2017 TRB/ITE 5th Urban Street Symposium
Raleigh, North Carolina

Improving Pedestrian Operations at Innovative Geometric Designs

ATS/American

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Advanced Transportation Solutions

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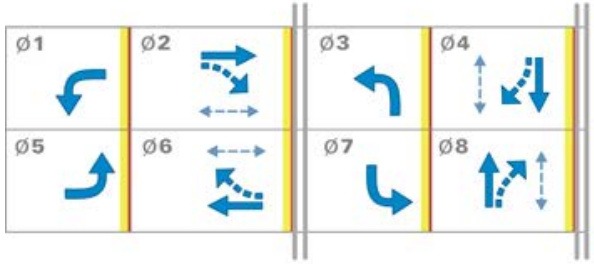
Need for Pedestrian Improvements at IGDs

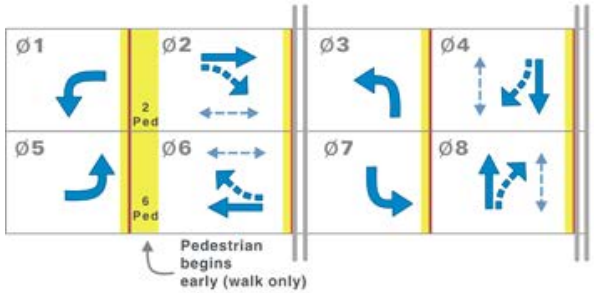
- Very Little Guidance on Pedestrian Accommodations for Innovative Geometric Design (IGD) outside of FHWA Informational Guidebooks (DDIs, RCUTs, MUTs, & CFIs)
- FHWA Guidebook Guidance based on Limited Applications and General Pedestrian Principles
  - Generally , IGDs have been a lot more concerned about vehicular operations than peds/bikes
  - IGDs have unique elements affecting pedestrian movements
  - FHWA Guidebooks do not include other IGDs

General Principles to Consider

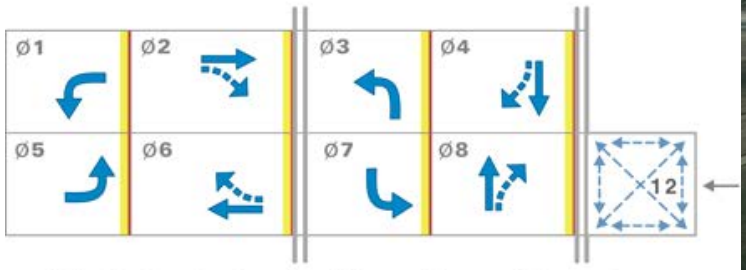
Lead, Lag, or Exclusive Ped Phasing



a) Standard Ring and Barrier Diagram

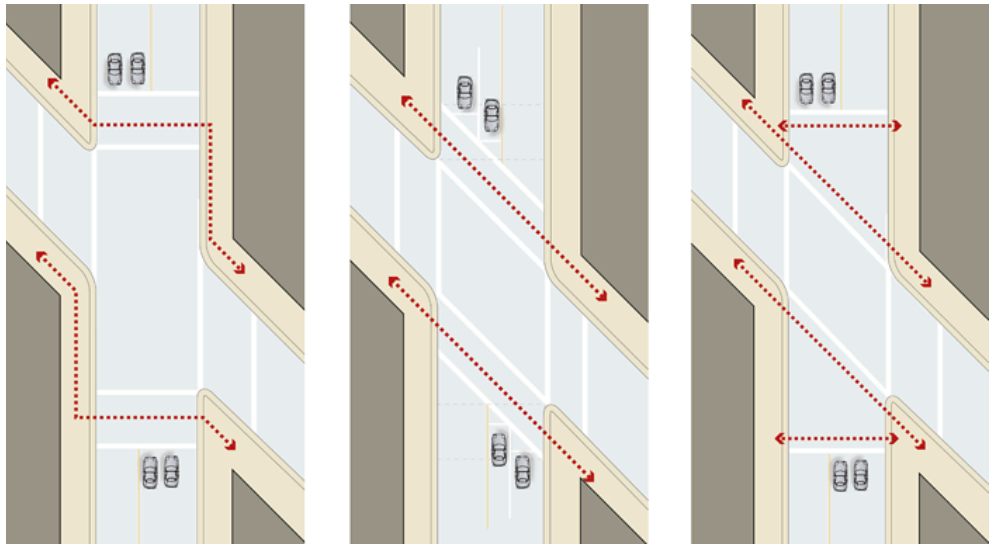


b) Leading Pedestrian Interval (on Phase 2 & 6)



c) Exclusive Pedestrian Phase (Barnes' Dance)

II vs ⊥ Crosswalks



Pedestrian Sight Distance

DDI – Pedestrian Sight Distance

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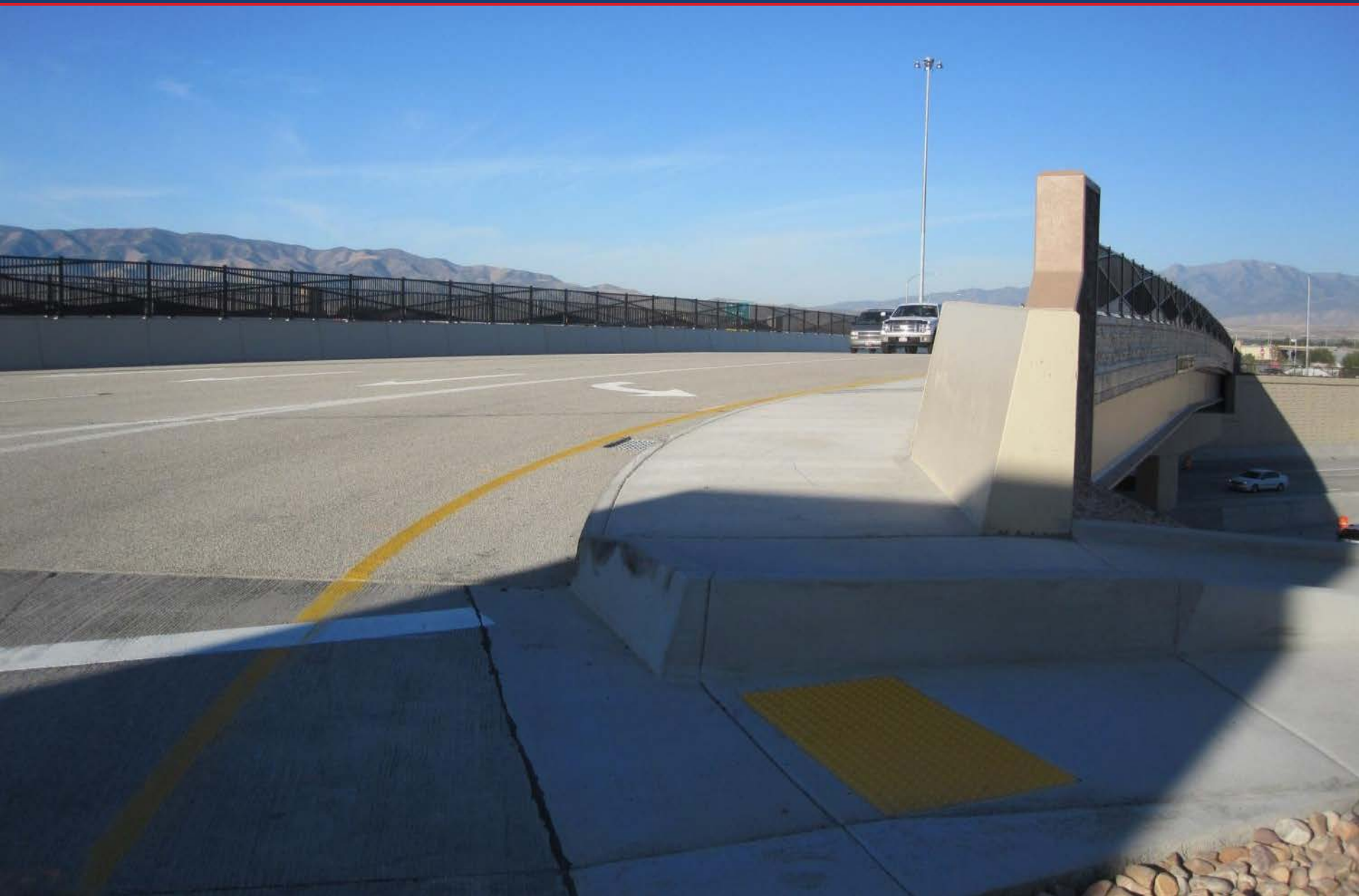

DDI – Pedestrian Sight Distance

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DDI – Parallel Crossing Pedestrian Sight Distance

DDI – Parallel Crossings

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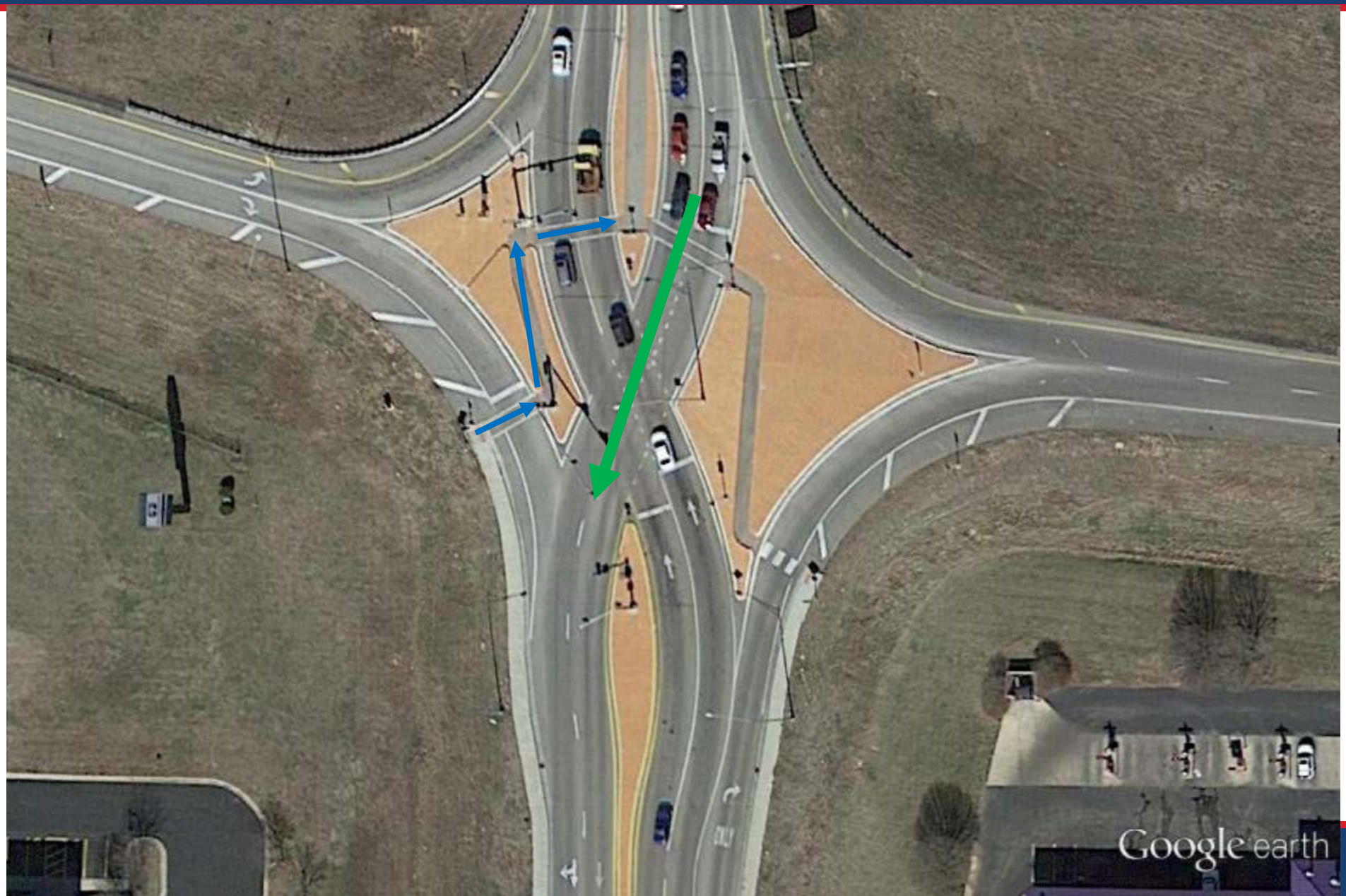
DDI – Parallel Crossings

