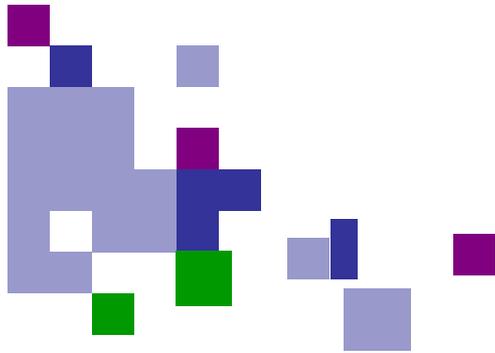




ITE Annual Meeting
July 19-22, 2015
Las Vegas



ADVANTEC
Consulting Engineers





Introduction

Name: Jimmy Woo

Title: Senior Project Engineer

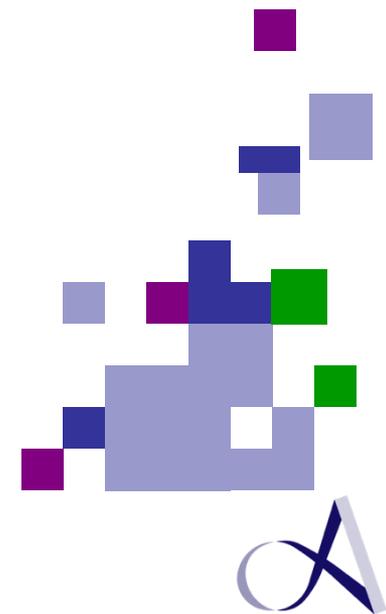
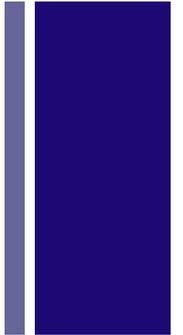
Experience: 15+ years

Expertise:

- Highway & Street Design
- Roadway Grading
- Retaining Wall/Sound Wall Design
- Rail/Roadway Interface
- Utility Relocations

Key Projects:

- I-5 Grapevine Interchange
- Westside Purple Line Extension
- SR-22 HOV Widening Design-Build Project



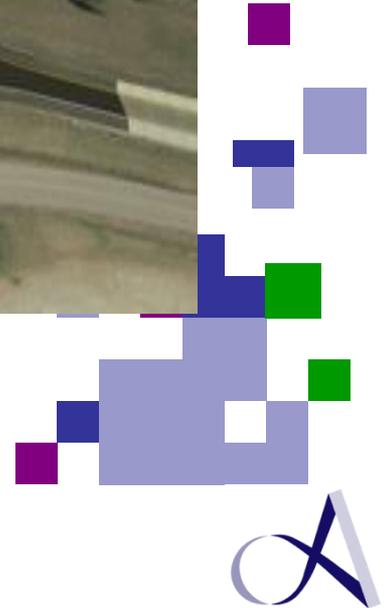
+ Advantage and Disadvantage of Diverging Diamond Interchange (DDI)



L9

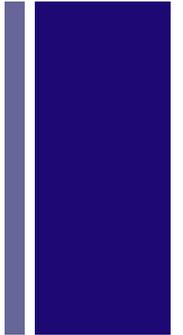


DDI

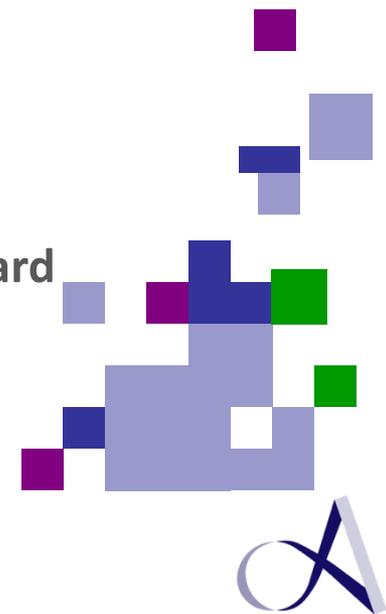




How did the idea of Diverging Diamond Interchange (DDI) come about?



