveling over a freeway (in both directions) to temporarily divide and cross to the opposite side, which allows traffic greater ease in accessing (or exiting from) the freeway.

WHAT ARE THE TYPICAL DESIGN CHARACTERISTICS OF A DDI INTERCHANGE?

The main difference between a DDI and a conventional interchange is the design of directional crossovers on either side of the interchange (Figure 4). The DDI can be considered in locations with heavy left-turn traffic volumes on to freeway entry and exit ramps, locations without adjacent traffic signals or nearby driveways and locations where there is limited roadway width for left-turn lanes (such as between ramp intersections and in locations with limited available space).

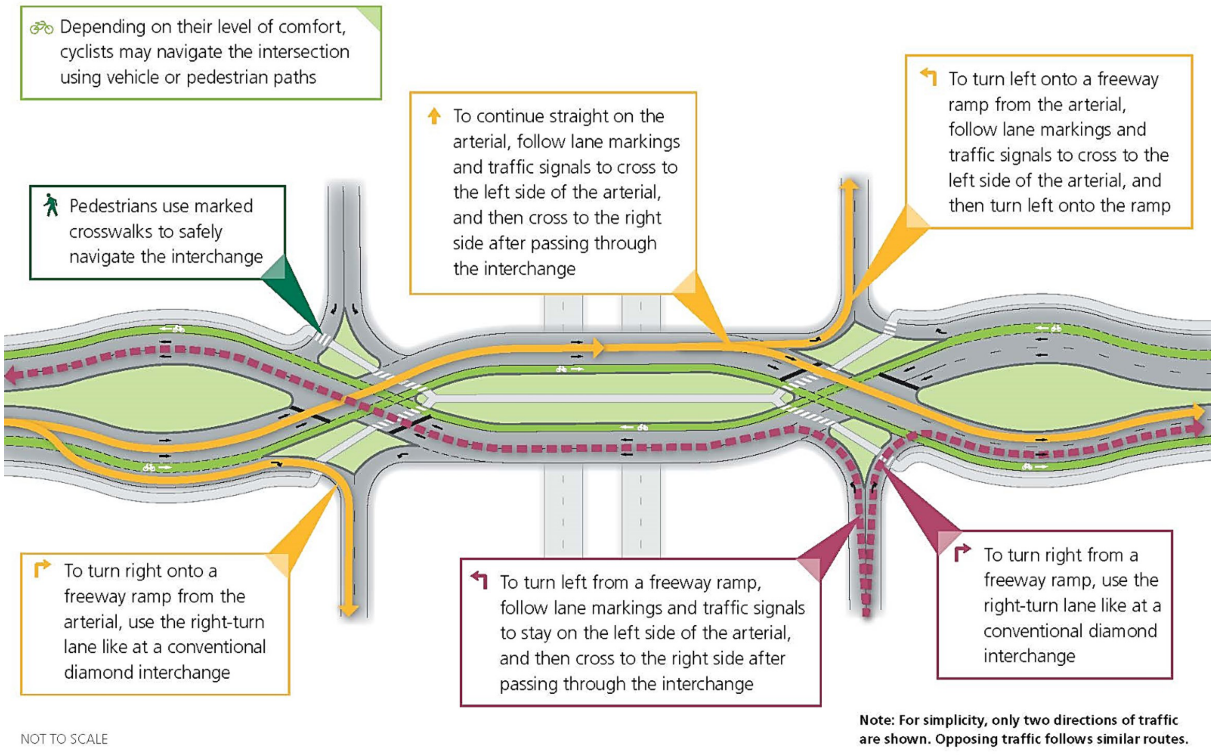


FIGURE 4 - DIVERGING DIAMOND INTERCHANGE

WHAT ARE THE BENEFITS OF USING DDI INTERCHANGES?

The DDI design improves traffic capacity when used with a two-phase signal configuration. Reducing the number of conflict points found at a traditional interchange improves safety. A DDI design is often cost-efficient due to its small-size footprint, shorter construction time, opportunities to incorporate existing structures into the design and traditionally low-to-moderate right-of-way requirements.

MEDIAN U-TURN

Here are some key points to emphasize when discussing median U-turn intersections.

WHAT IS A MEDIAN U-TURN?