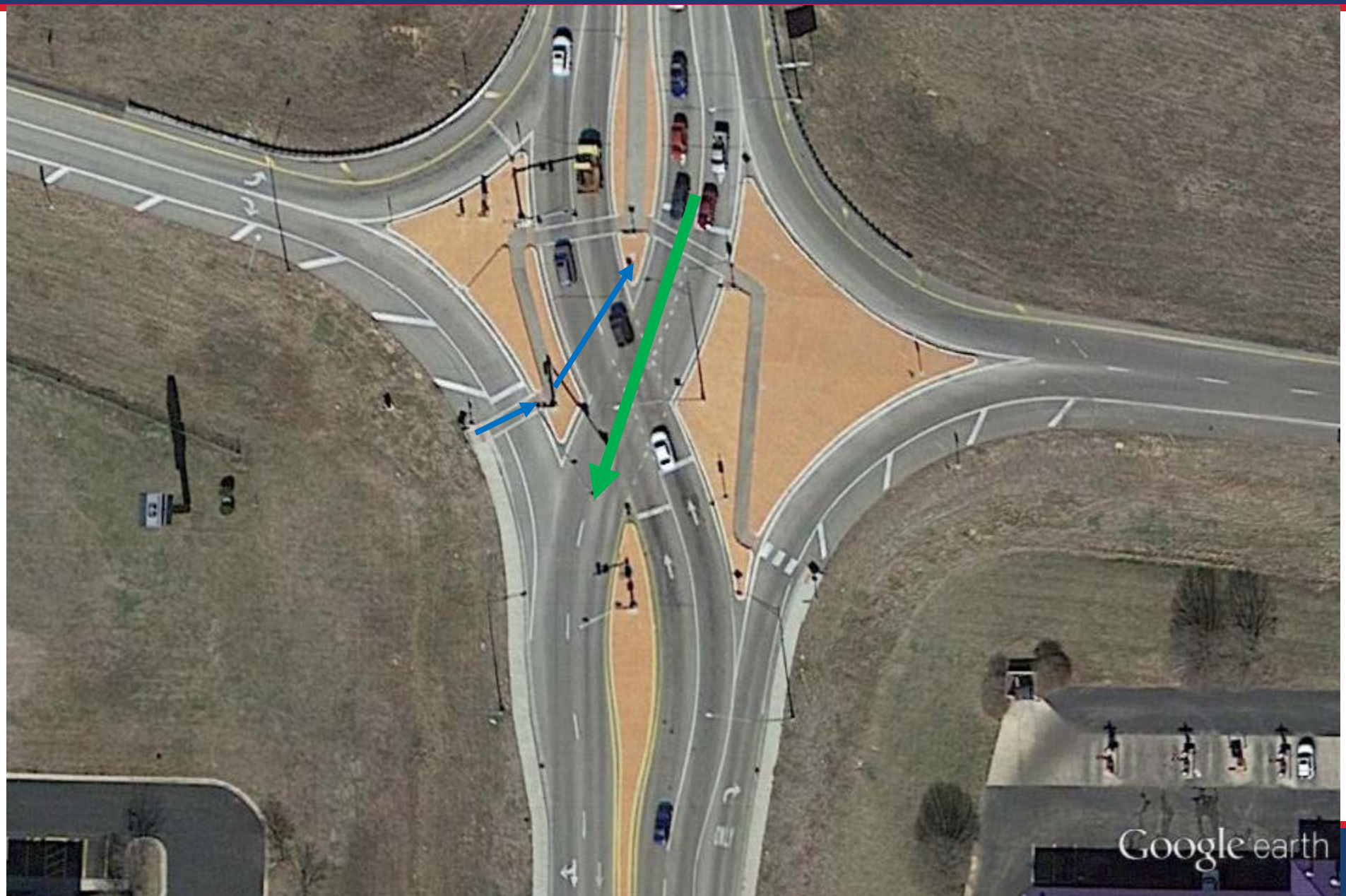
Stagger Stop Bar
= Less Clearance Time

More Direct Walk Paths

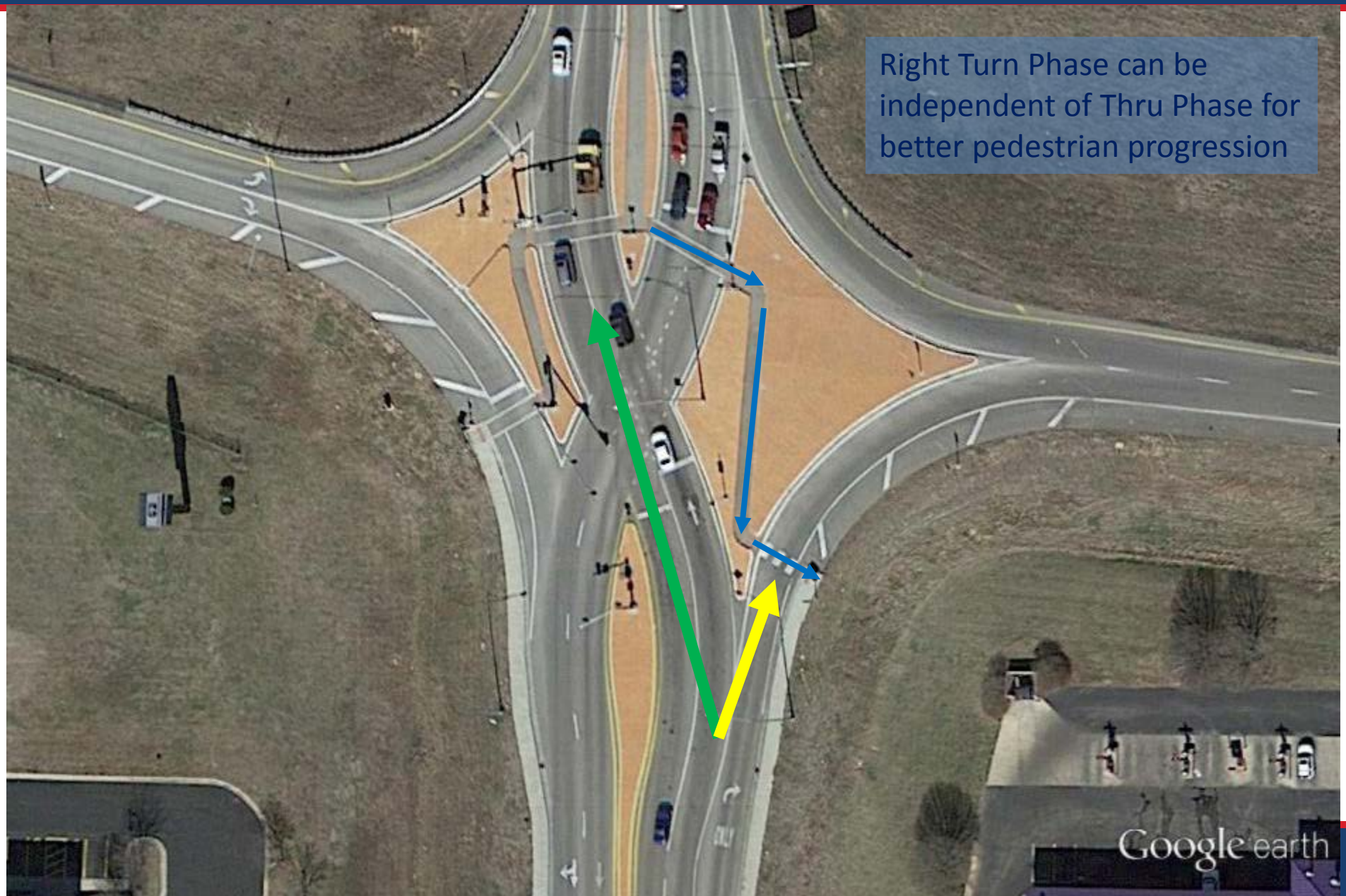
DDI – Ped Phase Coordination



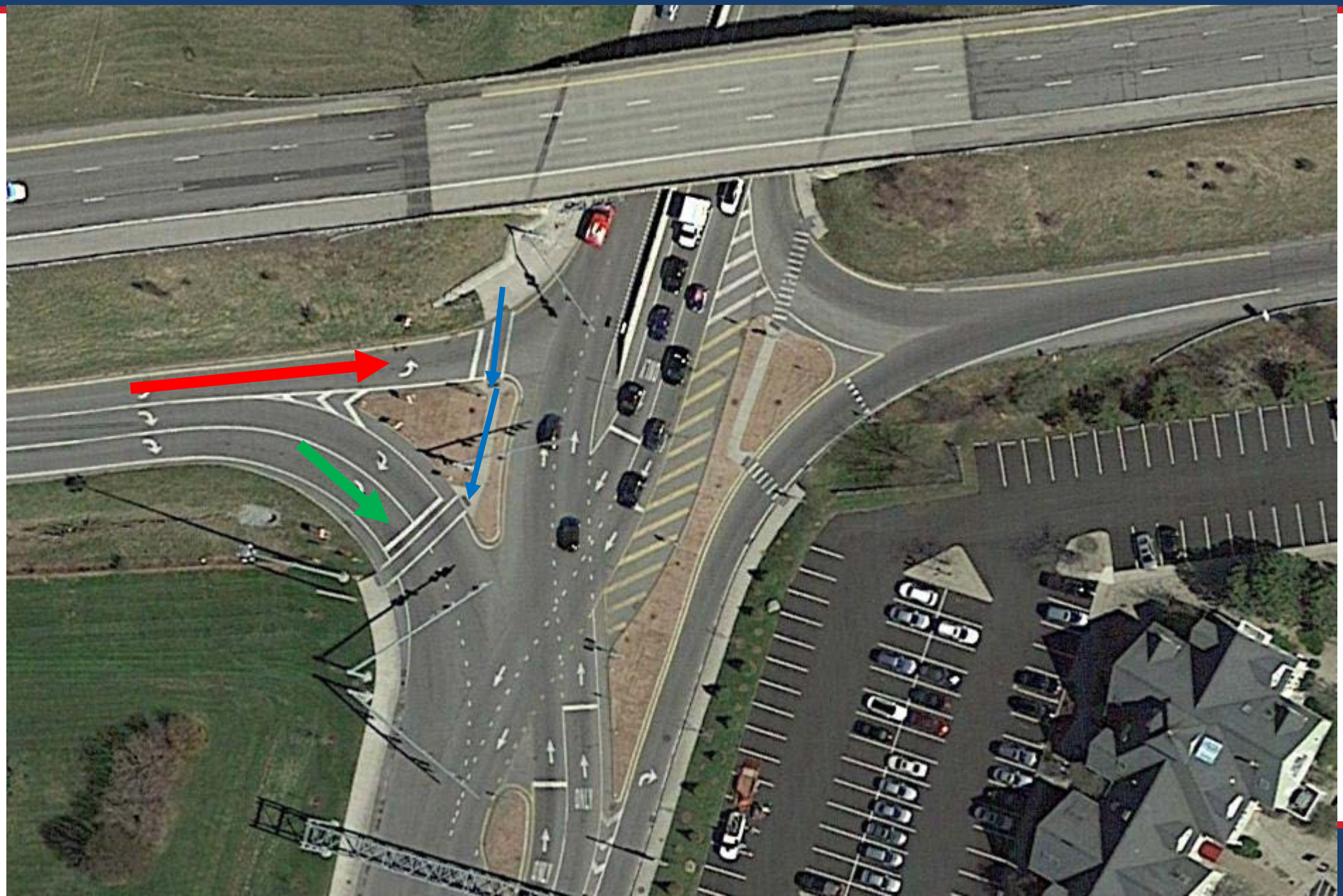
DDI – Ped Phase Coordination



DDI – Ped Phase Coordination



DDI – Ped Phase Coordination



DDI – Ped Phase Coordination

Ped Crossing almost always Two-Stages.

Adding spacing between crossings will reduce pedestrian delay

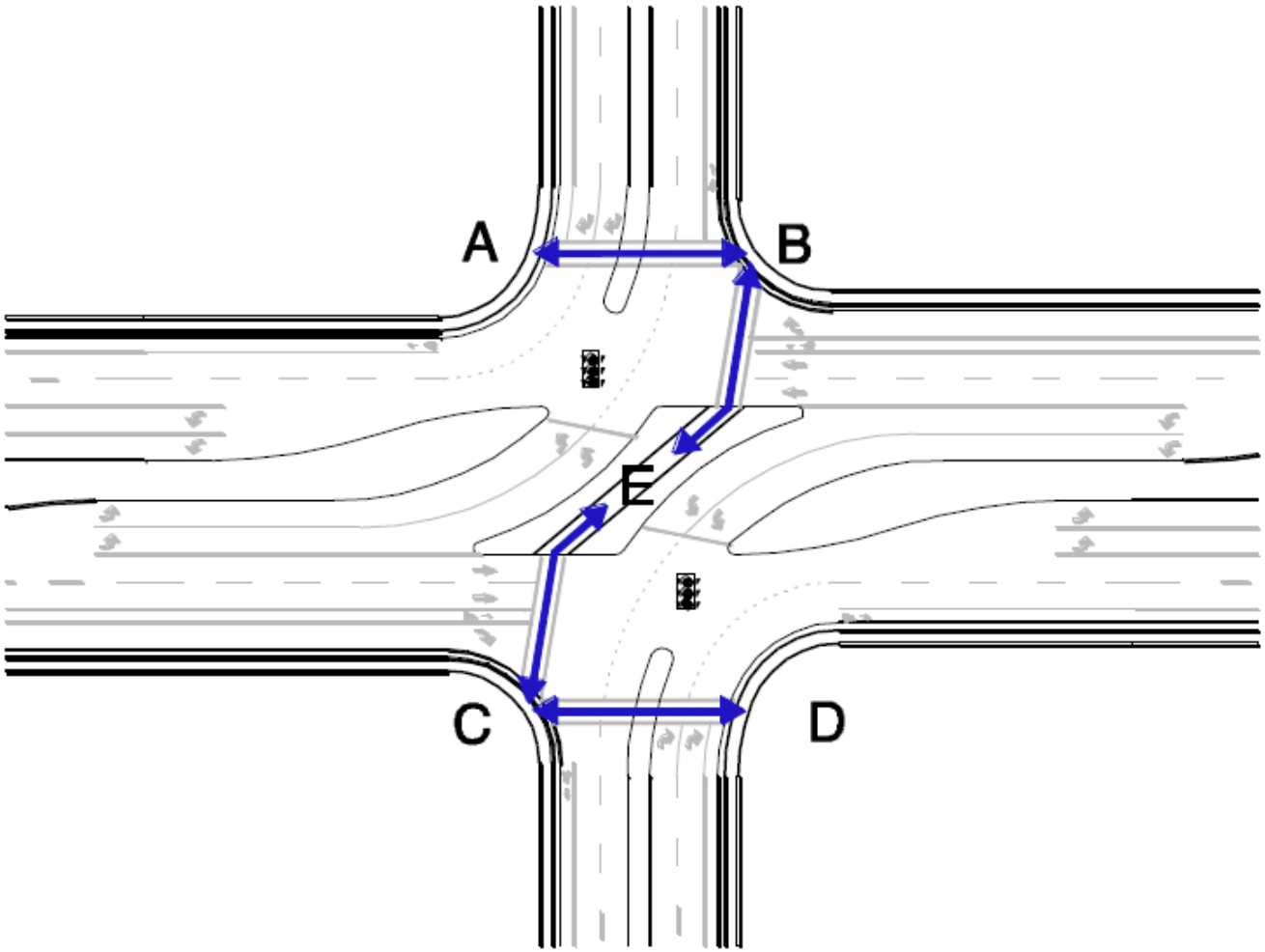
Also consider shorter cycle lengths, especially during non-peak hours

Superstreets – Crosswalk Locations

Current way of providing pedestrian crossings at SS

No turning conflict with a concurrent phase for C-E or E-B crossings

Three-Stage Crossing From A-C (A-B-E-C)

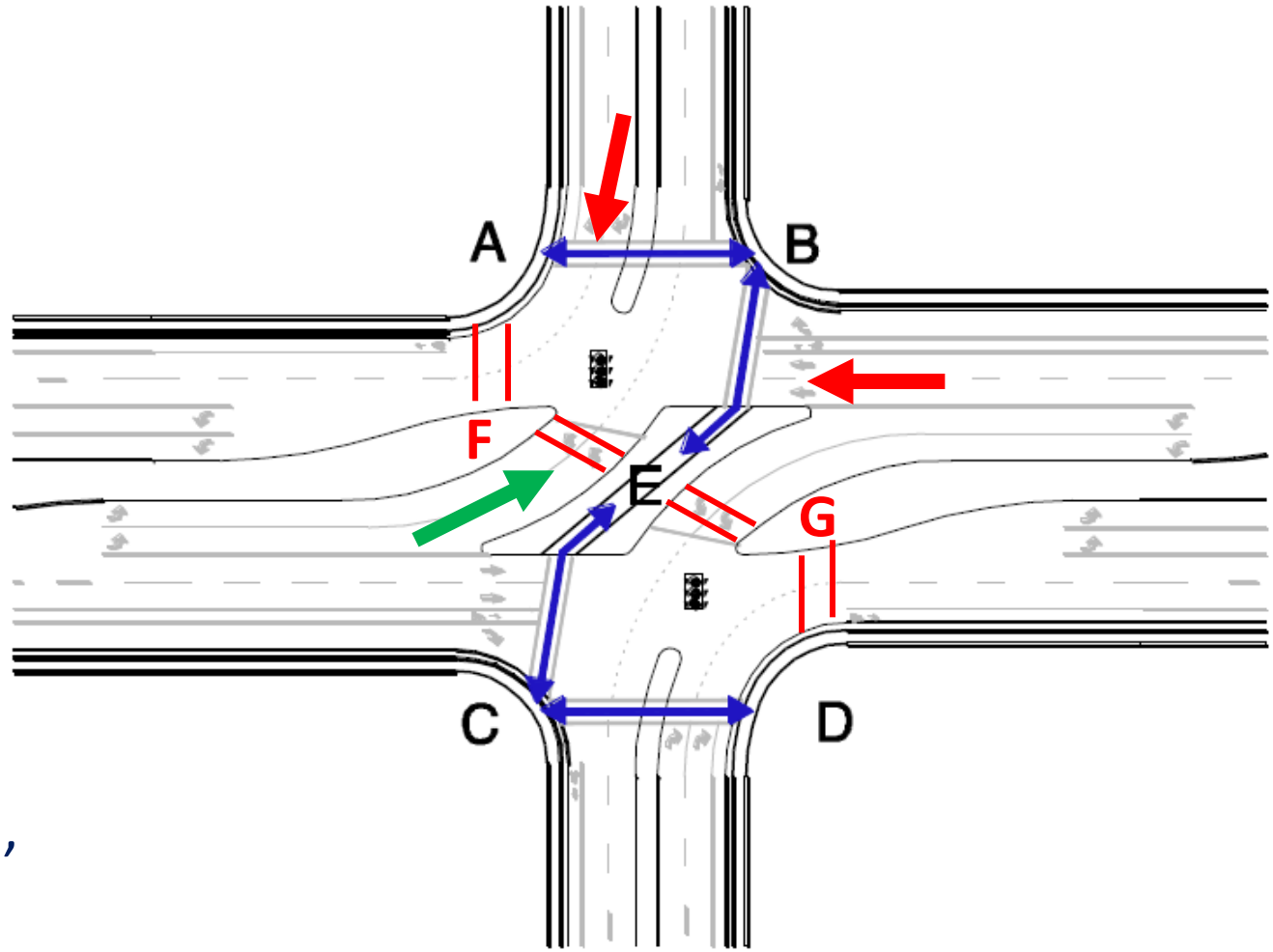


Superstreets – Crosswalk Locations

Add Points F & G and crosswalks to those points

Two options from A-C (& D-B) with a nearly guaranteed initial walk phase

If concern with concurrent phase conflicts, have Exclusive Ped phase, or F-A Ped **Lead**, or A-F Ped **Lag**