- Mr. Gilbert Chlewicki, P.E. – ATS/American’s Division Director; Father of the DDI; National Expert
- University of Maryland – topic idea for term paper (2000)
- “Criss-Cross Intersection” to “Diverging Diamond Interchange” (DDI)
- Six months later vacationing in France, he surprisingly drove through a “diverging diamond” on a tour bus
- After more research and studying of the DDI, he wrote and presented a paper on the DDI at a Transportation Research Board sponsored conference in 2003
- 48 Existing; 7 In construction; 6 In Planning in the U.S.

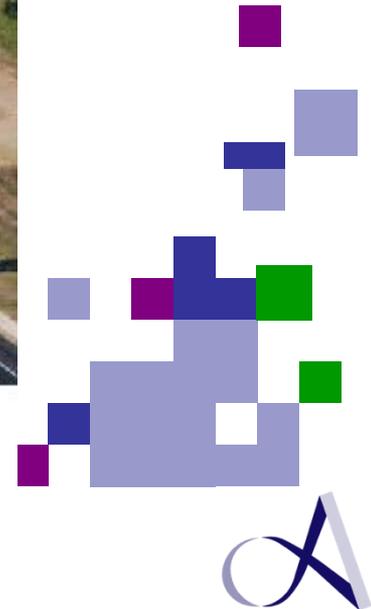
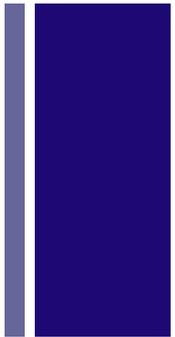