A median U-turn intersection replaces direct left turns with indirect left turns that are completed through the use of wide, median-located U-turn movements. A median U-turn is ideal for wide, median-divided highways that experience heavy through traffic and moderate left-turn traffic.

WHAT ARE THE TYPICAL DESIGN CHARACTERISTICS OF A MEDIAN U-TURN?

A median U-turn can be signalized, stop controlled, or yield-controlled and can be designed in one of two ways:

- **Partial:** Only left turn vehicles from the major street make U-turns at medial openings.
- **Full:** A median U-turn is used for both the major and cross street. Multimodal transportation is accommodated with pedestrian and bicycle crossings located at the main intersection (Figure 5).

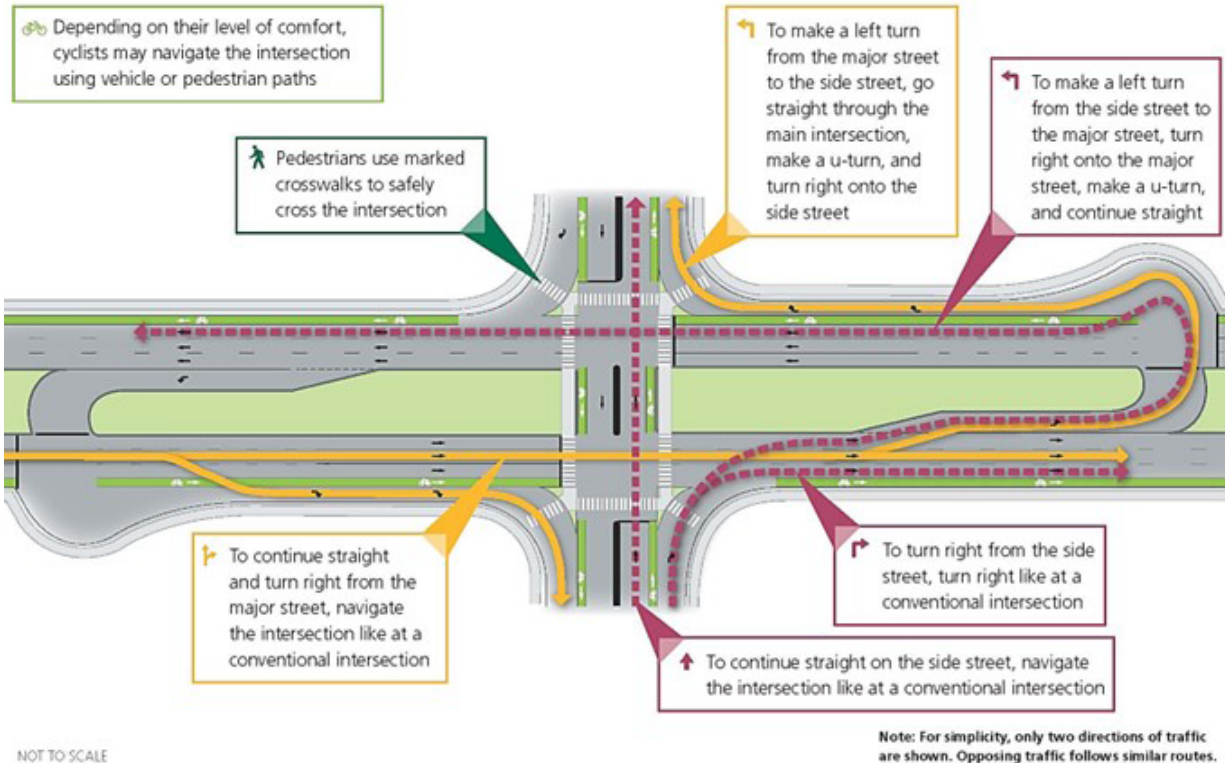


FIGURE 5 - MEDIAN U-TURN

WHAT ARE THE BENEFITS OF USING MEDIAN U-TURNS?

This design improves safety by reducing the number of conflict points and minimizing the potential of right-angle crashes. It also reduces the delay normally caused by left turn activity taken at main intersection and reduces the number of signal cycles required to cross the main intersection.

MODERN ROUNDABOUT

Here are some key points to emphasize when discussing modern roundabout intersections.