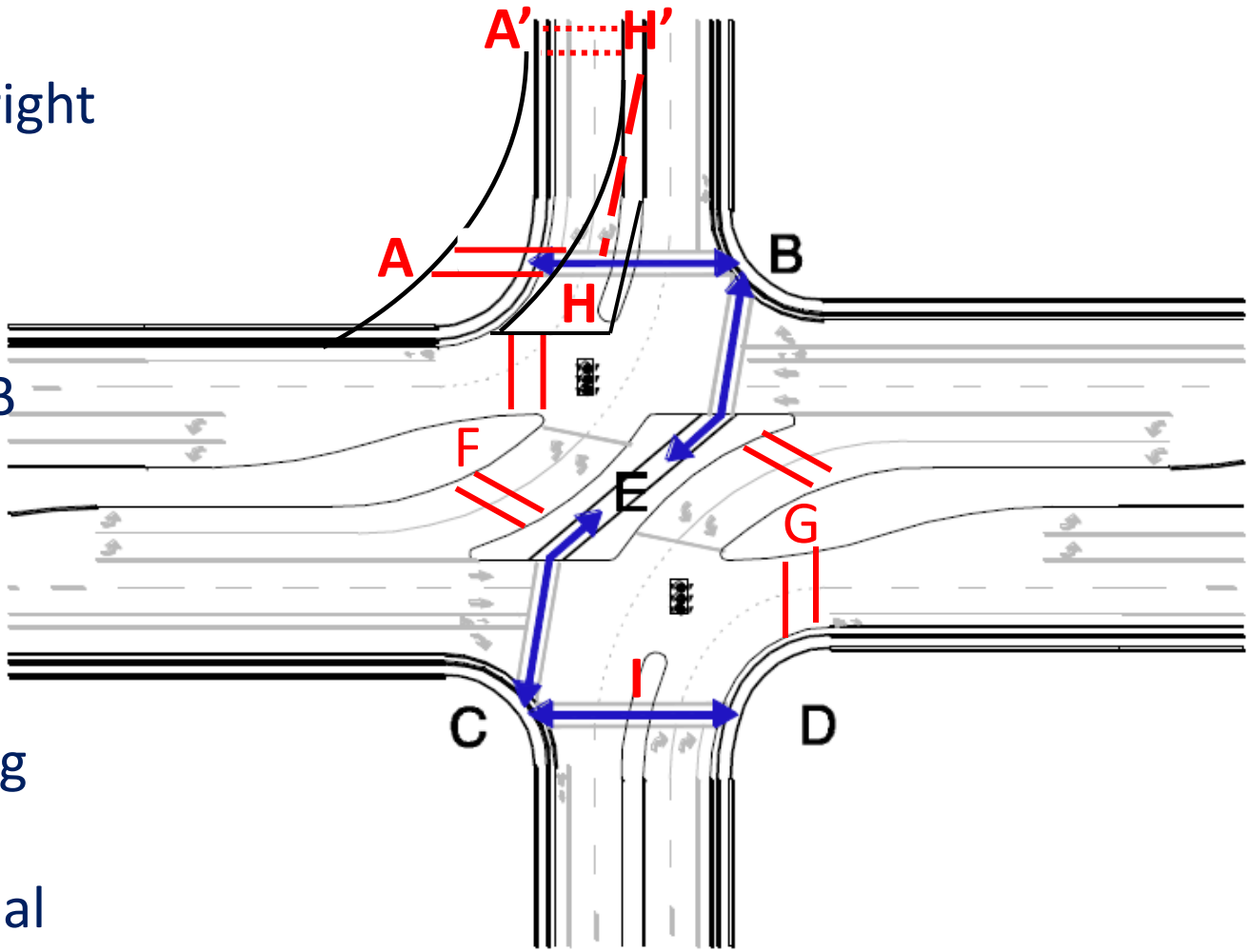


Superstreets – Crosswalk Locations

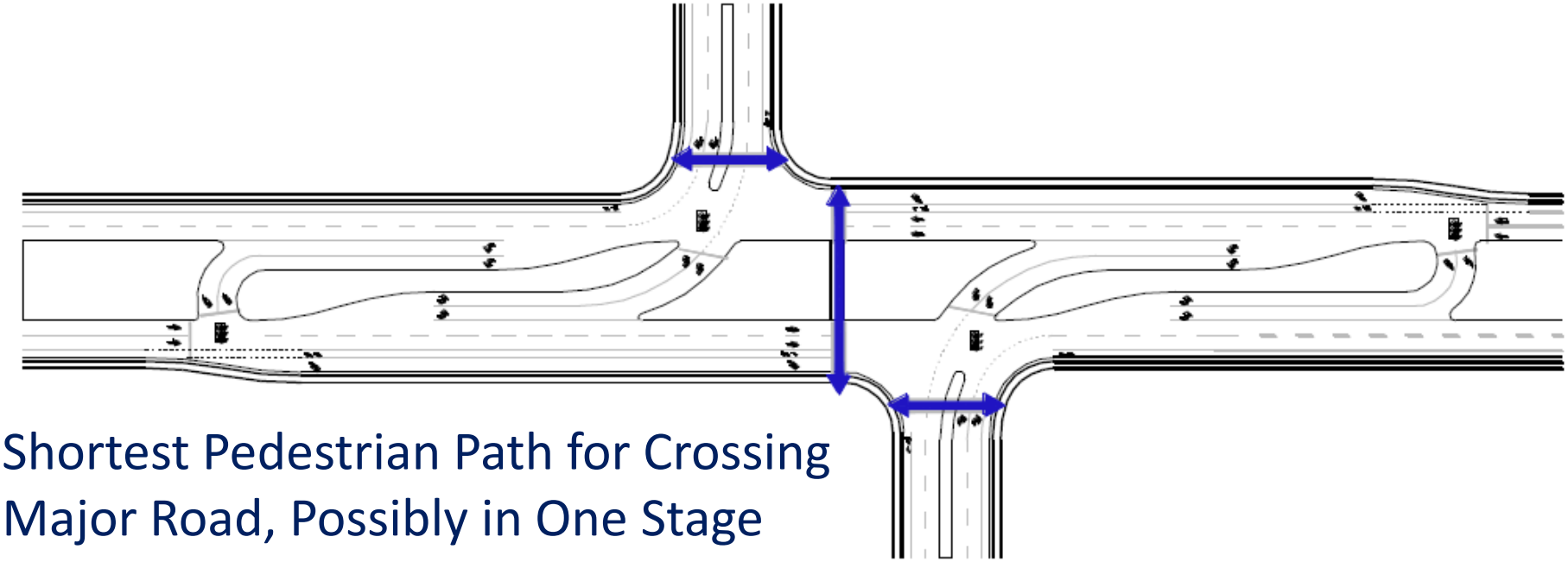
Add Points H & I and crosswalks to those points and shift SB right turn geometry

H-F does not have a conflicting phase, SB right turn accesses u-turn lanes better

This option does add another crossing stage from C-A, but possibly with minimal delay with an H-H’ option



Superstreets – Placement of Major Street Left Turns

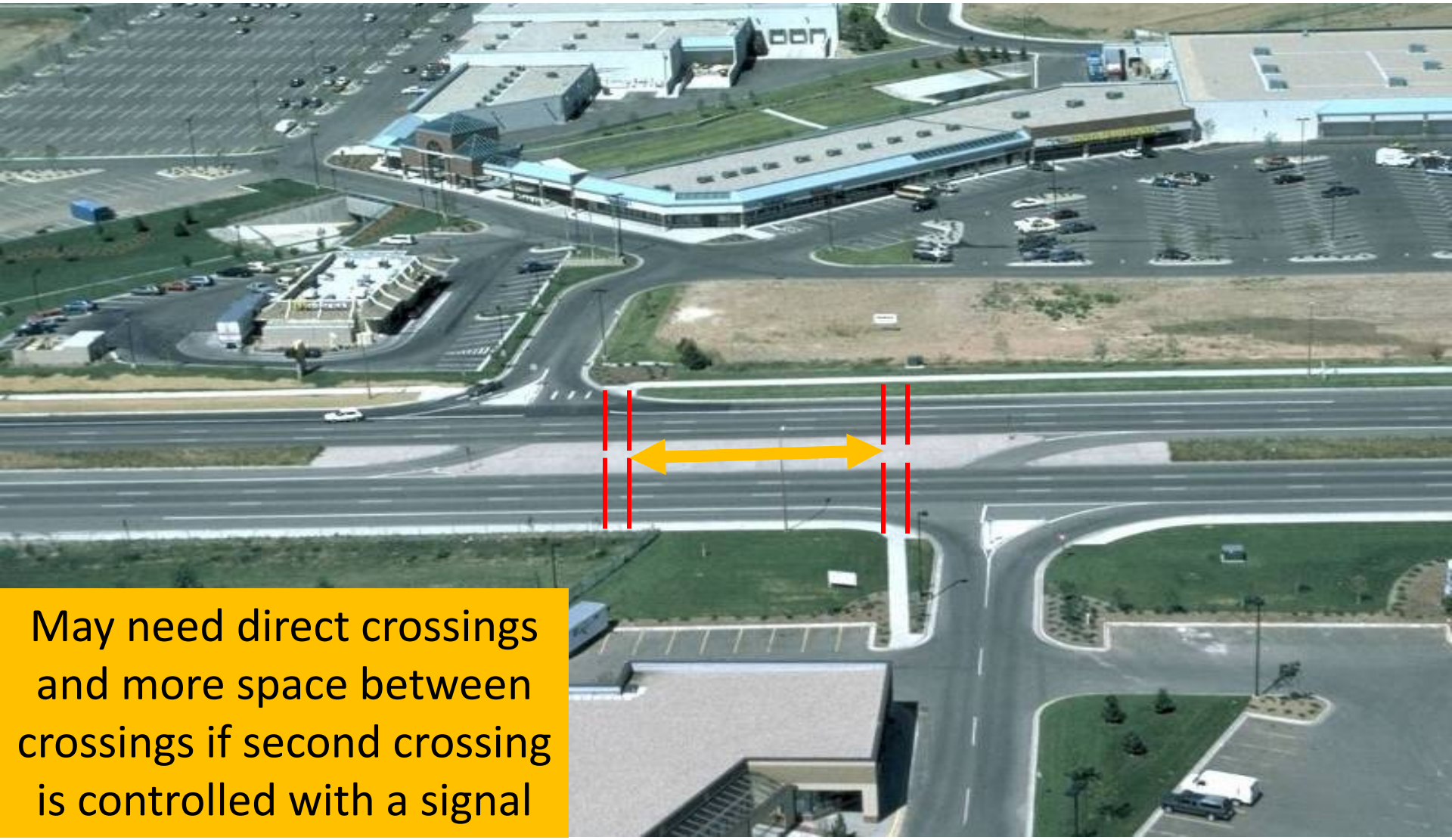


Shortest Pedestrian Path for Crossing Major Road, Possibly in One Stage

Superstreets – Placement of Major Street Left Turns

Use caution with offset mid-block crossings due to pedestrians walking with back towards traffic.

Superstreets – Placement of Major Street Left Turns

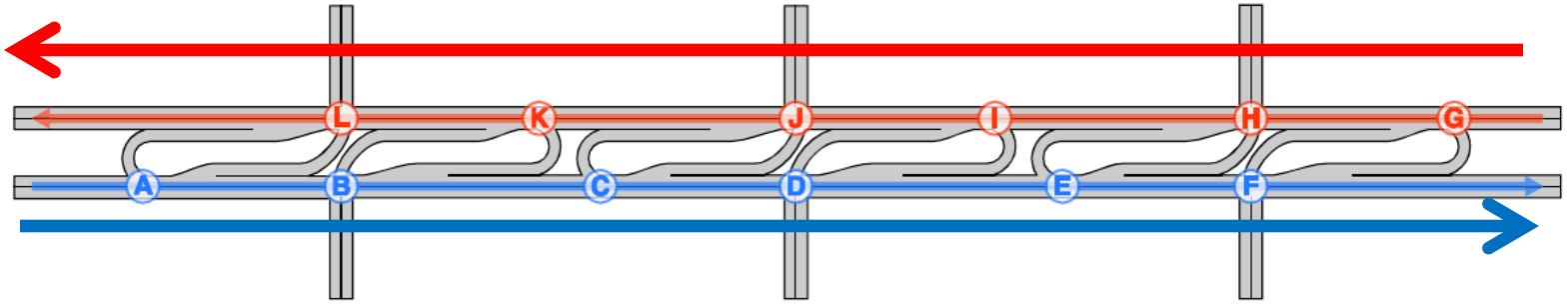


May need direct crossings and more space between crossings if second crossing is controlled with a signal

