NORTH CAROLINA
Department of Transportation









North Carolina Superstreets

DCHC Metropolitan Planning Organization

James H. Dunlop, P.E.
Congestion Management Engineer
Transportation Mobility and Safety Division
August 9, 2017

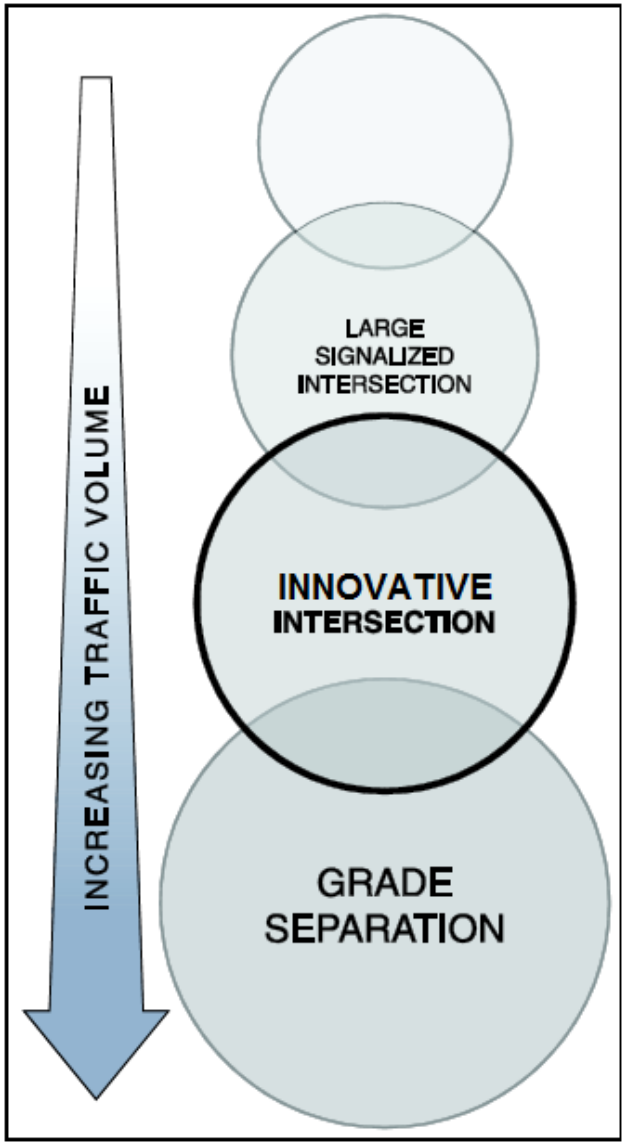
FHWA Everyday Counts Guidance

INTERSECTION & INTERCHANGE GEOMETRICS

About half of all severe crashes in the U.S. are intersection related. Left-turns represent a large portion of the intersection safety concern. As part of the safety focus area of the Every Day Counts (EDC) initiative, the Federal Highway Administration (FHWA) is promoting several proven techniques to improve the safety of intersections by strategically eliminating or relocating the left-turn conflicts. Transportation agencies that apply the intersection and interchange geometrics under this initiative can reduce crashes and greatly enhance the efficiency of moving traffic, often times with substantial cost savings and accelerated project delivery.

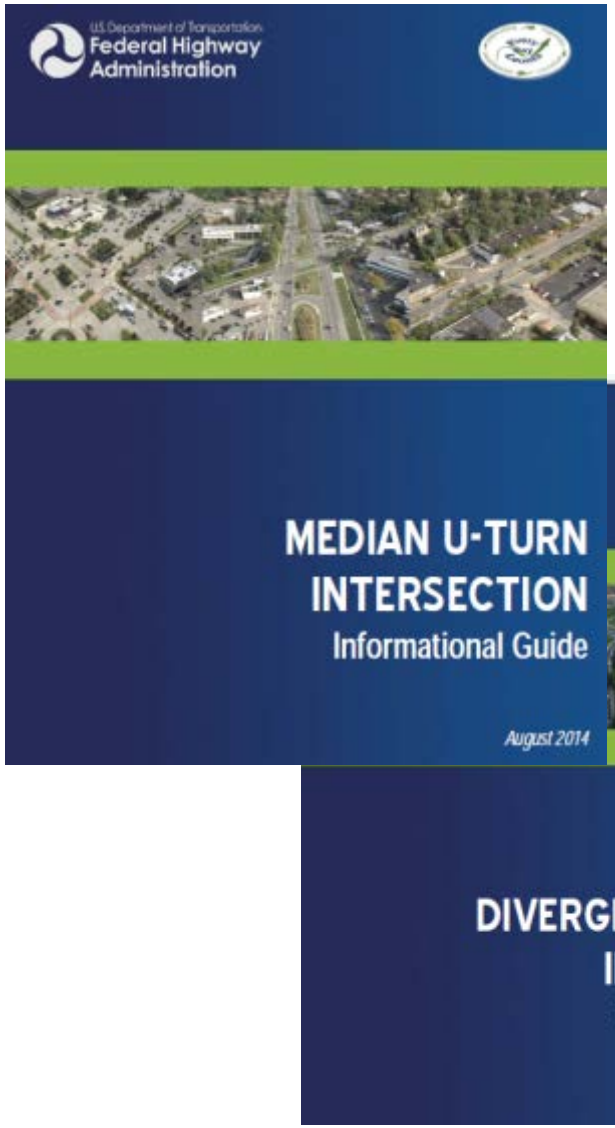
https://www.fhwa.dot.gov/everydaycounts/edctwo/2012/pdfs/edc_intersection_21.pdf