WHAT IS A MODERN ROUNDABOUT?

A modern roundabout is a circular intersection to move traffic in a counterclockwise direction around a central island. Traffic entering a roundabout must yield to traffic already circulating in the roundabout.

WHAT ARE THE TYPICAL DESIGN CHARACTERISTICS OF A MODERN ROUNDABOUT?

The modern roundabout design may use one of the following configurations: mini, single-lane and multi-lane (Figure 6). Based on traffic volumes and project constraints or impacts, the roundabout design can be used in both urban and rural settings. This intersection type can be adjusted to facilitate traffic bypass (via a channelized right-turn design) or accommodate large vehicular traffic (a traversable central island or use of a split islands design approach).

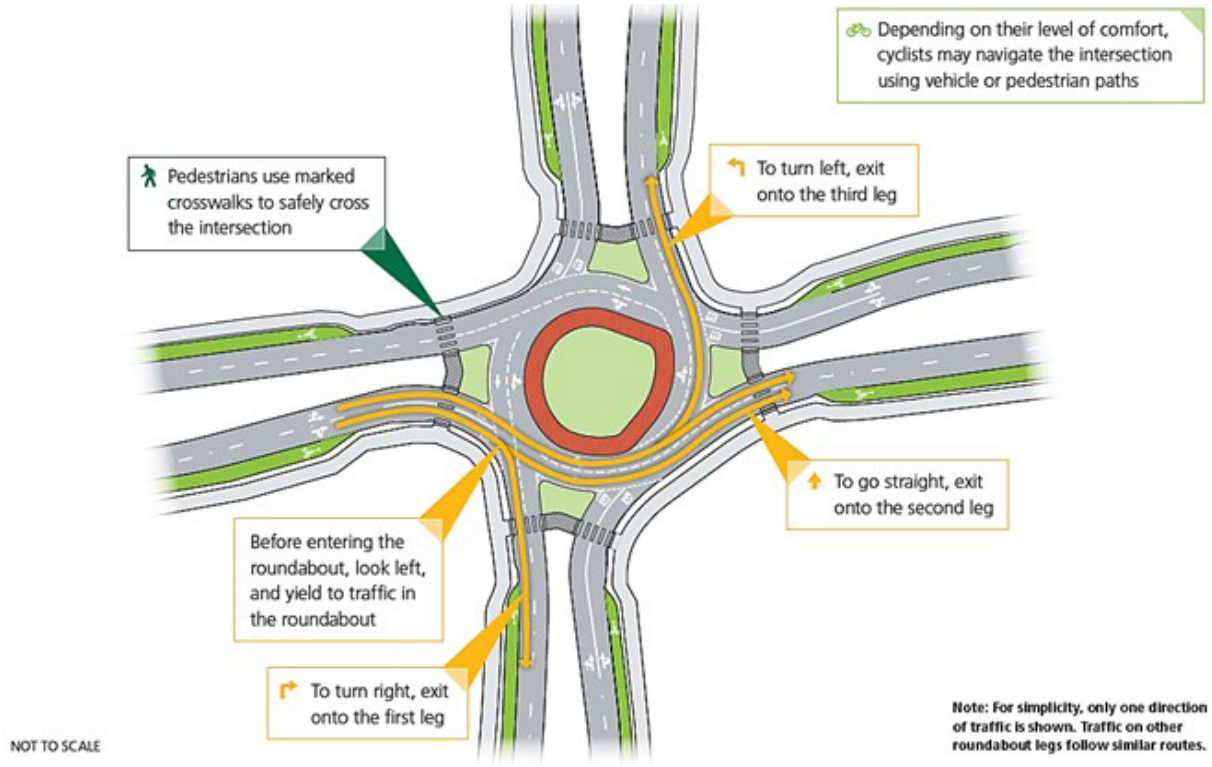


FIGURE 6 - MULTI-LANE ROUNDABOUT

WHAT ARE THE BENEFITS OF USING MODERN ROUNDABOUTS?

This design improves safety by promoting lower speeds, reducing conflict points and minimizing head-on and right-angle collision potential as a result. The low number of conflict points also make roundabouts bicyclist and pedestrian friendly. In addition, modern roundabouts reduce traffic delays and vehicle back-ups by distributing traffic volume across two intersections instead of one. Modern roundabouts are not signalized, and as a result, they reduce potential maintenance costs relative to a signalized intersection. The roundabout design also allows for landscaping and beautification.