Superstreets – Placement of Major Street Left Turns

Adding direct crosswalks eliminates a crossing stage

Superstreets – Progression of Signals



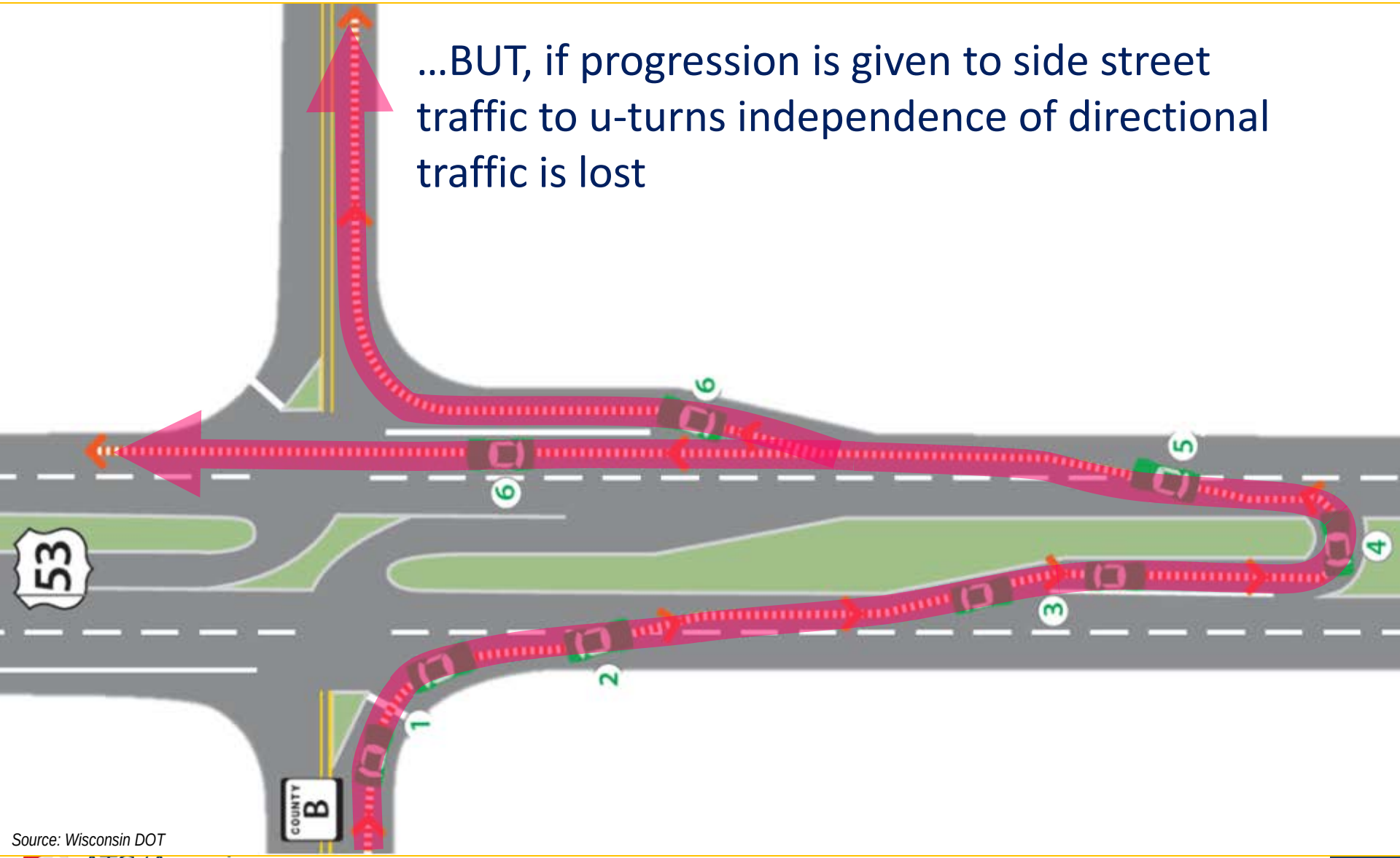
Direction	Parameter						
Right to left	Signal	F	E	D	C	B	A
	Distance from previous signal, ft	750	650	1000	700	600	Not applicable
	Offset to start of green, sec	74	59	46	26	12	0
Left to right	Signal	G	H	I	J	K	L
	Distance from previous signal, ft	Not applicable	600	850	1050	600	600
	Offset to start of green, sec	0	12	29	50	62	74

Note: Assumed progression speed of 50 feet per second (34 mph) in both directions

Superstreet Corridor can theoretically have each direction of major road independent from each other

Superstreets – Progression of Signals

…BUT, if progression is given to side street traffic to u-turns independence of directional traffic is lost

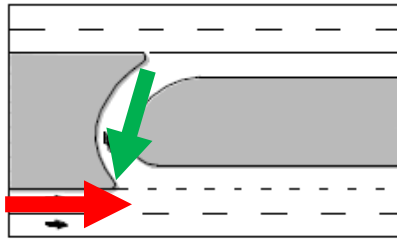


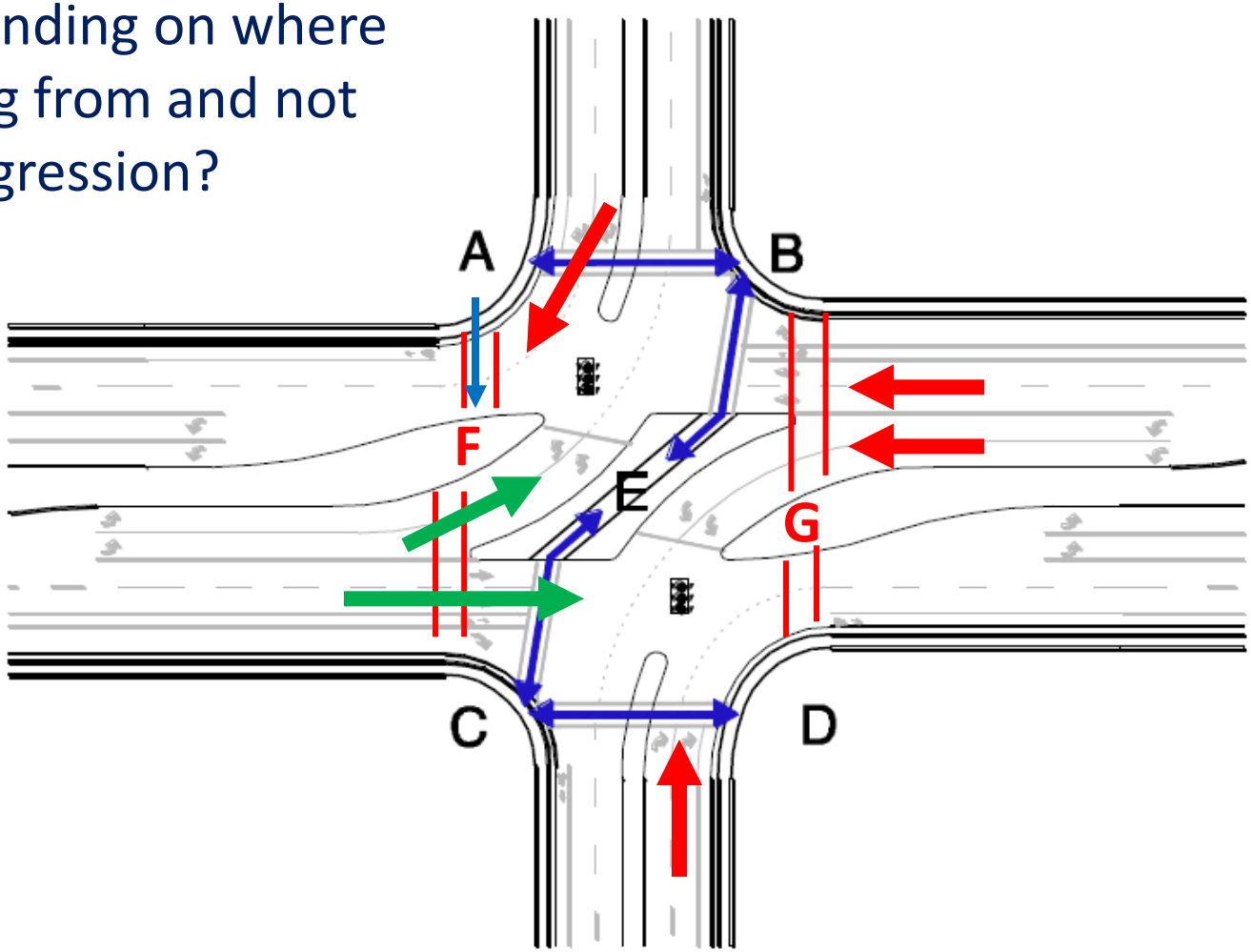
Source: Wisconsin DOT

Superstreets – Progression of Signals

Could we progress pedestrian phases as well depending on where pedestrian is coming from and not affect vehicular progression?

A-F Ped Lag Phase

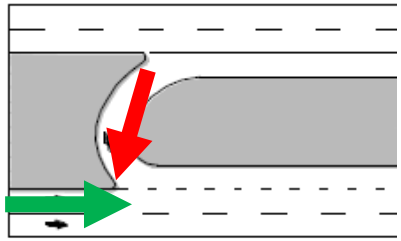


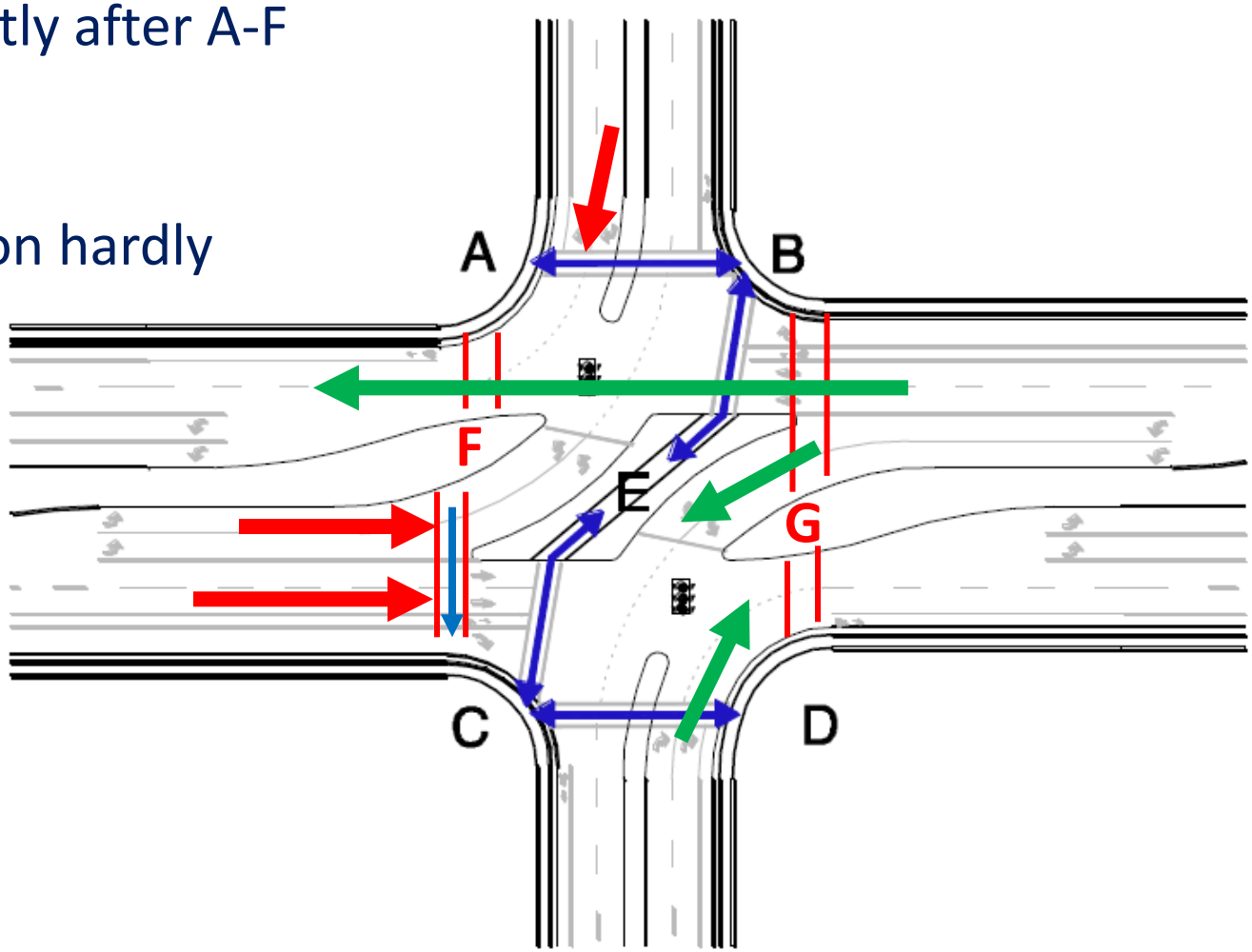


Superstreets – Progression of Signals

F-C is now one stage, not F-E-C and can be crossed shortly after A-F crossing.

Vehicular progression hardly affected.

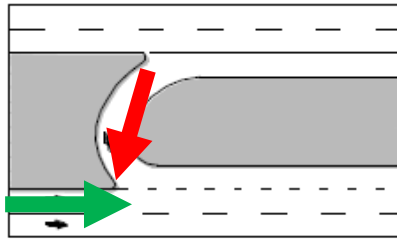




Superstreets – Progression of Signals

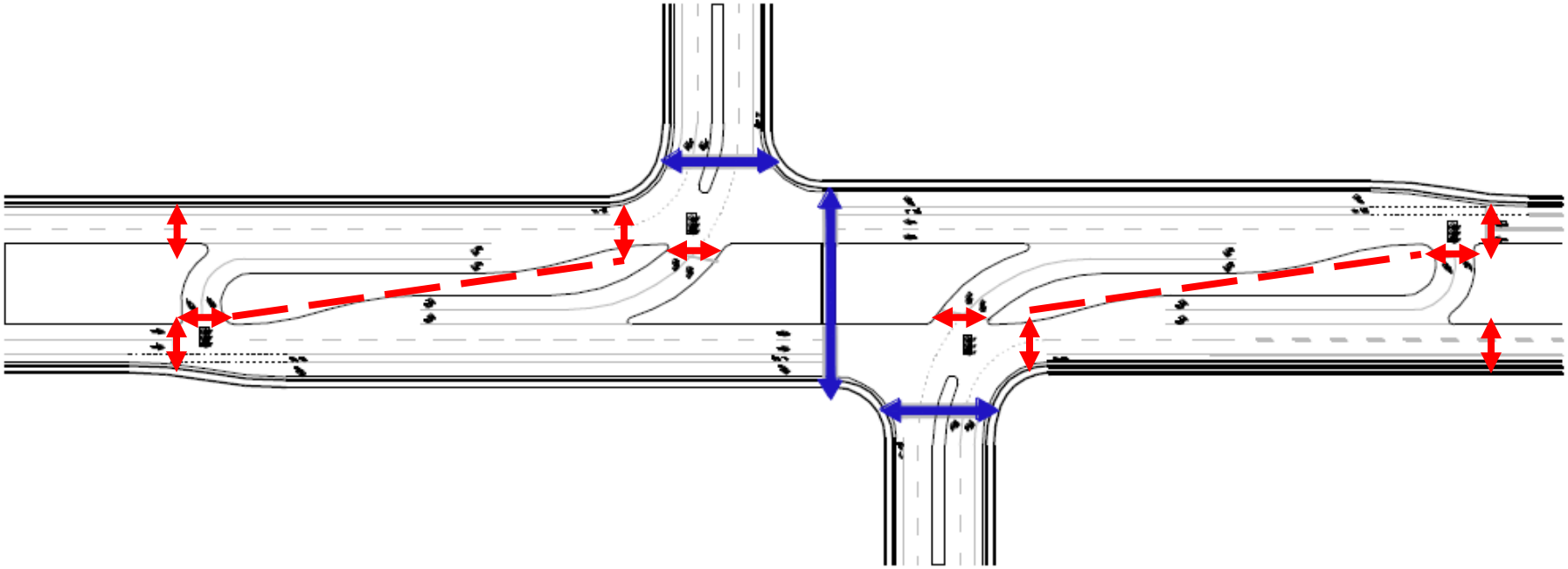
Major thru movement can still have longer thru phase.

PEDS WIN!!!
DRIVERS WIN!!!
ARNOLD WINS!!!