FHWA Everyday Counts Guidance



https://www.fhwa.dot.gov/everydaycounts/edctwo/2012/pdfs/edc_intersection_21.pdf

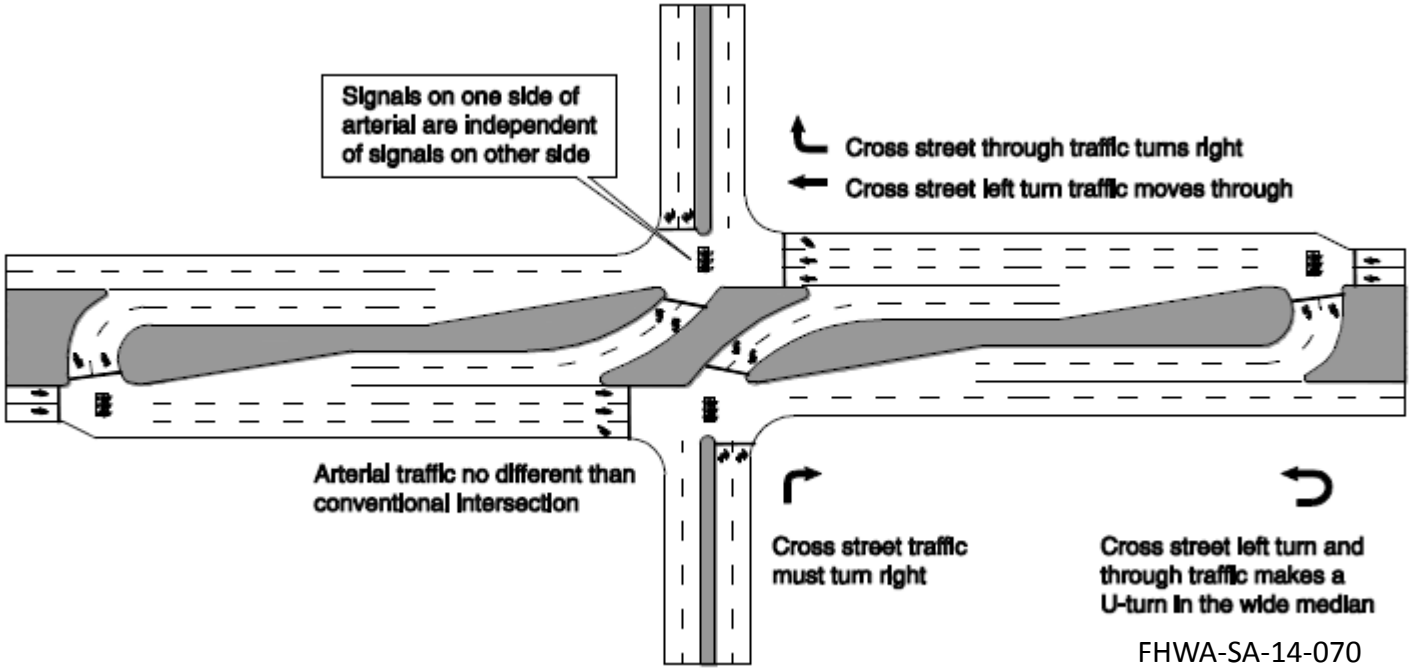
FHWA Everyday Counts Guidance



The Superstreet

A type of intersection in which minor cross-street traffic is restricted from going straight through or left at a divided highway intersection. *

Minor cross street traffic must turn right, but can then access a U-turn to proceed in the desired direction.



FHWA uses the term RCUT (Restricted Crossing U-Turn)
Some states use the term “J-Turn” or “Reduced Conflict Intersection”
For signalized corridors, some use the term “Synchronized Streets”

*Other configurations possible based on site specific conditions.

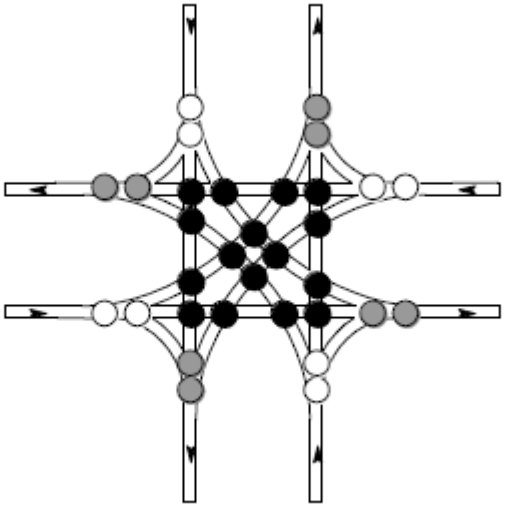
Superstreet Advantages

- SAFETY!!!!
  - 15 to 46 percent total crash reduction
  - 22 to 63 percent injury and fatal crash reduction
- Reduce delay
- Great progression through signals
- Speed control

- And superior pedestrian service

Safety - Vehicular Conflict Points

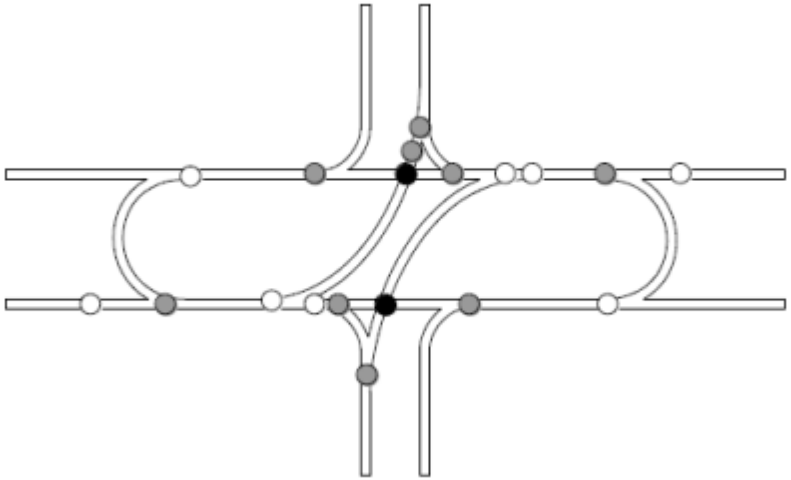
Conventional Intersection



Crossing
Merging
Diverging

Conflict Points = 32

Superstreet Intersection



Conflict Points = 14

FHWA-SA-14-070

Safety – Reduction in Crashes

Safety impact by collision type for unsignalized superstreets

Collision Type	Crash Reduction %
Total	-46
Fatal and injury	-63
Angle and right turns	-75
Rear ends	-1
Sideswipes	-13
Left turns	-59
Other	-15

Safety Study of Signalized Superstreets

FHWA sponsored study, to be published in 2017
11 treatment sites, good comparison sites
Crash Modification Factors (CMF)

Sites	CMF All Crashes	CMF Injury Crashes
All AL	0.44	0.41
All OH	0.98	1.06
All TX	0.88	0.88
AL, NC, and OH	0.71	0.63
All	0.85 (SD = 0.16)	0.78 (SD = 0.20)