I-44/MO-13: The Diverging Diamond

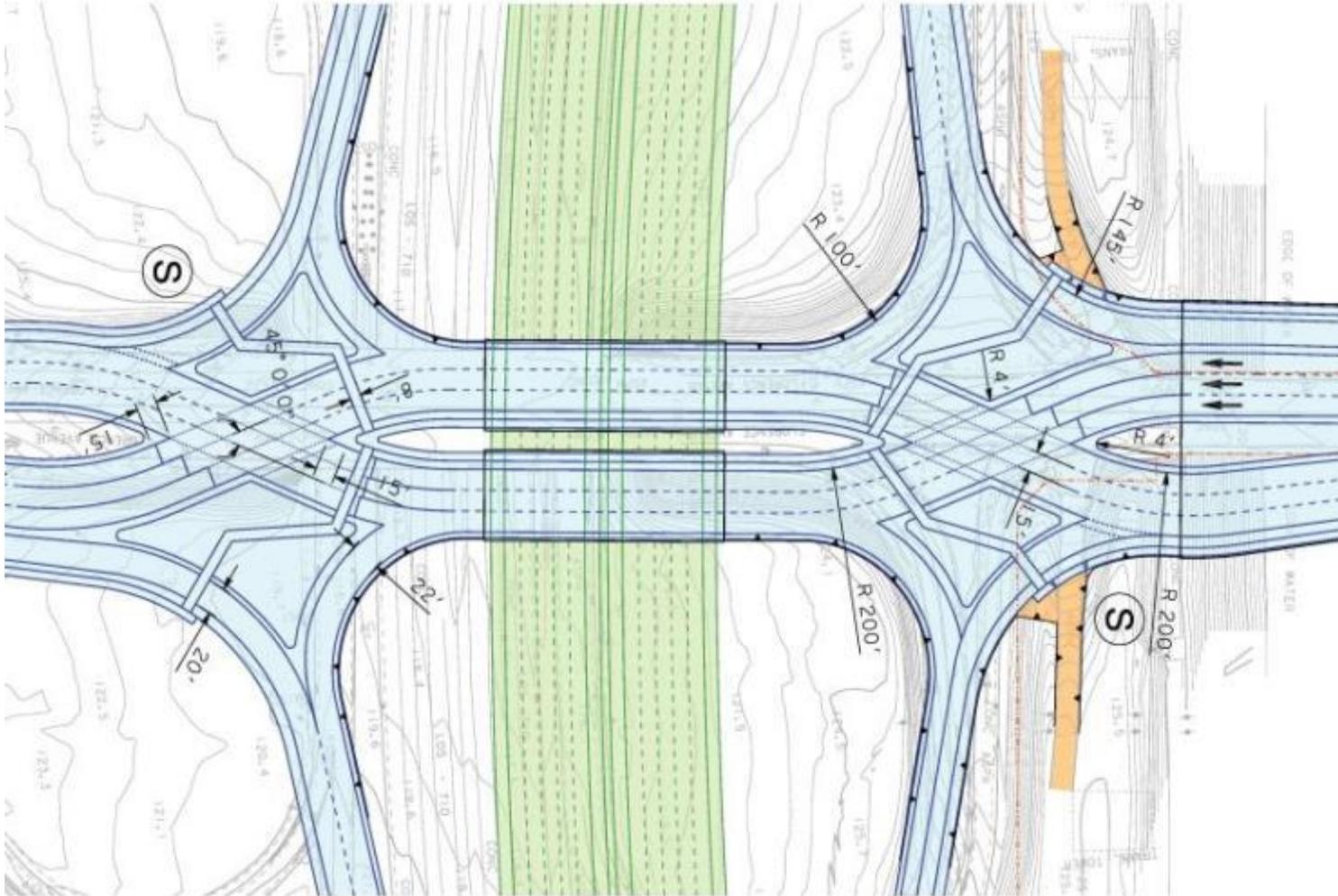


First in the Nation

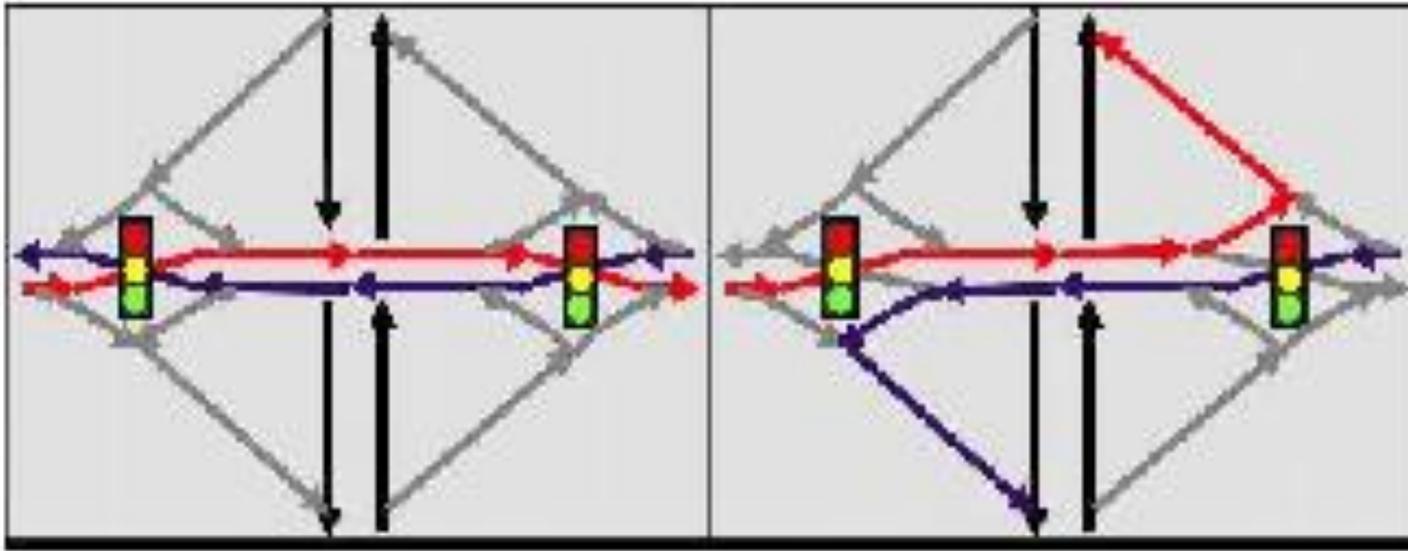
First ever DDI in the U.S. was build in Springfield, MO on Jun 21, 2009