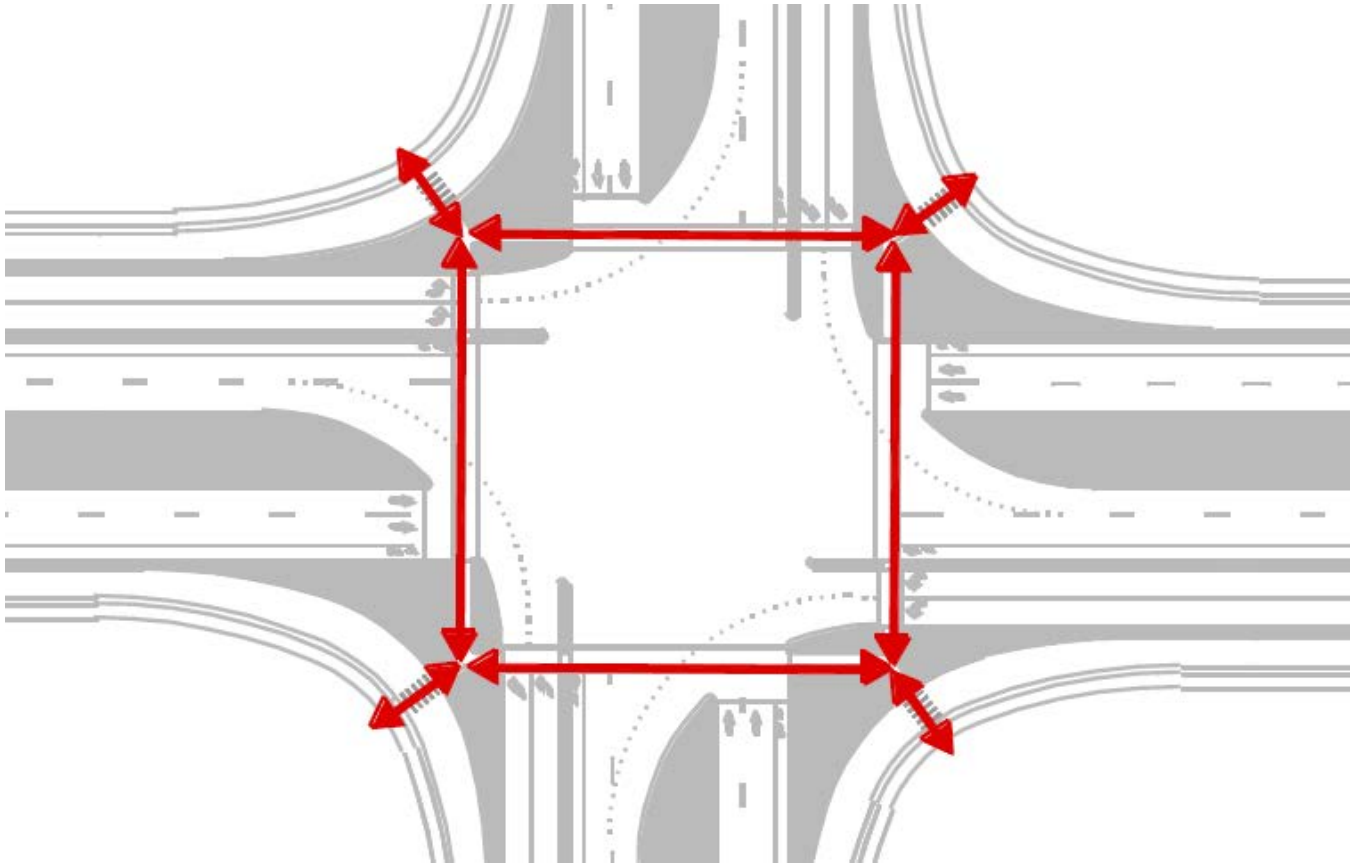
Superstreets – Median Sidewalks

Superstreets have potential to increase pedestrian options such as median u-turns and mid-block crossings at u-turns.

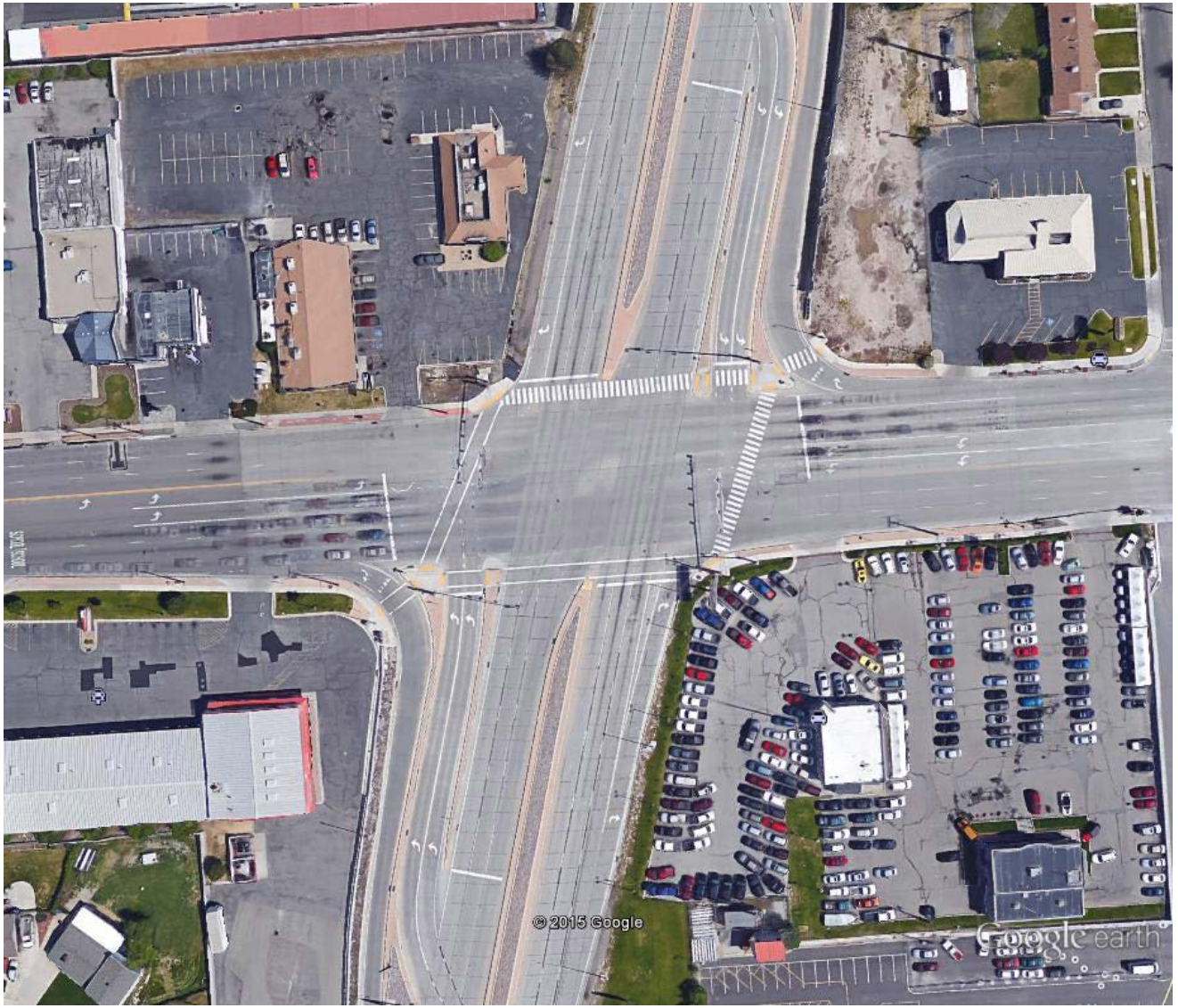


Continuous Flow Intersections One-Stage Crossing

Long Crossing and Pedestrians cannot cross at same time as left turns

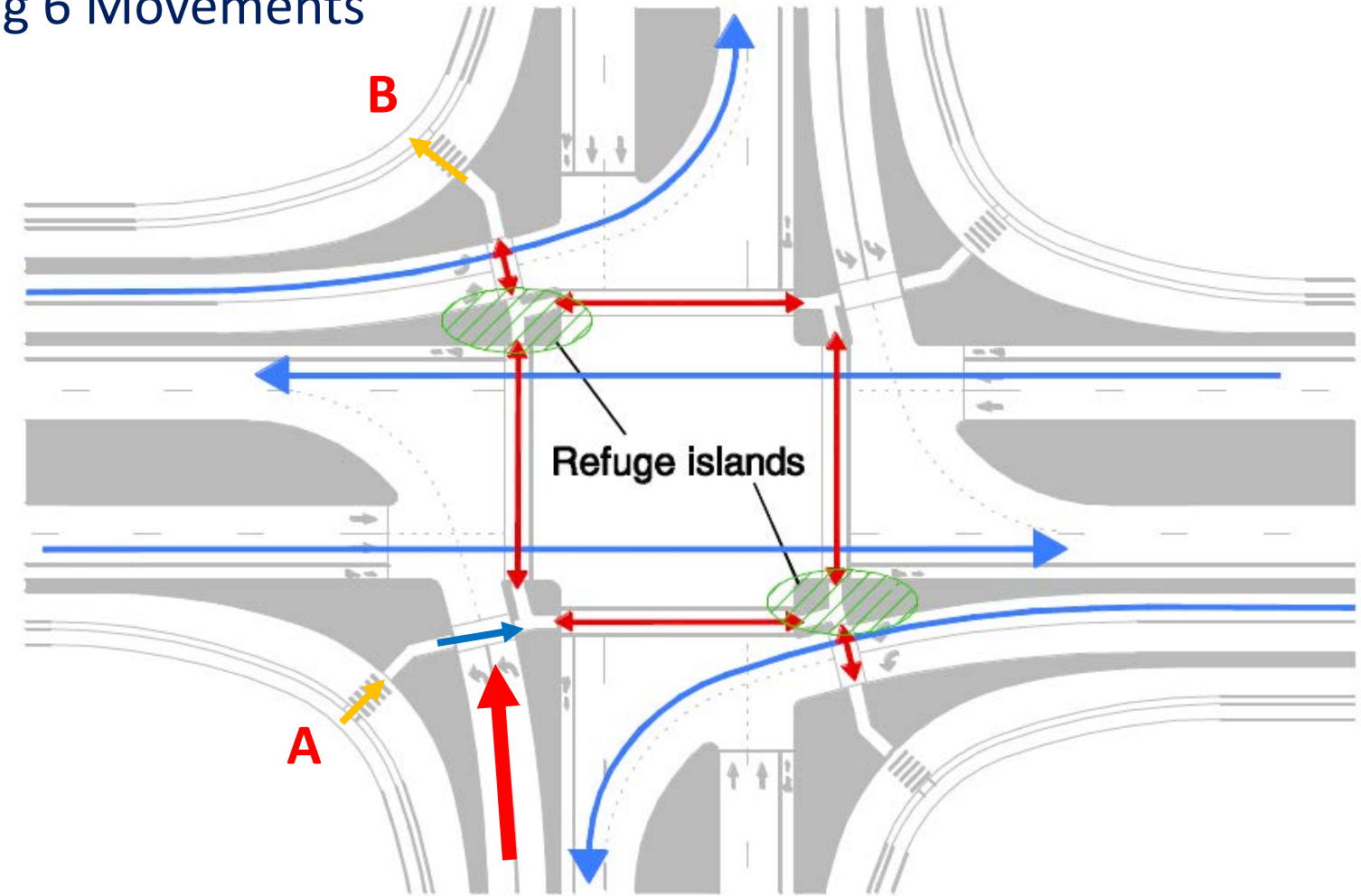


Continuous Flow Intersections One-Stage Crossing



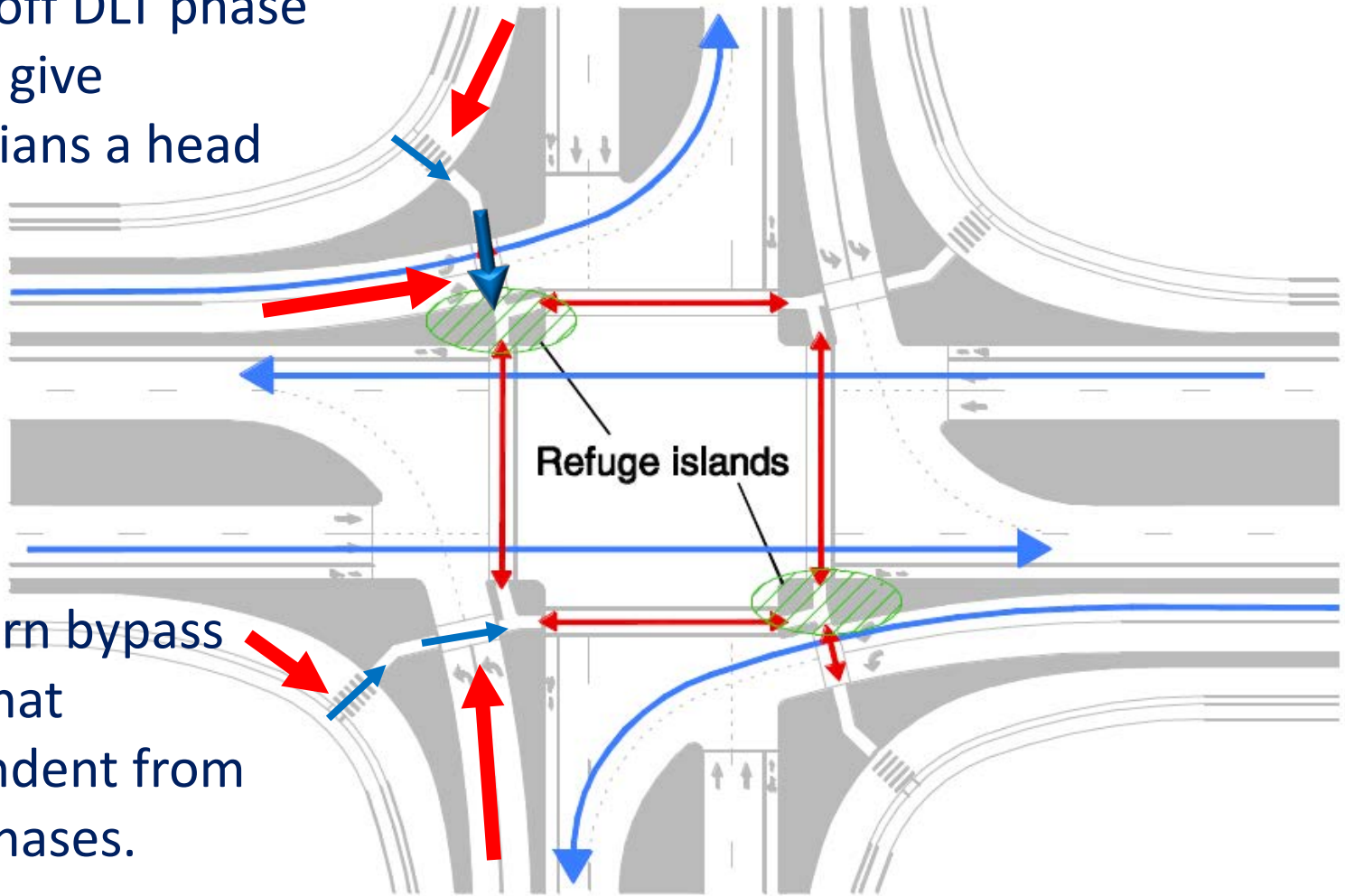
Continuous Flow Intersections Multiple Stage Crossings

Shorter Crossings, No Left Turn Conflict, Poor Pedestrian Progression, Crossing 6 Movements



Continuous Flow Intersections Multiple Stage Crossings

Look for opportunities to turn off DLT phase early to give pedestrians a head start.