Safety - US 17 Superstreet - Leland

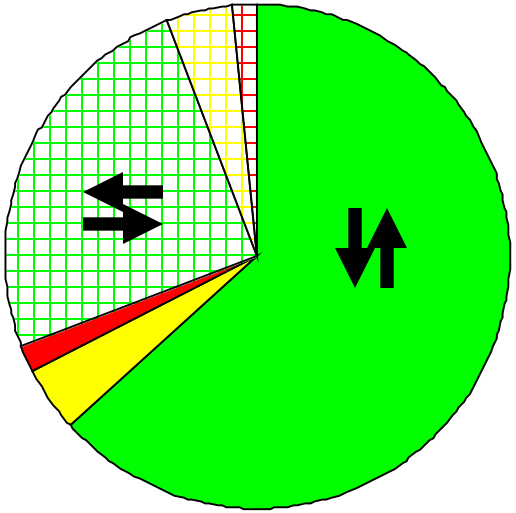
Comparison of Signalized Superstreet and Traditional Intersection Corridors	US 64 Cary Traditional	US 17 Leland Superstreet	Percent Difference +/-
	7/1/2006-6/30/2009		
Total Crash Rate	308.5	180.0	-41.7%
Total Crashes/Mile	125.1	84.8	-32.2%
Intersection Crashes	177.0	95.0	-46.3%
Total Crash Severity Index	4.6	5.0	8.2%
Fatal Injury Crashes/Mile	0.9	0.8	-11.1%
Class A Injury Crashes/Mile	1.8	0.8	-55.6%
Class B Injury Crashes/Mile	6.0	9.8	63.3%
Class C Injury Crashes/Mile	27.2	19.6	-27.9%
PDO Crashes/Mile	89.1	53.8	-39.6%
Frontal Impact Crashes/Mile	25.4	25.3	-0.4%
Rear End Crashes/Mile	80.3	40.0	-50.2%
AADT	37,000	43,000	16.2%
Intersection Density (/Mile)	3.7	3.3	n/a
Length (Miles)	2.2	1.2	n/a

Operations – Less Travel Time

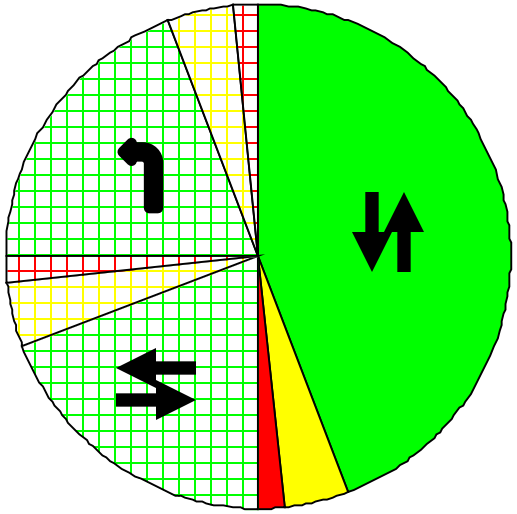
- Recapturing roadway capacity lost by installation of multi-phase signals
- Reduced “wait time” or delay
- Improved Signal Coordination
  (Synchronized Street Concept)