QUADRANT ROADWAY

Here are some key points to emphasize when discussing quadrant roadways.

WHAT IS A QUADRANT ROADWAY?

A quadrant roadway features one main and two secondary intersections where left turns are directed to a connector road located in one corner (or quadrant) of the main intersection.

WHAT ARE THE TYPICAL DESIGN CHARACTERISTICS OF A QUADRANT ROADWAY?

No left turns are made at the main intersection, with vehicles turning left from any of the four approaches to the intersection using the secondary intersections and quadrant connector road to complete the left turn movement. Grade-level separation is typically a part of a quadrant roadway design (Figure 7).

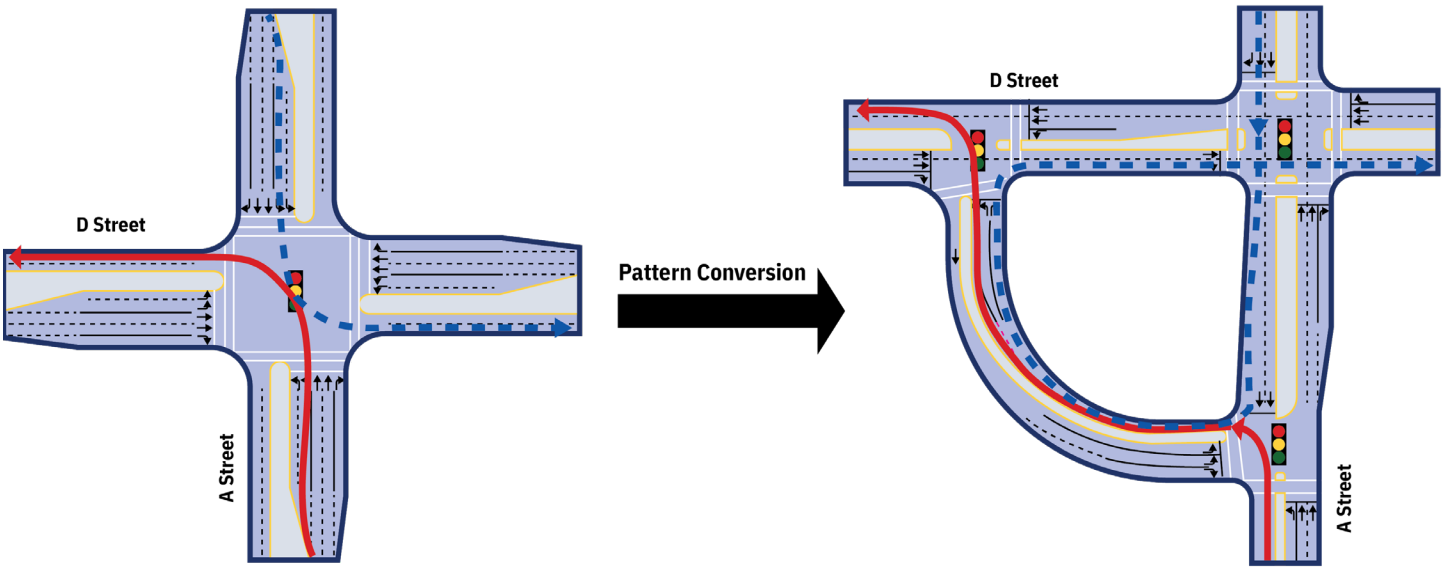


FIGURE 7 - TRADITIONAL INTERSECTION (LEFT) / QUADRANT ROADWAY (RIGHT) COMPARISON

WHAT ARE THE BENEFITS OF USING QUADRANT ROADWAYS?

This design improves safety by reducing the number of conflict points compared to a traditional intersection. The absence of direct left turns and left turn lanes at the main intersection decreases pedestrian and bicyclist crossing distances, shortens traffic signal cycle lengths and eliminates left-turning conflicts with pedestrians and bicyclists (who cross instead at the signalized secondary intersections). It also distributes traffic volume across two intersections instead of one.