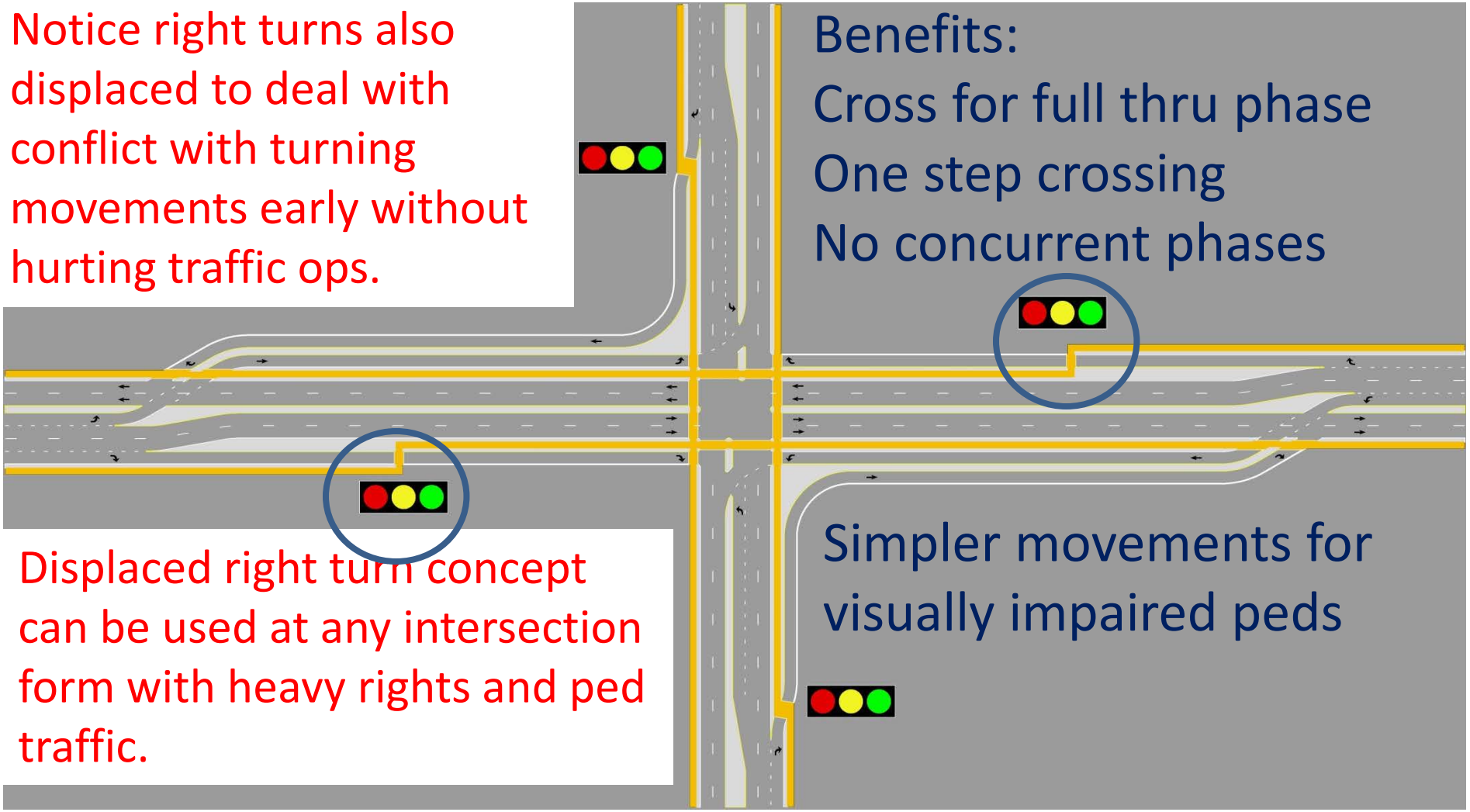


Right turn bypass somewhat independent from other phases.

Continuous Flow Intersections Multiple Stage Crossings

Continuous Flow Intersections Chlewicki Option

Notice right turns also displaced to deal with conflict with turning movements early without hurting traffic ops.



Displaced right turn concept can be used at any intersection form with heavy rights and ped traffic.

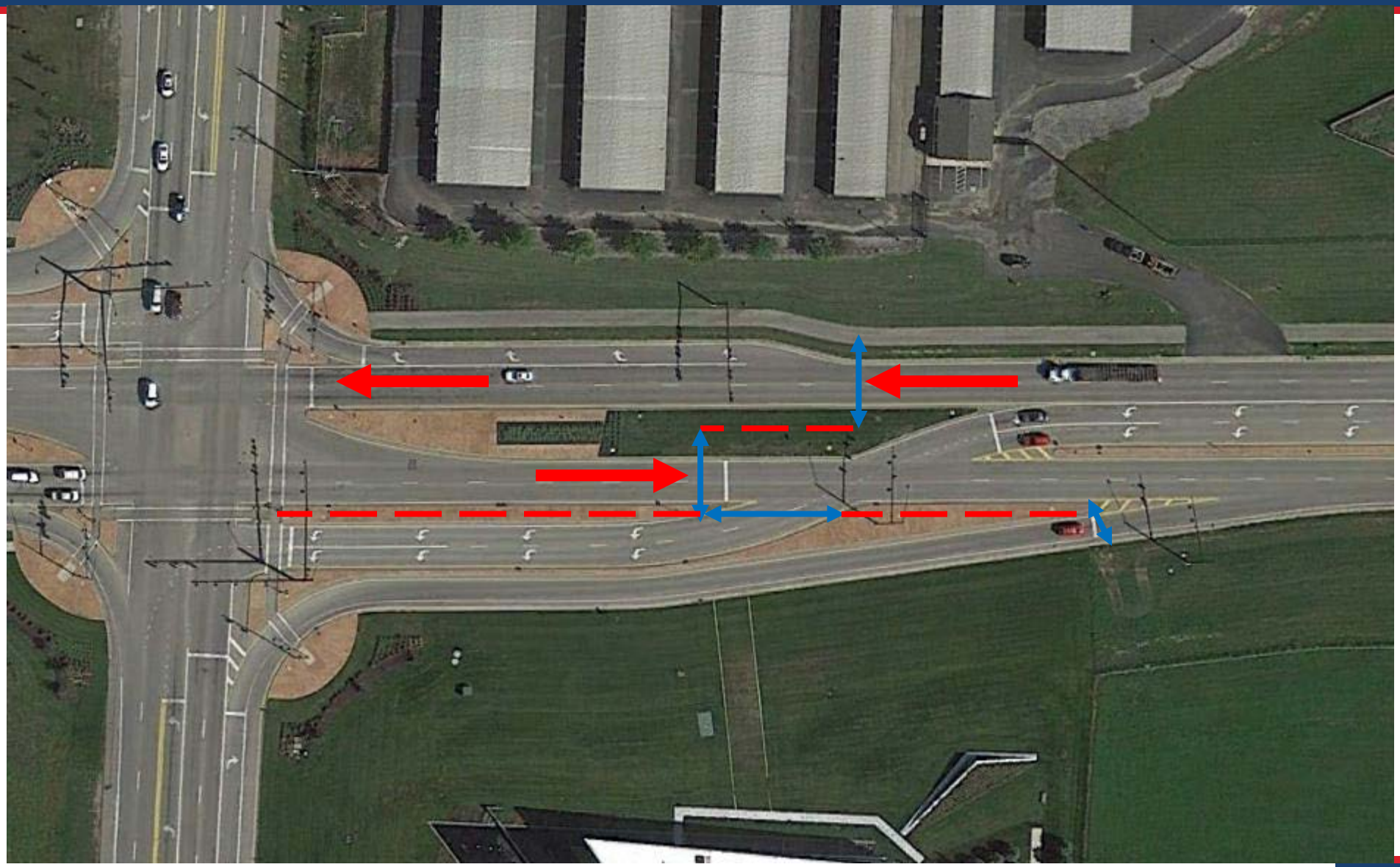
Continuous Flow Intersections Reduced Median

Narrow medians at main CFI intersection reduces clearance time for all users

Can be used in all options

Continuous Flow Intersections
Median Sidewalk

Continuous Flow Intersections Mid-Block Crossing

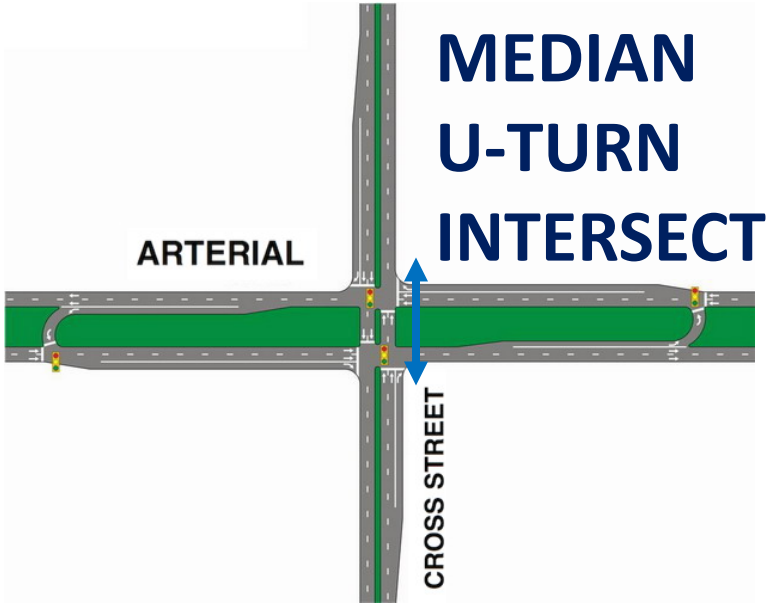


Continuous Flow Intersections Mid-Block Crossing

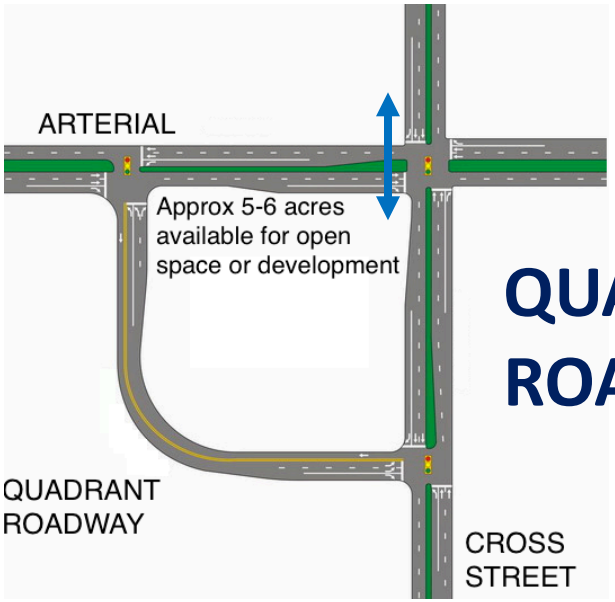
Would **CFI**s be more pedestrian friendly if the Displaced Left Turns were moved away from the main intersection and have more of a **QUADRANT ROADWAY** geometry?