Main Street Green Time

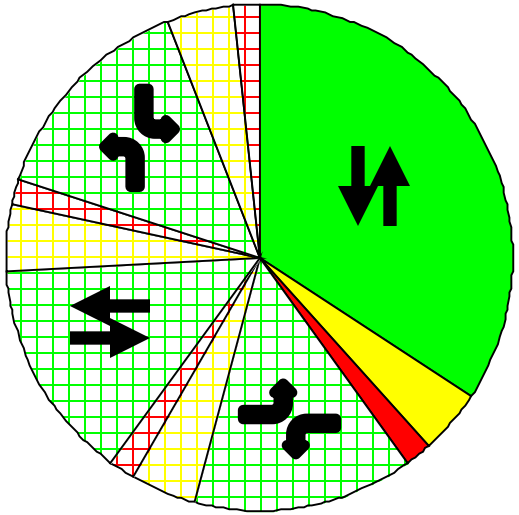
Signal Timing - Two Phase



Signal Timing - Three Phase



Signal Timing - Eight Phase

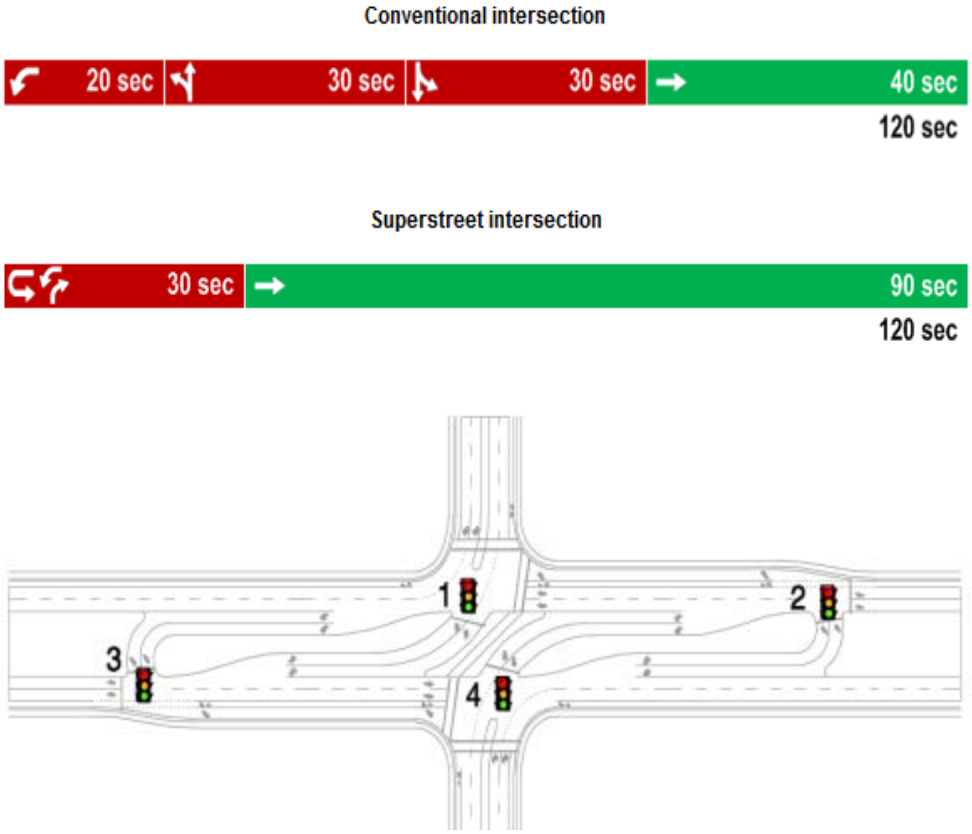


Eight-Phase Signal – Nine+ Lanes Wide

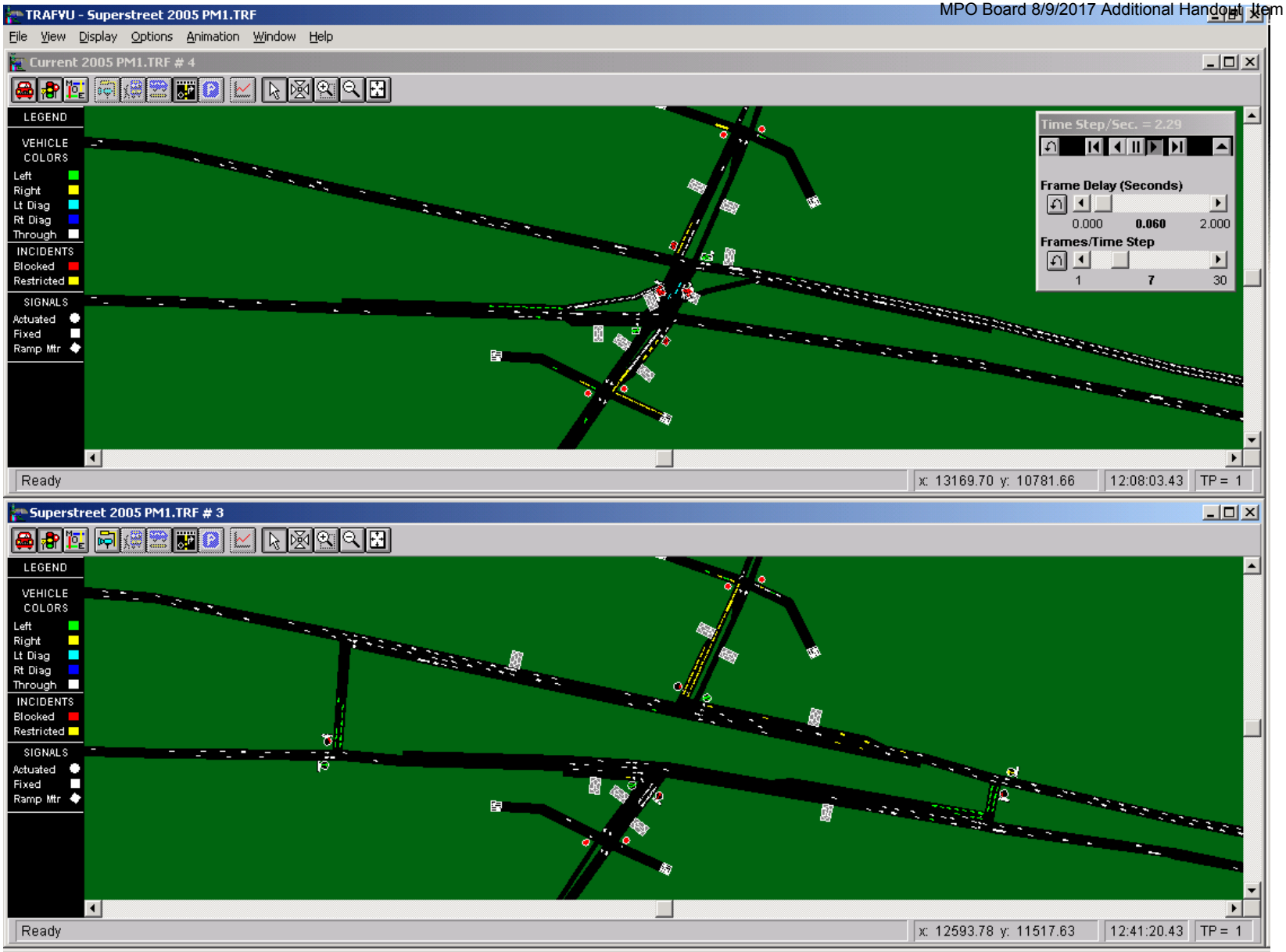
US 15-501 at Mt. Moriah Road, Durham

Signalized Superstreet Operation

- Two-phase signals allow more green time for the major street through movements
- Shorter cycle lengths
- Reduced delay for most vehicles and for pedestrians
- Can have different cycle lengths for each direction on the major street
- High capacity - side street volume can exceed 20,000 AADT

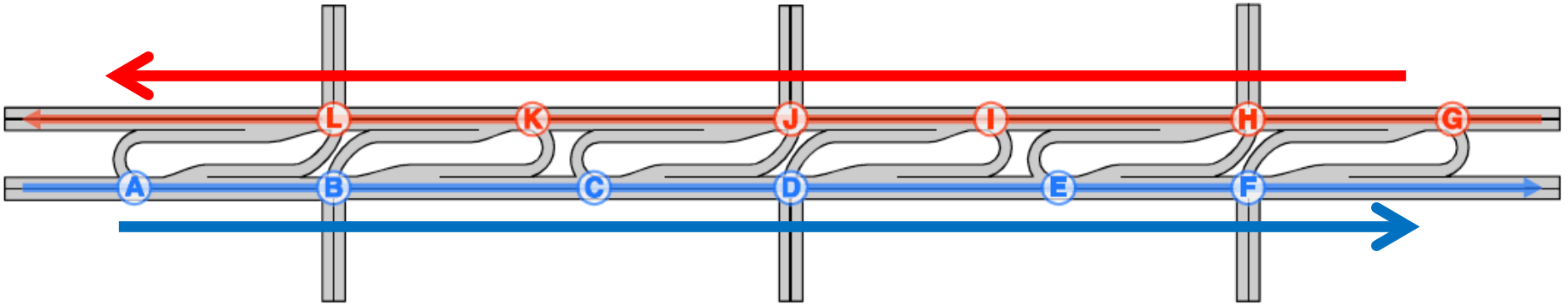


U-4008 – US 15-501 at Erwin/Europa



US 15-501 - 2005 Current vs. Superstreet

Superstreet Signal Progression



- Signals only affect one direction of main street travel
- One-Way Street – “Perfect” progression in both directions
- Maximized efficiency
- Effective at any speed or any signal spacing
- Can control speeds using progression – the progression speed can be adjusted by location, direction, time, day – drivers will adjust quickly
- No special signal equipment is needed