RESTRICTED CROSSING U-TURN (RCUT)

Here are some key points to emphasize when discussing the Restricted Crossing U-Turn (RCUT) intersection.

WHAT IS A RCUT INTERSECTION?

Also known as a superstreet, a RCUT is divided roadway whose major intersections are modified to eliminate left turns and straight-through traffic on roads that intersect a main roadway.

WHAT ARE THE TYPICAL DESIGN CHARACTERISTICS OF A RCUT INTERSECTION?

The RCUT design converts traffic flow at minor intersections into right-in/right-out movements (i.e., traffic can only turn right onto or from those streets). Turnarounds are placed in a median and are used to facilitate vehicle left turns and crossovers via U-turn movement (Figure 8).

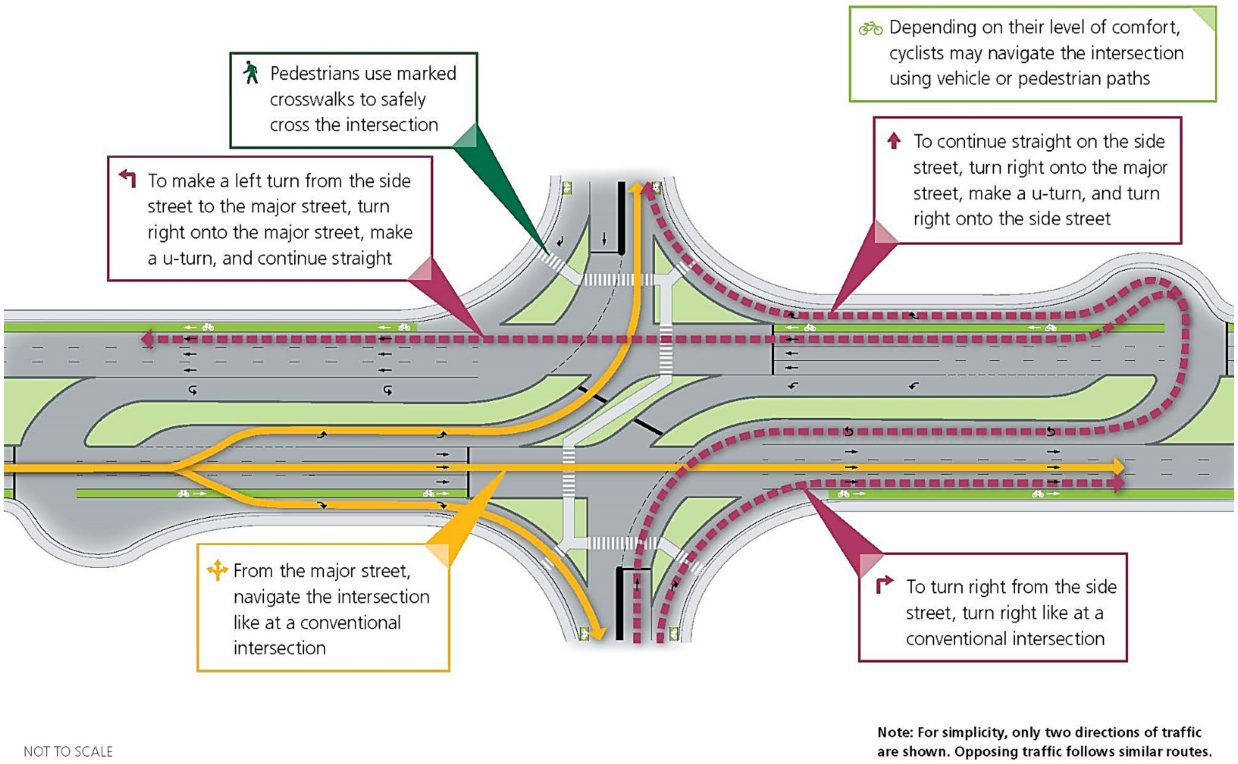


FIGURE 8 - RCUT INTERSECTION

WHAT ARE THE BENEFITS OF USING RCUT INTERSECTIONS?

This design reduces vehicle conflict points while simplifying the decision process for drivers approaching a RCUT intersection. When a driver approaches a traditional four-legged intersection to make a left-turn, a driver must assess at least two different directions of traveling vehicles: crossing traffic and opposing traffic.