Reduced Median – For all Types of IGDs

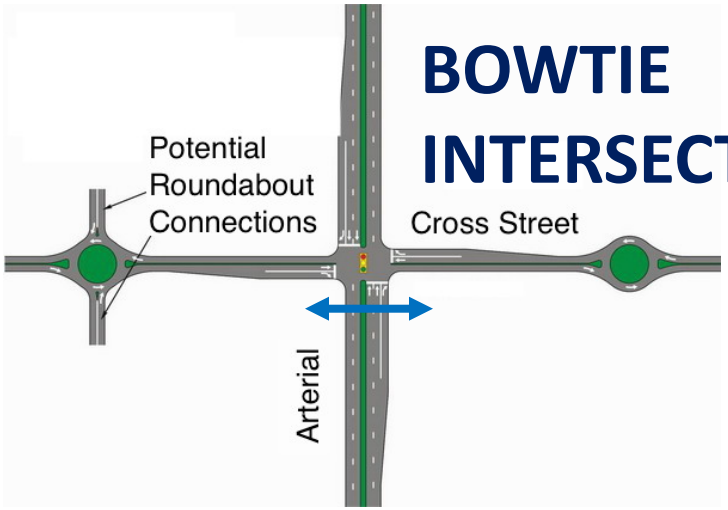
MEDIAN U-TURN INTERSECTION



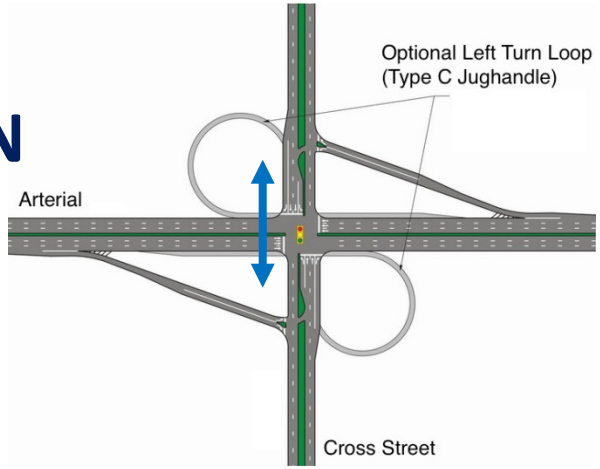
QUADRANT ROADWAY



BOWTIE INTERSECTION



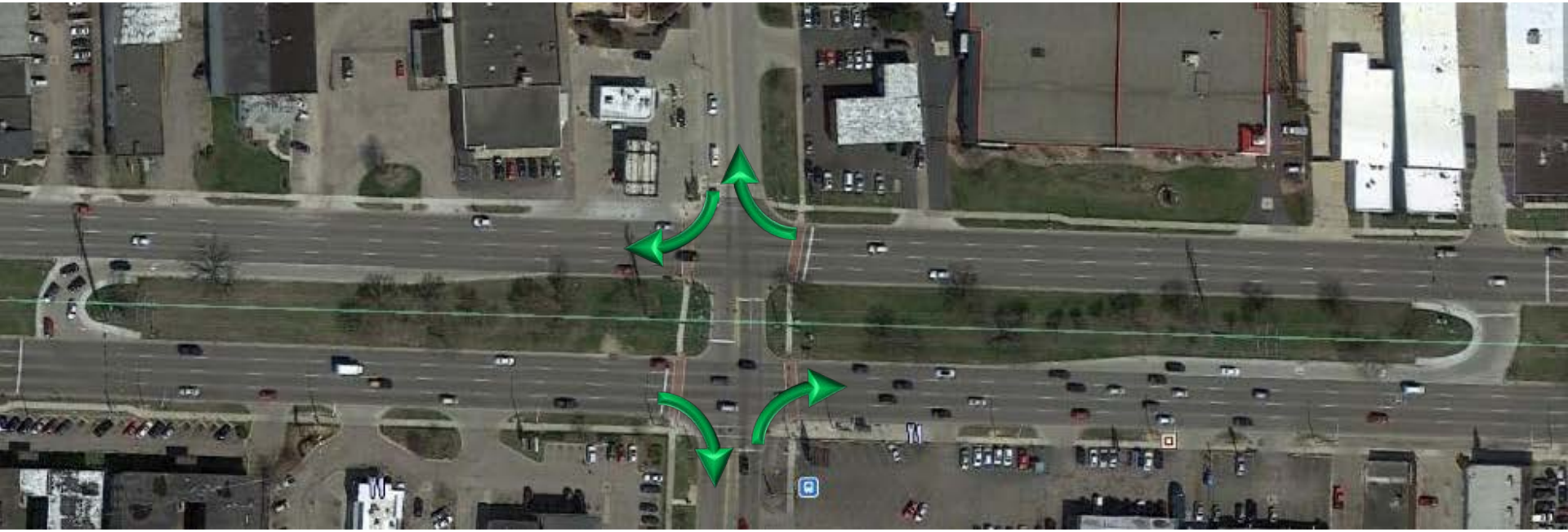
JUGHANDLE



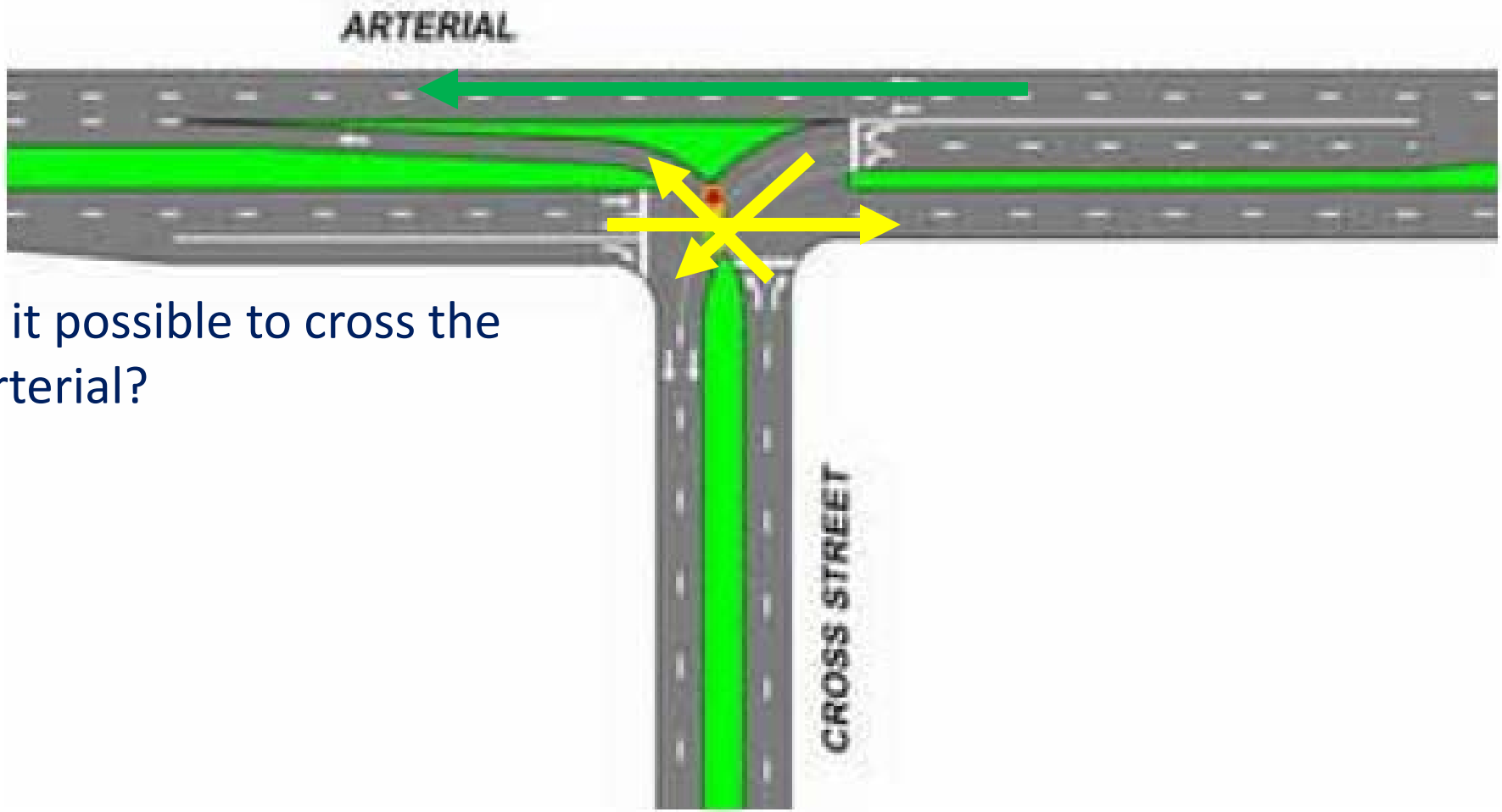
Median U-Turn – Higher Right Turn Volume

Median U-Turns have higher right turn volume because all left turn volume transfers to the right at one location

Consider Pedestrian Lead Phases or Displaced Right Turns

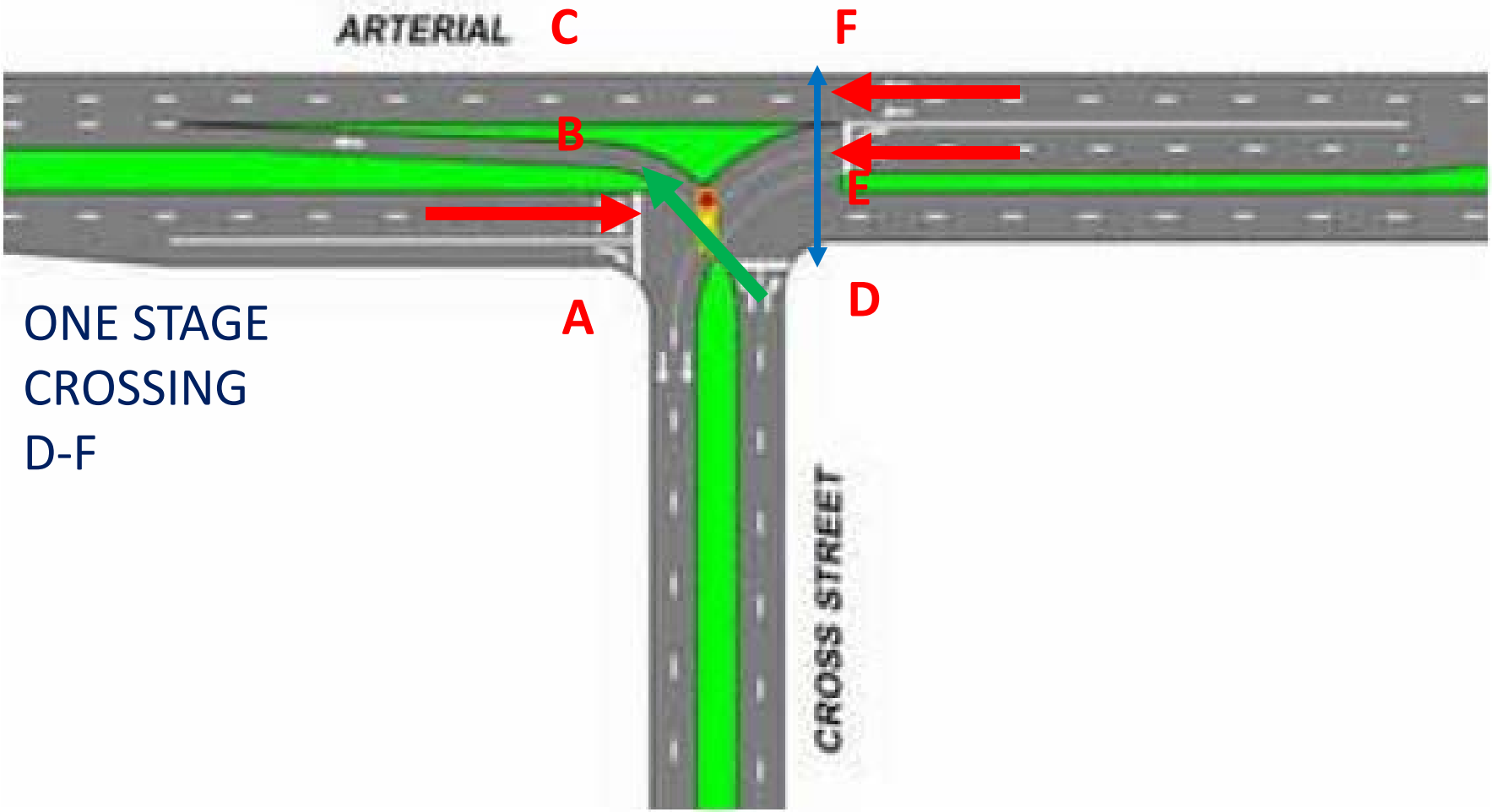


Continuous-T Intersection – Crossing the Arterial



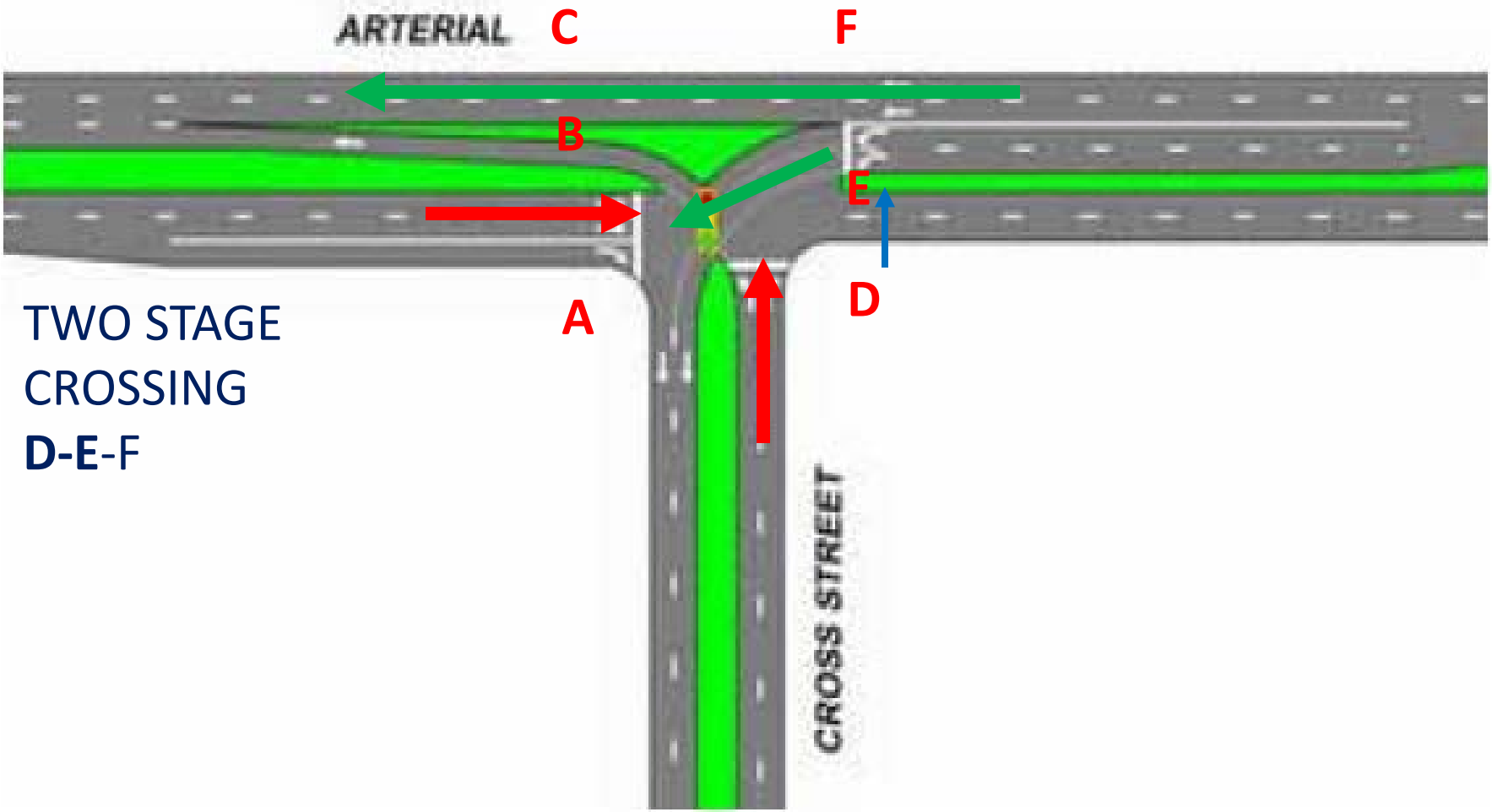
Is it possible to cross the arterial?