Superstreet - US 321 Hickory-Lenoir Corridor Operation

U-4700 - 2035 Full Network Delay Analysis (Traditional Build vs. Three-lane Superstreet Build)						
	AM			PM		
	Traditional	Superstreet	% Change	Traditional	Superstreet	% Change
Vehicles Exited (veh / hr)	31,760	35,618	12.15%	31,358	34,601	10.34%
Vehicles Entered (veh / hr)	33,730	37,283	10.53%	34,039	36,494	7.21%
Travel Distance (mi)	76,355	86,120	12.79%	73,721	82,465	11.86%
Travel Time (hr)	10,121	6,628	-34.52%	10,245	7,051	-31.17%
Total Delay (hr)	8,488	4,755	-43.98%	8,671	5,250	-39.45%
Total Stops (number)	111,713	122,511	9.67%	120,421	119,534	-0.74%
Fuel Usage (gal)	44,308	39,617	-10.59%	44,001	39,781	-9.59%
Per Veh. Distance (mi)	2.40	2.42	0.57%	2.35	2.38	1.38%
Per Veh. Time (hr)	0.32	0.19	-41.61%	0.33	0.20	-37.62%
Per Veh. Delay (hr)	0.27	0.13	-50.05%	0.28	0.15	-45.13%
Per Veh. Stops (number)	3.52	3.44	-2.21%	3.84	3.45	-10.04%
Per Veh. Fuel (gal)	1.40	1.11	-20.27%	1.40	1.15	-18.06%

Superstreet – US 17 in Leland (Brunswick County)

US 17 at Ploof Road/Old Waterford Way, Leland

US 281 (San Antonio TX)

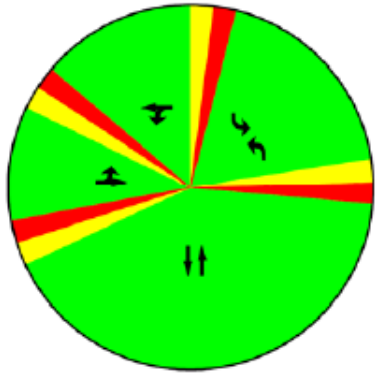
2009 – Looking south above Evans Road, PM peak

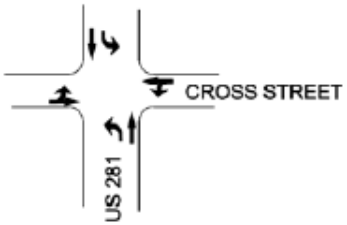
US 281 (San Antonio TX)

EXISTING US281 SIGNAL SPLITS

PAPE-DAWSON ENGINEERS

20s YELLOW + ALL RED (TYPICAL) = 15% OF CYCLE
154s GREEN TIME (TYPICAL) = 85% OF CYCLE

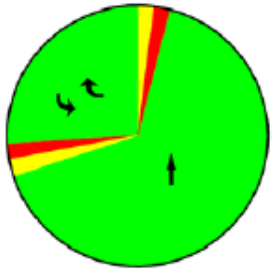




CONVENTIONAL STREET

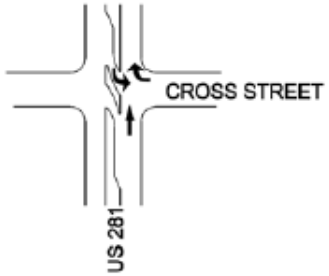
TYPICAL CYCLE LENGTH =180s

PROPOSED US281 NB SIGNAL SPLITS

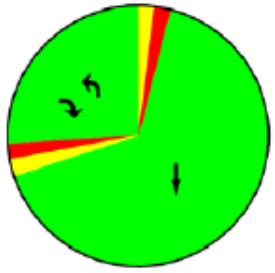


CYCLE LENGTH=100s

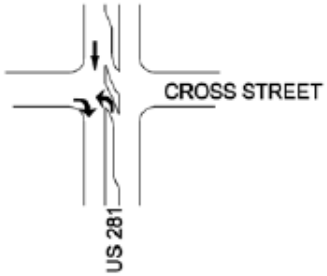
11s YELLOW + ALL RED (TYPICAL) = 11% OF CYCLE
89s GREEN TIME (TYPICAL) = 89% OF CYCLE



PROPOSED US281 SB SIGNAL SPLITS

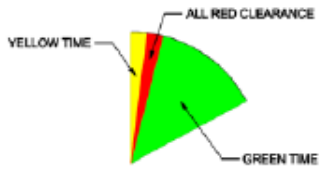


CYCLE LENGTH=100s



SUPERSTREET

LEGEND



US 281 Superstreet (San Antonio TX)

US 281 Superstreet Comments

As traffic congestion on U.S. Highway 281 eases due to the completion of the superstreet project, construction of new commercial and retail developments along the far North Central San Antonio corridor is ramping up.