+ Design Criteria of a DDI

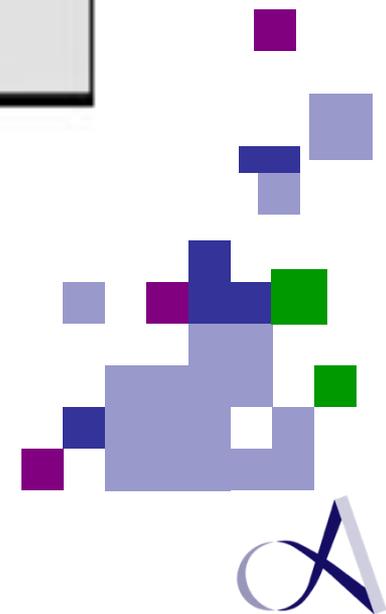
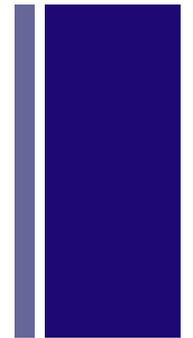


+ Traffic Movements

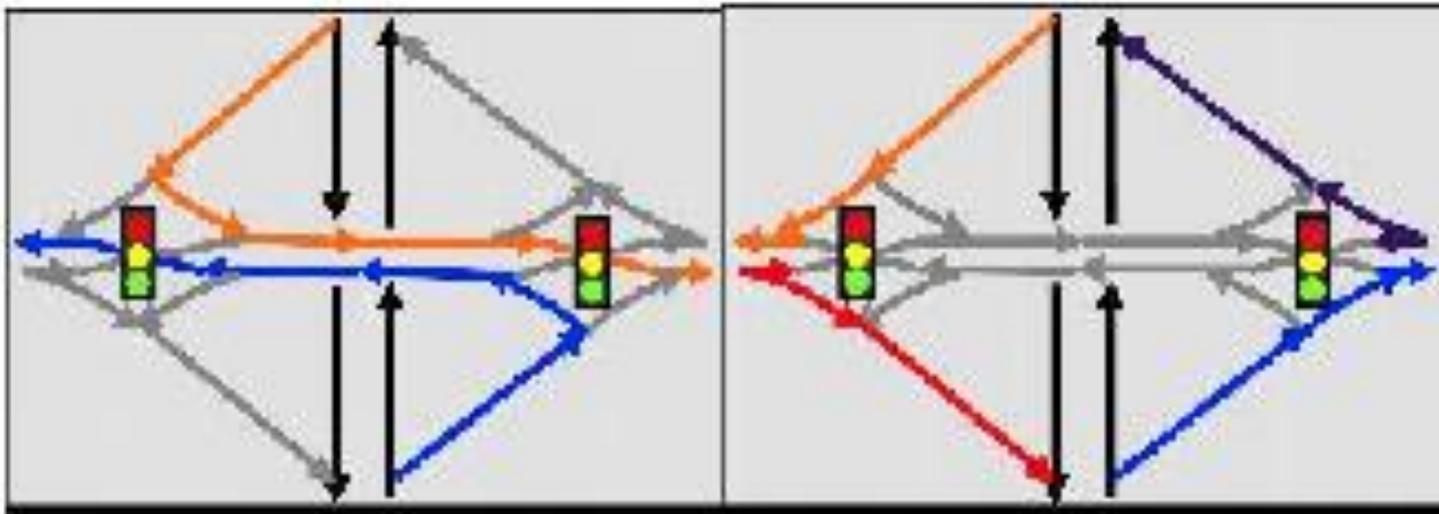


Thru Movements

Lefts from arterial road

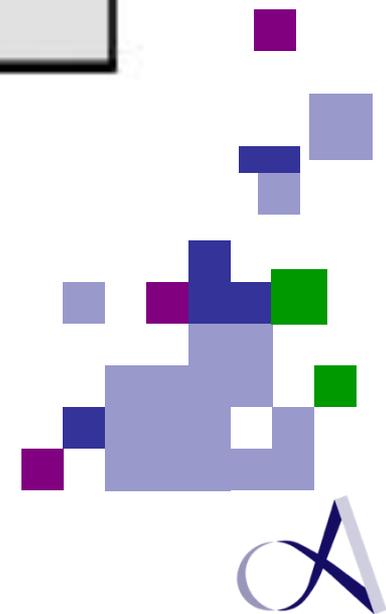
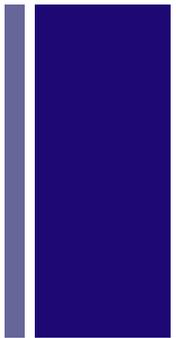