Continuous-T Intersection – Crossing the Arterial



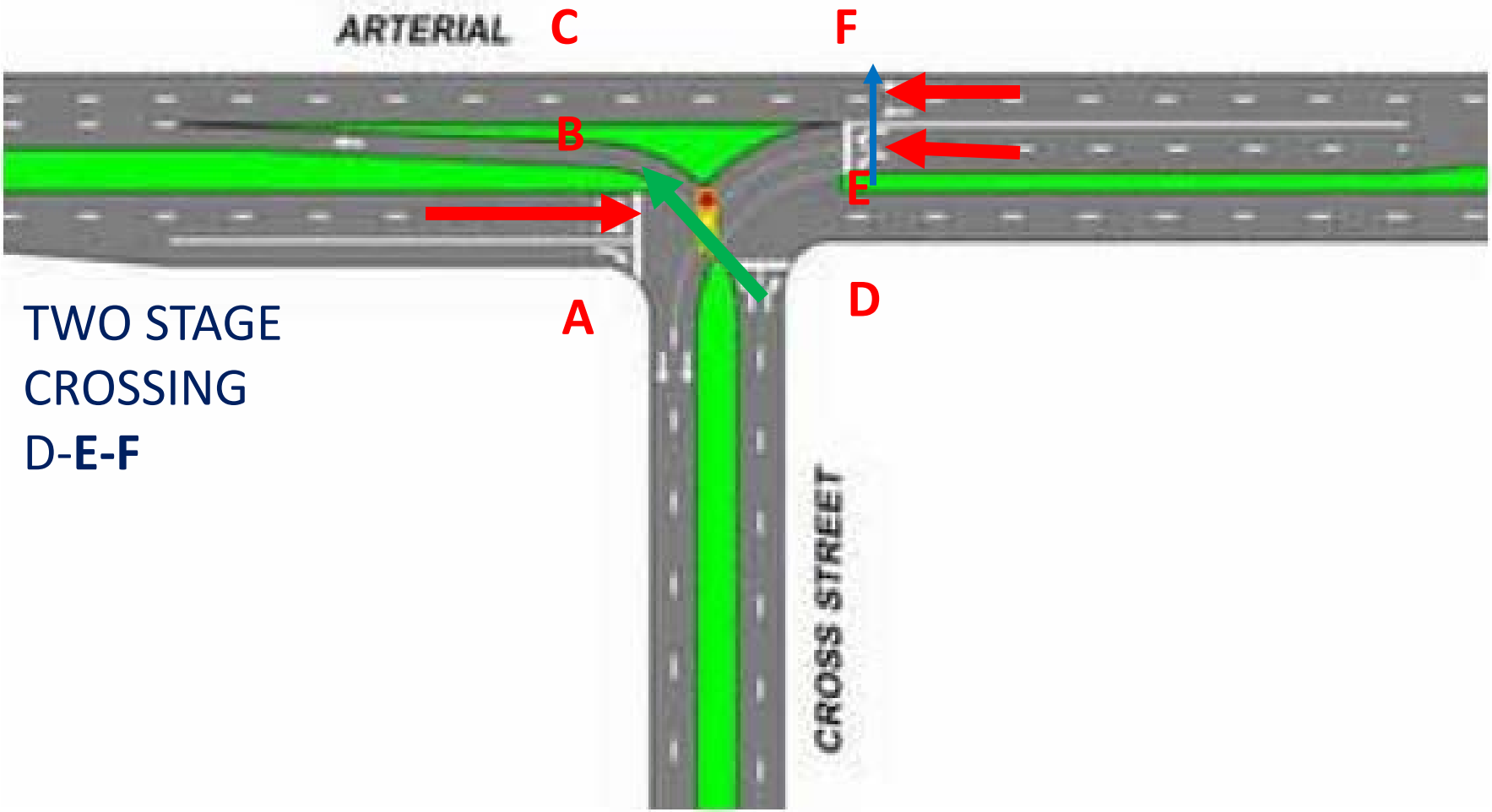
ONE STAGE
CROSSING
D-F

Continuous-T Intersection – Crossing the Arterial



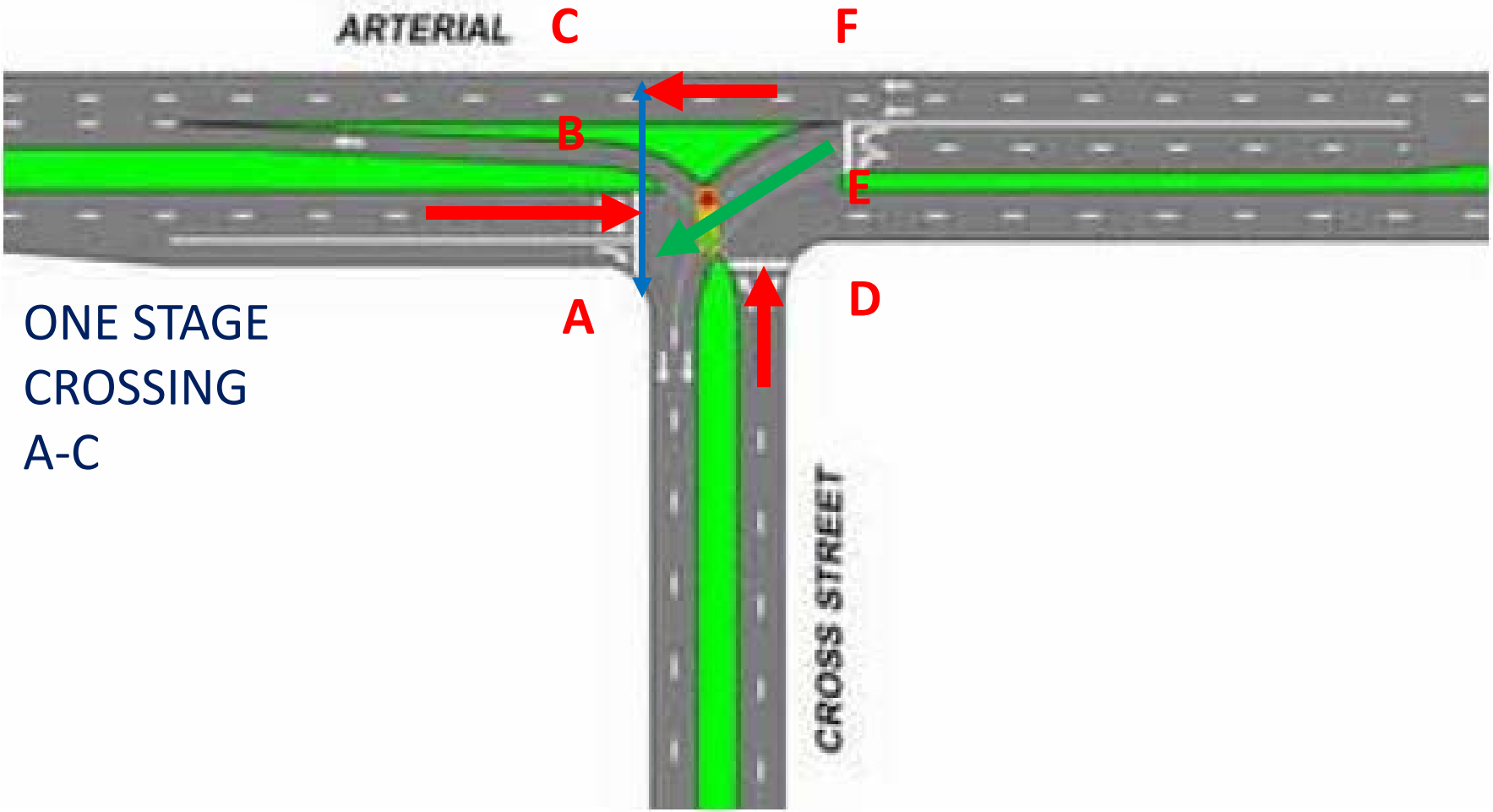
TWO STAGE CROSSING
D-E-F

Continuous-T Intersection – Crossing the Arterial



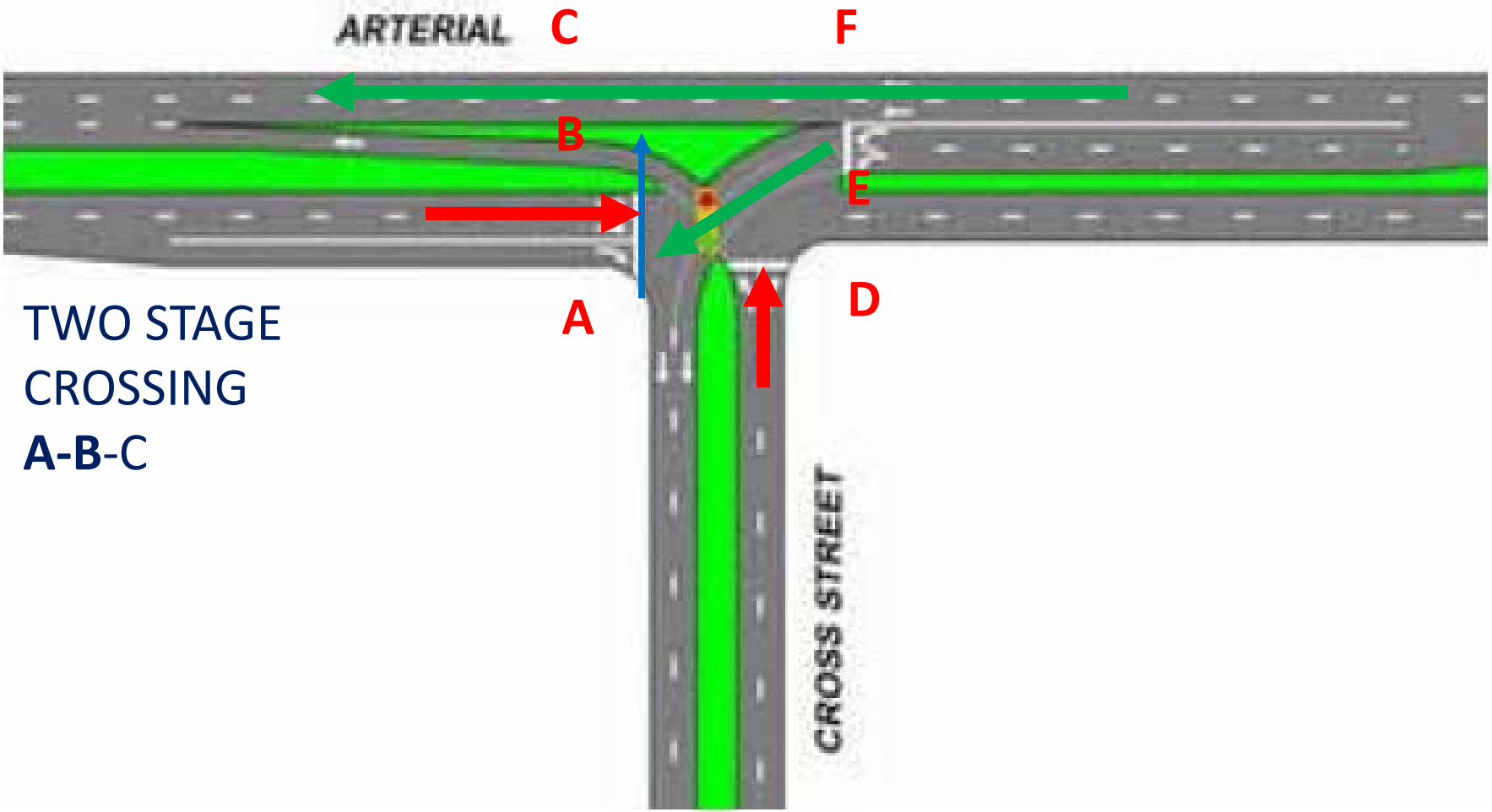
TWO STAGE
CROSSING
D-**E-F**

Continuous-T Intersection – Crossing the Arterial



ONE STAGE
CROSSING
A-C

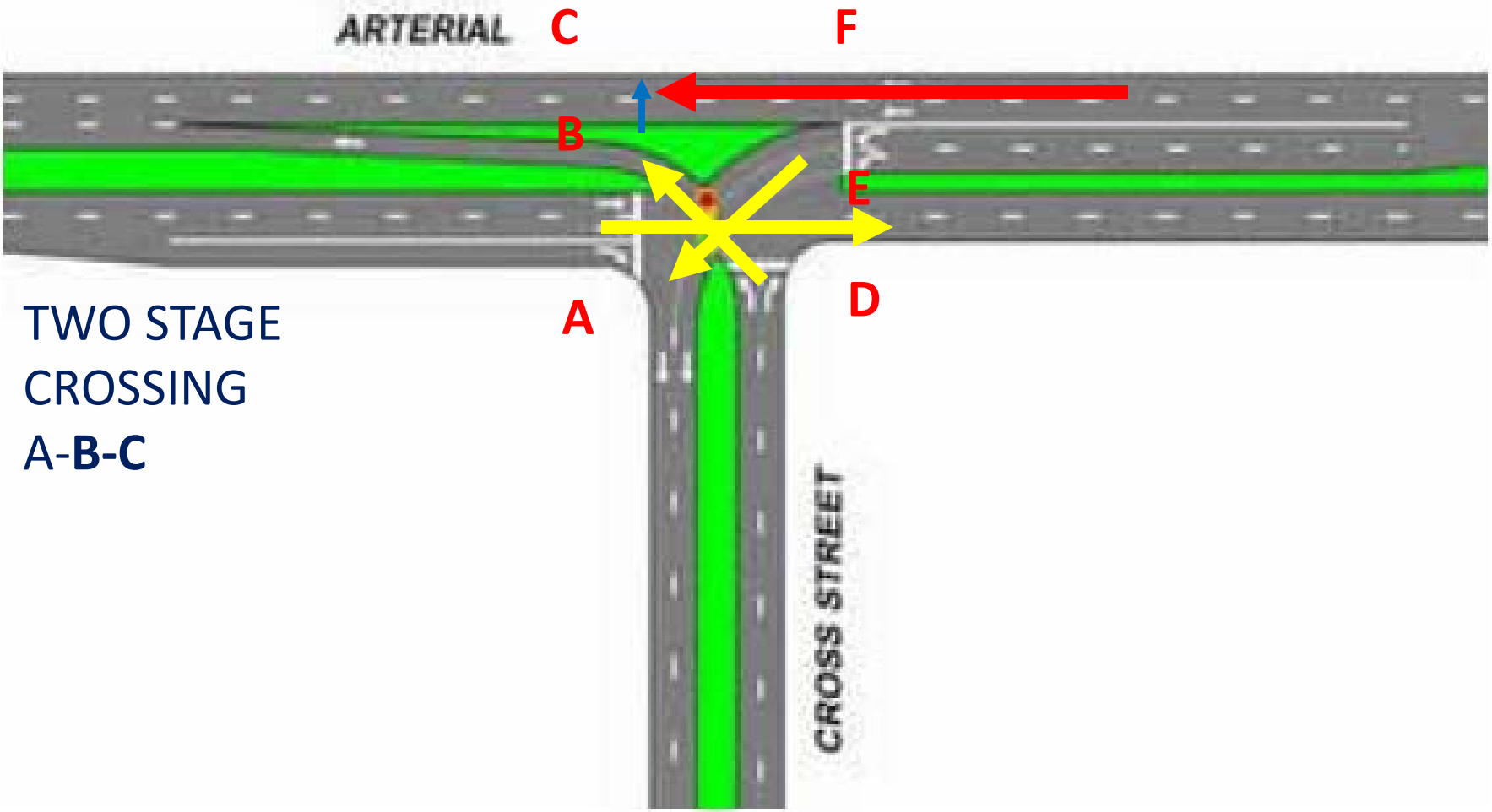
Continuous-T Intersection – Crossing the Arterial



TWO STAGE CROSSING

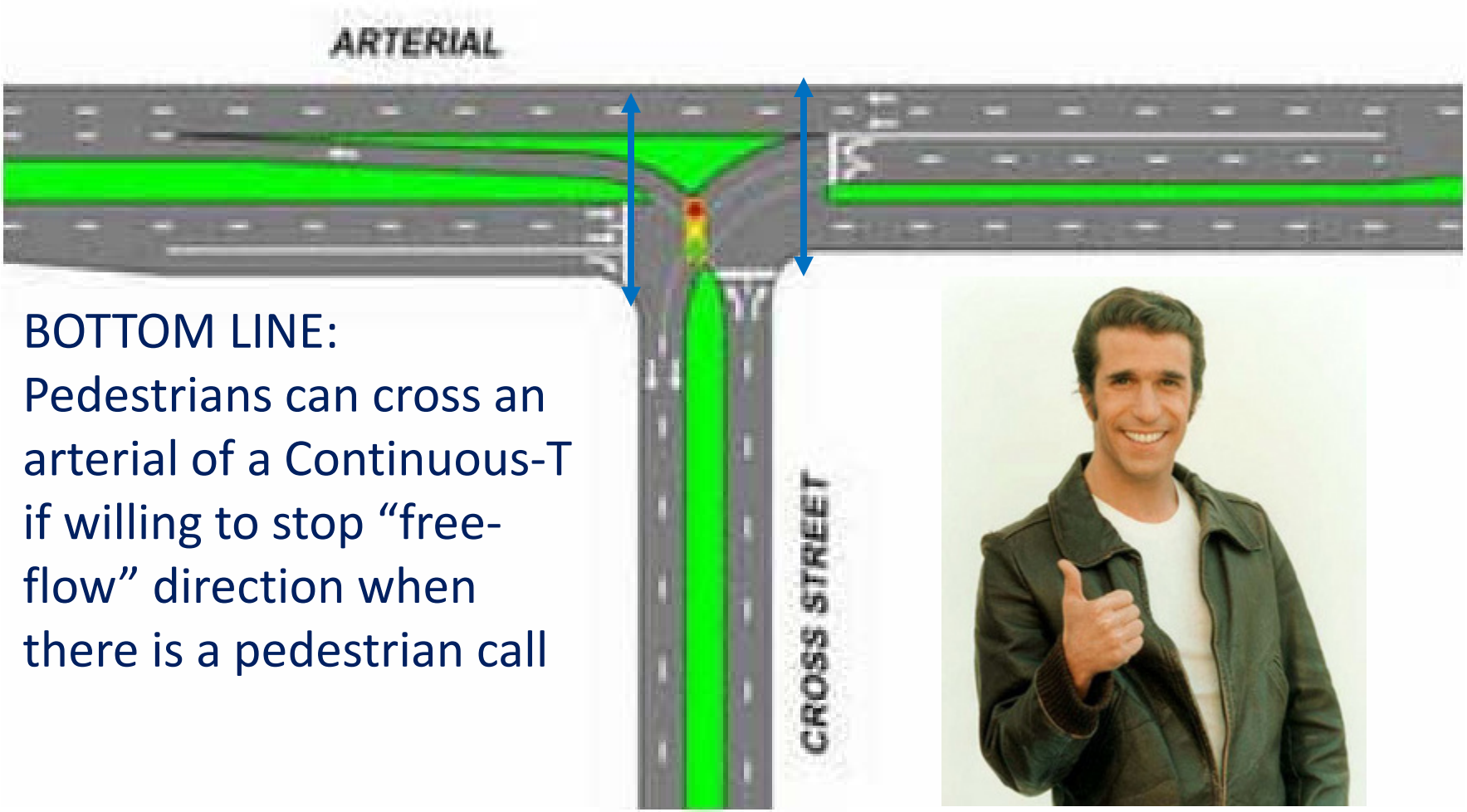
A-B-C

Continuous-T Intersection – Crossing the Arterial



TWO STAGE CROSSING
A-**B-C**

Continuous-T Intersection – Crossing the Arterial



BOTTOM LINE:
Pedestrians can cross an arterial of a Continuous-T if willing to stop “free-flow” direction when there is a pedestrian call

Jughandles – Crossing Ramps

Similar Techniques to Interchange Ramp Crossings

Jughandles – Crossing Ramps

Conclusions

- Many Ways to Improve Pedestrian Accommodations at IGDs
- Very Possible for Most IGDs to be MORE Pedestrian Friendly than Conventional Intersections (Some already are)
- Need to consider operations, geometry, safety, and accessibility all at the same time
- Don’t be afraid to explore new techniques, understanding that the current techniques have lots of room for improvement
- Don’t be too quick to say “NO” to a new idea

Conclusions

- Always consider the context of the intersection
- Explore ideas more in NCHRP Project 07-25 – Guide for Pedestrian and Bicycle Safety at Alternative Intersections and Interchanges
- ALL can agree that we need to improve pedestrian safety and design at IGDs

Contact Information

Questions???

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