"We are close to 90 percent leased with no pad sites left," Elliott remarked. "We've had quite a bit of interest because of the market, which is in a high growth area. **And a lot of our tenants say they feel like business has increased since the superstreet was finished.**"

San Antonio Express-News March 17, 2011

UPS Saves Millions by Favoring Right Hand Turns

First year savings:

About 26 million miles

3 million gallons fuel

Pedestrian and Bicycle Access

PEDESTRIAN AND BICYCLE ACCOMODATIONS ON SUPERSTREETS

by

Joseph E. Hummer, Ph.D., P.E., Professor and Chair
Department of Civil and Environmental Engineering
Wayne State University

Anne M. Holzem, P.E., Graduate Research Assistant
Department of Civil, Construction, and Environmental Engineering
North Carolina State University

And

Nagui M. Rouphail, Ph.D., Director,
Christopher M. Cunningham, P.E., Program Manager and
Sarah W. O'Brien, Program Manager
Bastian J. Schroeder, Ph.D., P.E., Assistant Director
Katy Salamati, Ph.D., Transportation Engineer
Robert S. Foyle, P.E. former Associate Director

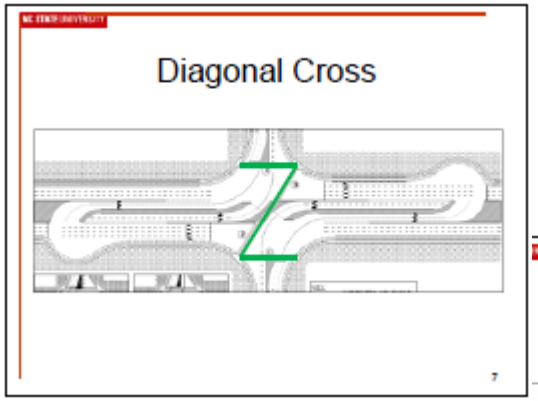
Institute for Transportation Research and Education
North Carolina State University
Raleigh, NC

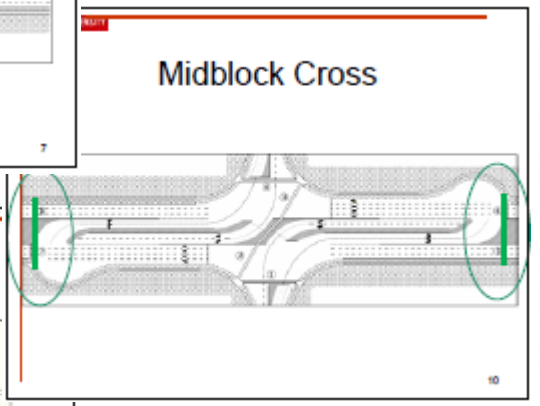
For the

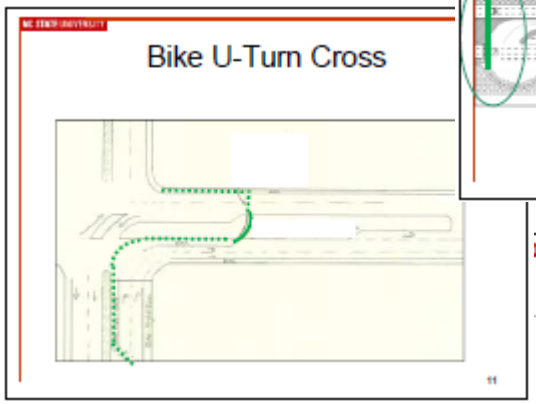
North Carolina Department of Transportation