+ Traffic Movements



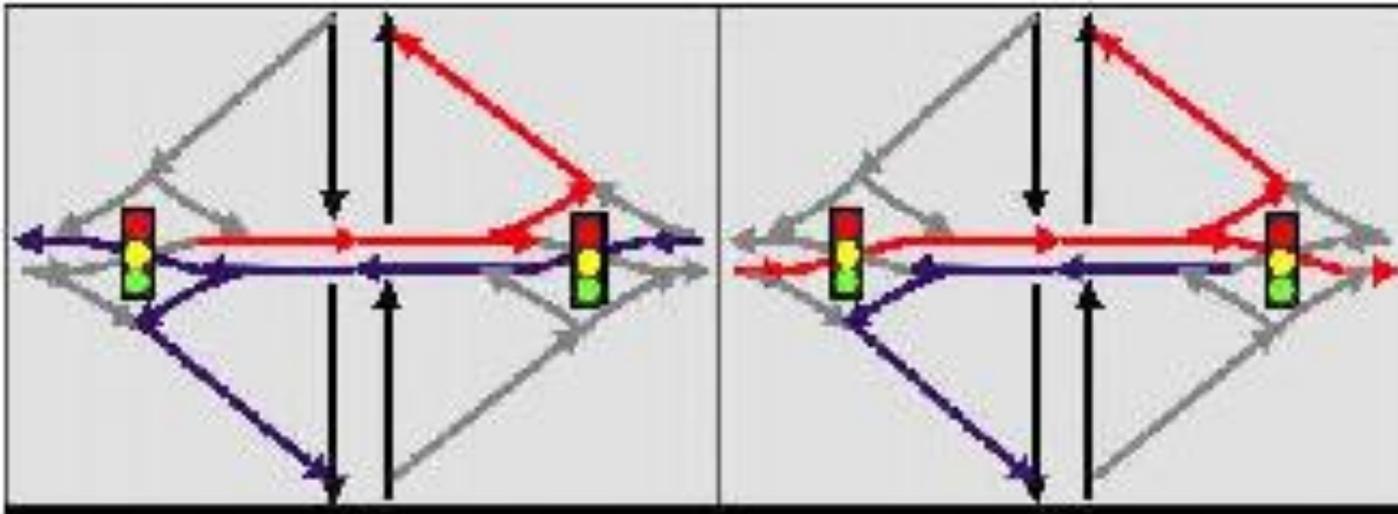
Lefts from ramps

Right turns

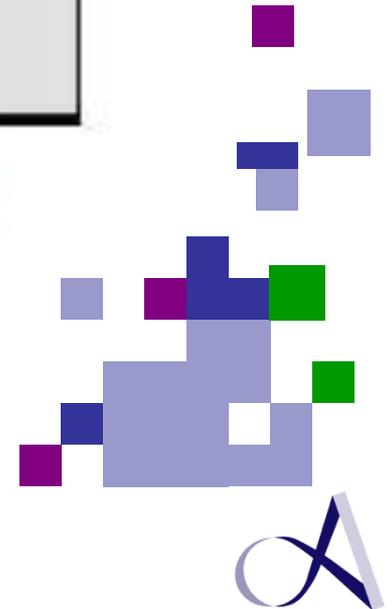


+ Unique Phase Combinations

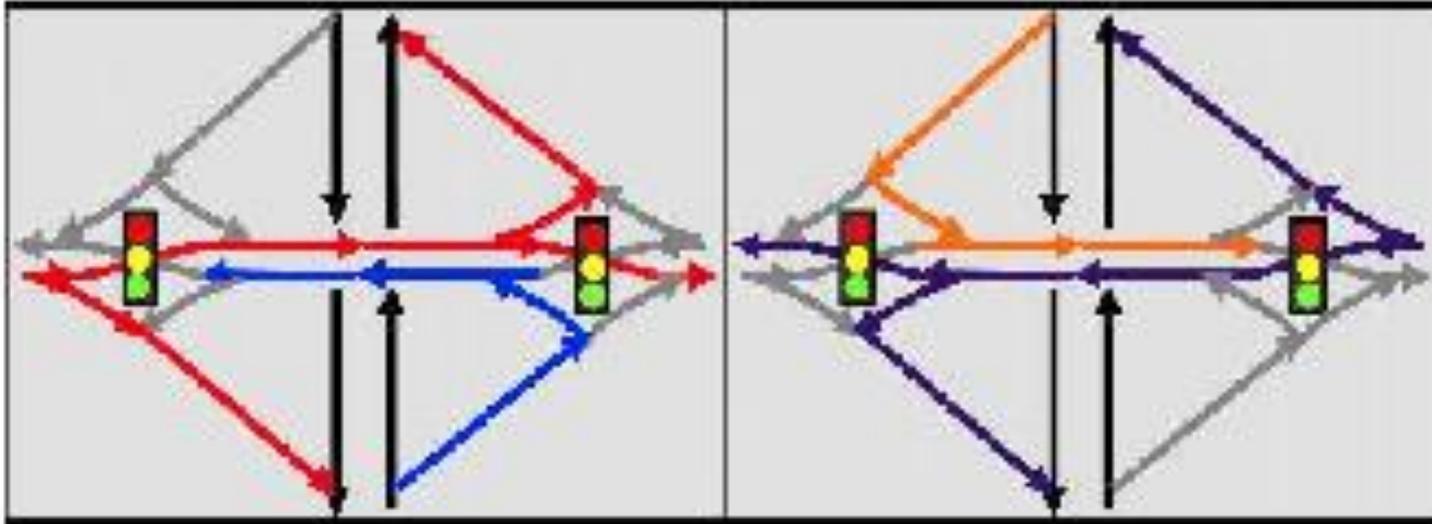
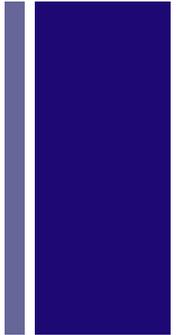
UNIQUE PHASE COMBINATIONS



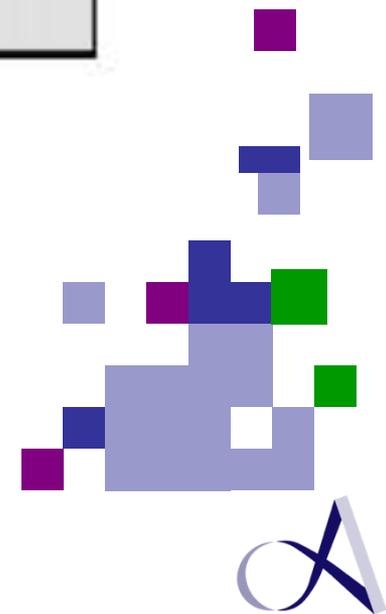
Lefts turns in one direction can be partially phased with all movements in the other direction.