In a RCUT intersection, the driver only considers one direction of traveling vehicles at a time, such as left-turn movement by vehicles traveling in the opposite direction. The RCUT's simplified driver experience also reduces travel time through the intersection.

SINGLE POINT URBAN INTERCHANGE

Here are some key points to emphasize when discussing the Single Point Urban Interchange (SPUI).

WHAT IS A SPUI INTERCHANGE?

A SPUI is a grade-separated interchange where freeway ramps that begin or end at a signalized intersection located on an arterial portion of the crossroad.

WHAT ARE THE TYPICAL DESIGN CHARACTERISTICS OF A SPUI INTERCHANGE?

The SPUI design uses a signalized intersection that operates with a single, three-phase traffic signal. (Figure 9). Right-turn movements onto and off freeway ramps occur at unsignalized intersections that are separate from the main intersection. Much like a Diverging Diamond Interchange (DDI), a SPUI allows vehicles traveling in opposite directions to make left turns simultaneously. Unlike a DDI, left-turning traffic streams in a SPUI do not cross.

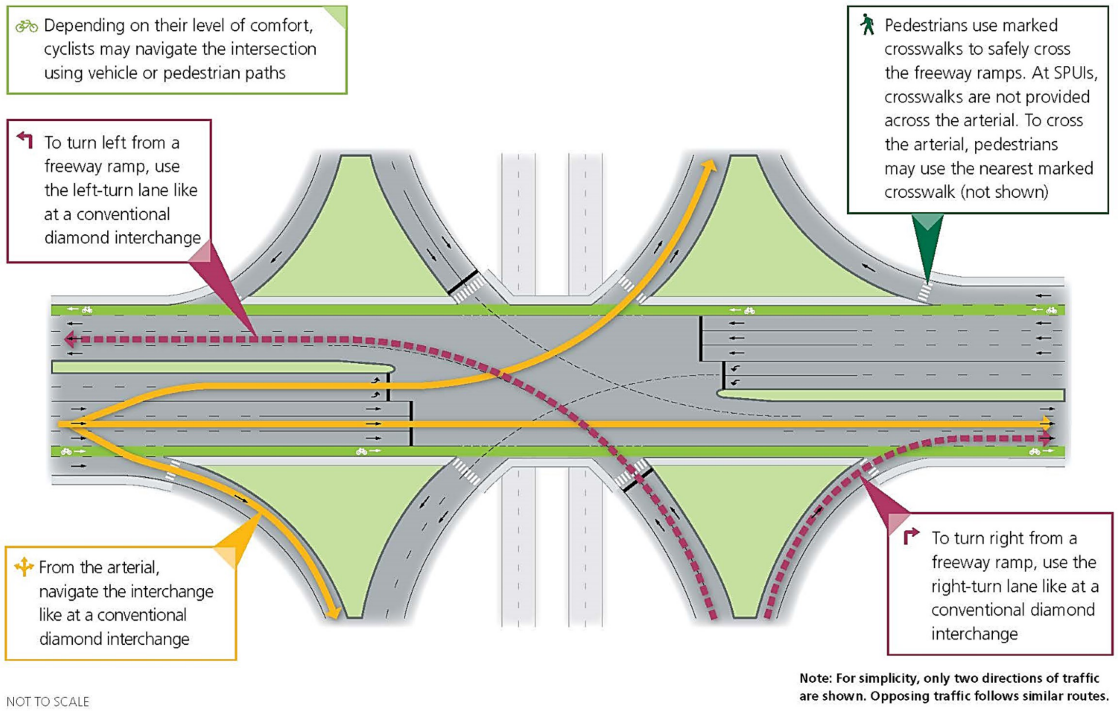


FIGURE 9 - SINGLE POINT URBAN INTERCHANGE (SPUI)

WHAT ARE THE BENEFITS OF USING SPUI INTERCHANGES?

The SPUI design's use of a single, three-phase traffic signal allows increased vehicular traffic volumes (compared to traditional intersections) for vehicles traveling through the signalized intersection. Managed left-turn and right-turn traffic streams, along with crossroad through traffic that bypasses the intersection, also supports higher traffic volumes while reducing the number of conflict points at the intersection. Right-of-way requirements for a SPUI are low-to-moderate as well.