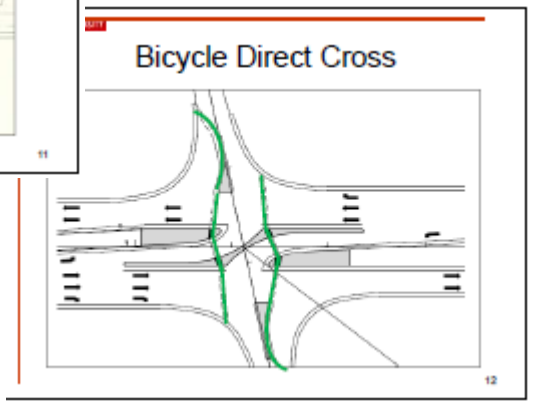
Final Report
Project: 2012 – 13

January, 2014







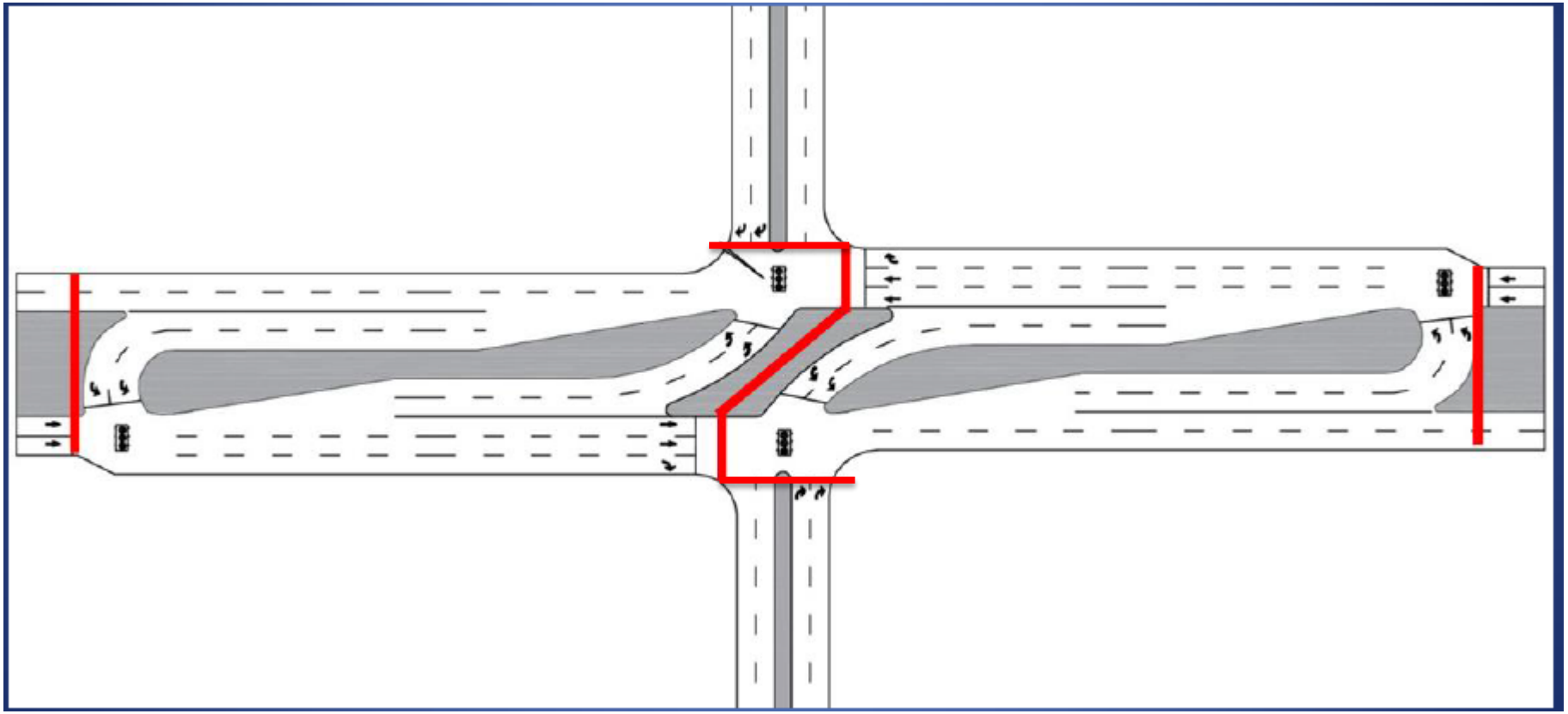


Traditional Intersection – Pedestrian Crossing

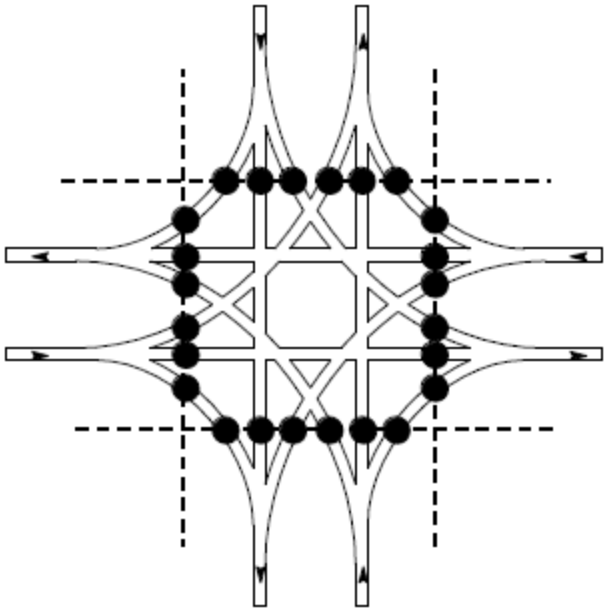
US 15-501 at Mt. Moriah Road, Durham

Single phase crossing ~140 ft.
= 40 seconds crossing time

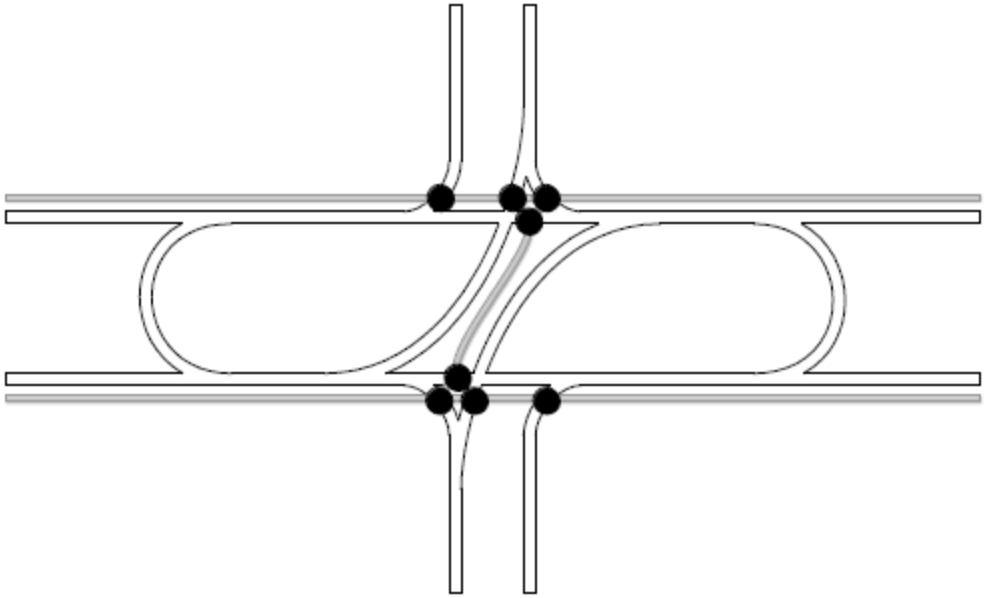
Superstreet Pedestrian Movements



Pedestrian Conflict Points



Conventional Intersection
24 Conflict Points