+ Unique Phase Combinations



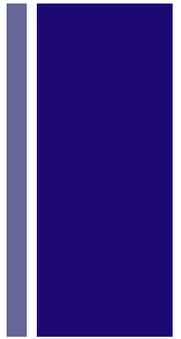
Left turn from ramp can be partially phased with all movements in one direction.

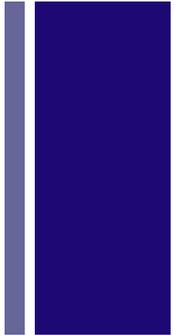




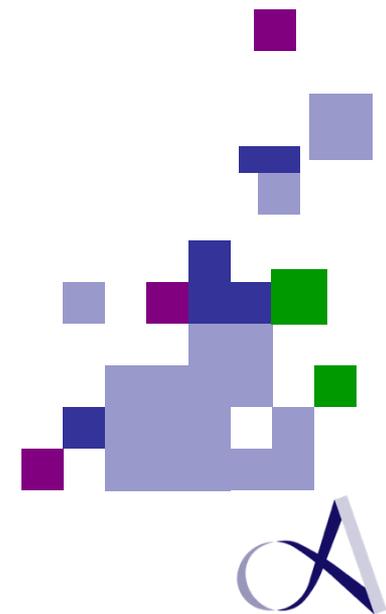
When should a DDI be considered?

- DDI should be considered for any interchange where signal lights can be expected on the cross road.
- DDI works best if one of the left turning movements is high and/or if thru movements are unbalanced during peak hours.
- DDI can solve many other issues such as queuing, synchronization, bottlenecks, lane balancing, weaving, pedestrians, special event needs, and widening needs.



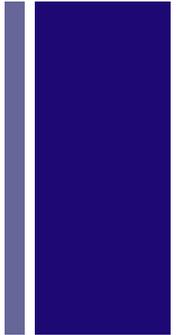


Advantage and Disadvantage of a Diverging Diamond Interchange (DDI)



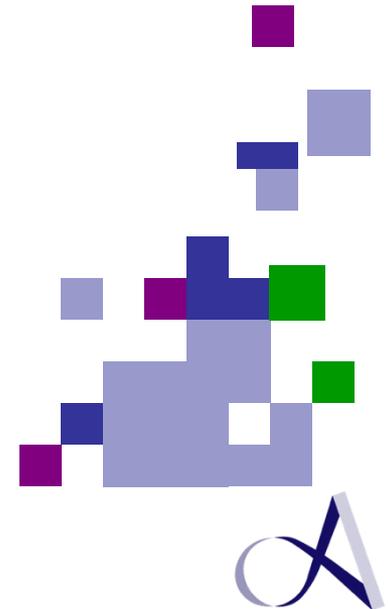
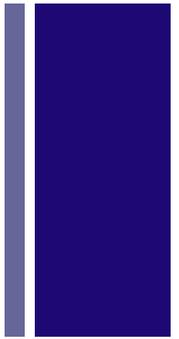
+ Advantages

- Fewer conflict points (14 for DDI, 26 for conventional), thus theoretically improving safety
- Two-phase signals with shorter cycle lengths, reduce delay significantly
- Better sight distance at turns
- Increases the capacity of turning movements to and from the ramps without needing more lanes
- Better storage between the ramp terminals
- U-turns from highway are accommodated well
- Better signal network synchronization
- Increases the capacity of an existing overpass or underpass by removing the need for turn lanes
- Due to no loop ramps in the design, therefore, smaller project footprint can be achieved
- Wrong way entry to ramps extremely difficult
- Pedestrian crossings are shorter



+ Disadvantages

- No standards currently exist for this design
- DDI may create unfamiliarity for drivers with regards to merging maneuvers along the left side of the roadway or the crossover flow of traffic thus cause accidents in the near future
- Pedestrian access requires at least four crosswalks
- Free-flow traffic in both directions on the local road is impossible; the signals cannot be green at both intersections for both directions simultaneously
- Allowing existing traffic to reenter the through road in the same direction requires leaving the interchange on the local road and turning around at the next intersection
- The design depends on site-specific conditions
- Since no DDIs existed in No. America until Jun 21, 2009, no crash history is available
- Additional signage, lighting, and pavement markings are needed compare to a conventional interchange (diamond, cloverleaf or parclo)
- Local road should be a low speed facility, <45 mph posted; but a higher design speed should be utilized for the crossing movements



+ Cost Benefits

■ For a retrofit

- Existing bridge can usually be used
- Additional right-of-way rarely needed
- Construction time is reduced
- Maintenance of traffic is simplified during construction

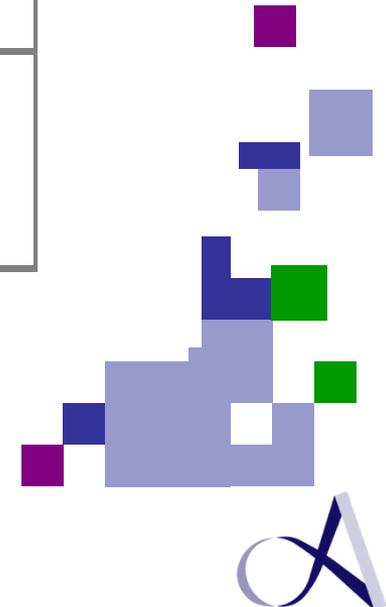
For a new interchange

- Fewer lanes than other interchange forms
- Less bridge structure
- Less right-of-way than a cloverleaf form

■

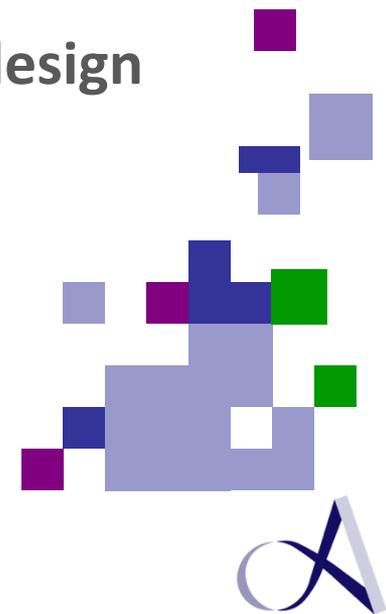
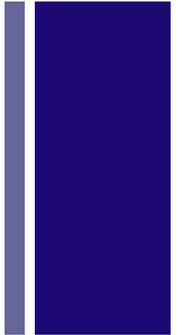
For further details on the benefits of the DDI, see our list of [courses](#).

Interchange	Location	DDI Cost (real or estimated)	Alternative Design Cost	Cost Savings
I-44 / Route 13	Springfield, MO	\$3.2 Million	Over \$10 Million	about 70%
I-435 / Front Street	Kansas City, MO	\$6.7 Million	Diamond \$11.4 Million Single Point Urban Interchange (SPUI) \$25 Million	about 75%
SR-265 / SR-62	Utica, IN	\$52 Million	\$118 Million	\$66 Million
I-590 / Winton Road	Brighton, NY	\$3-\$4 Million	SPUI \$10 Million Triple Left Diamond \$13.6 Million	about 75%



+ Conclusion

- I-5 Grapevine Interchange Project
- Chose L9 over DDI Design
- L9 was more commonly used in California
- Traffic volume movement dictates the preferred design option



The background is a dark blue technical drawing or blueprint. It features various lines, circles, and text, including numbers like '1115.70', '1830', '1760', '20', '310', '1510', '1430', '1350', '1300', '1250', '1200', '1150', '1100', '1050', '1000', '950', '900', '850', '800', '750', '700', '650', '600', '550', '500', '450', '400', '350', '300', '250', '200', '150', '100', '50', '0'. A pen is visible in the lower left quadrant. A large, stylized 'X' mark is drawn over the right side of the image, with a white outline and a dark blue fill.

Thank You

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