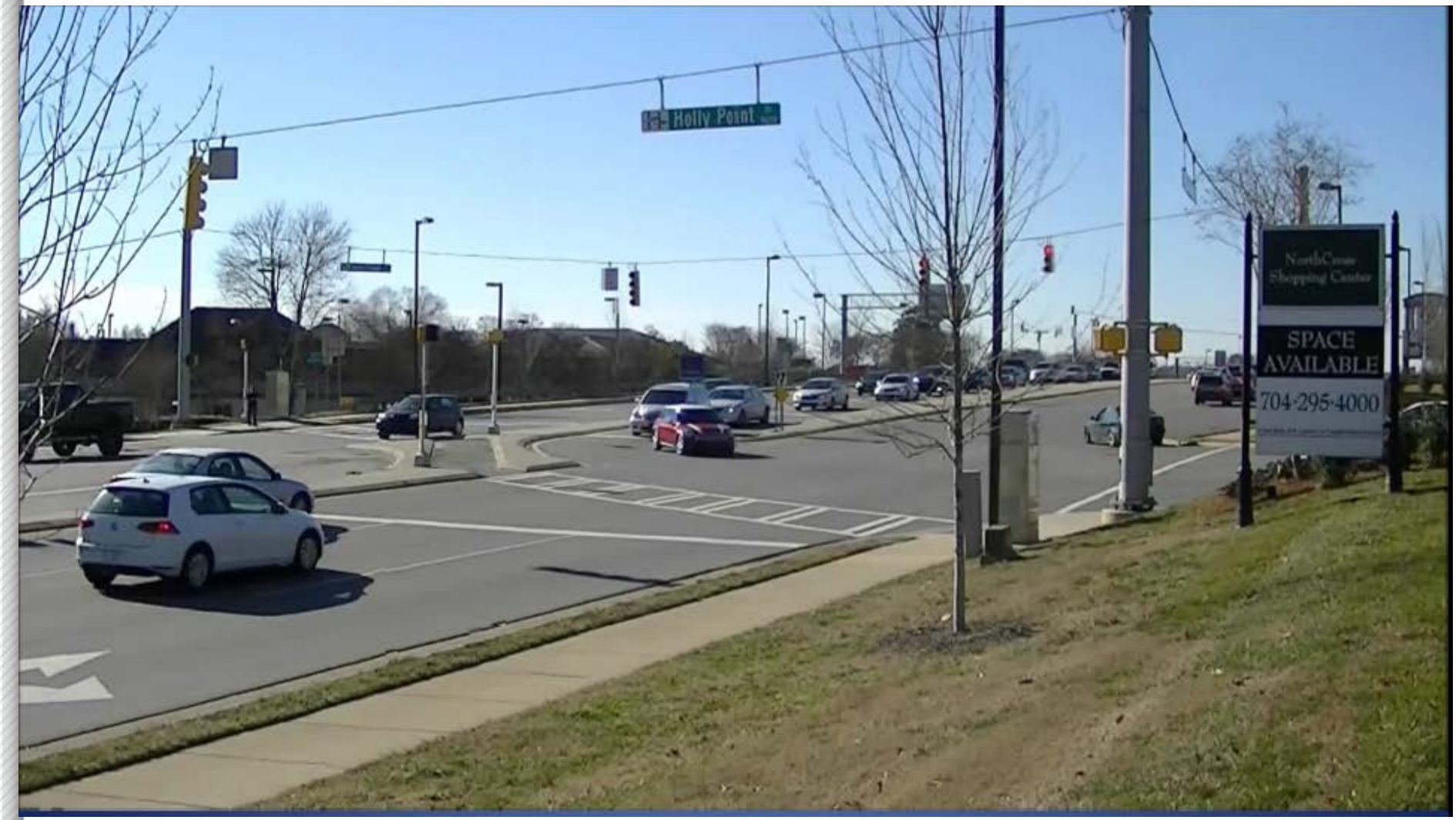


Superstreet Intersection
8 Conflict Points

Superstreet Ped Crossing in Center of Median

NC 55 Bypass at New Hill Road / Holly Springs Road, Holly Springs

Superstreet Ped Crossing – Street View

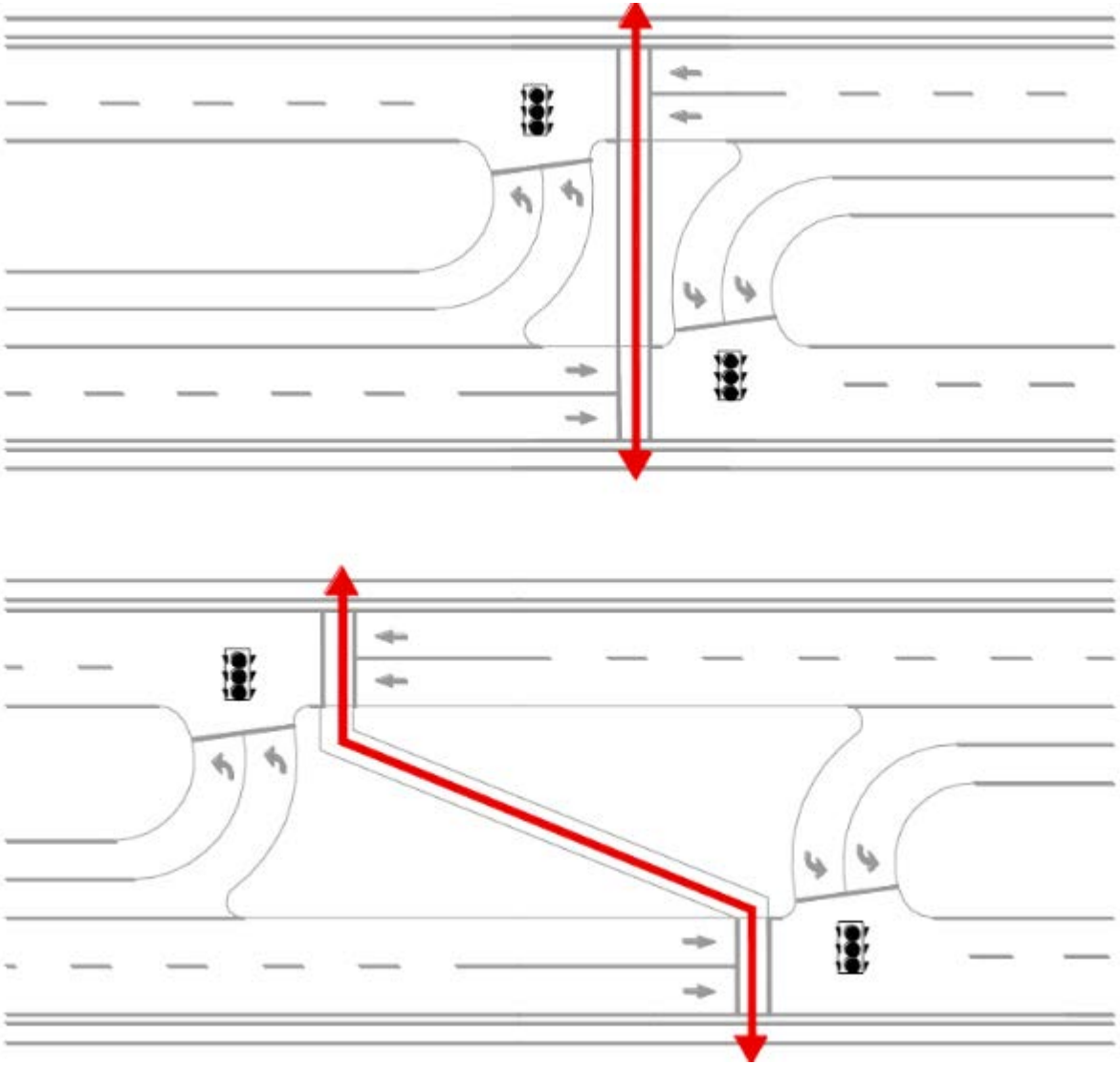


NC 73 at Holly Point Drive, Huntersville

Superstreet Multi-Use Path Crossing

US 15-501 at Erwin Road/Europa Drive, Chapel Hill

Pedestrian and Bicycle Crossing – Midblock Detail



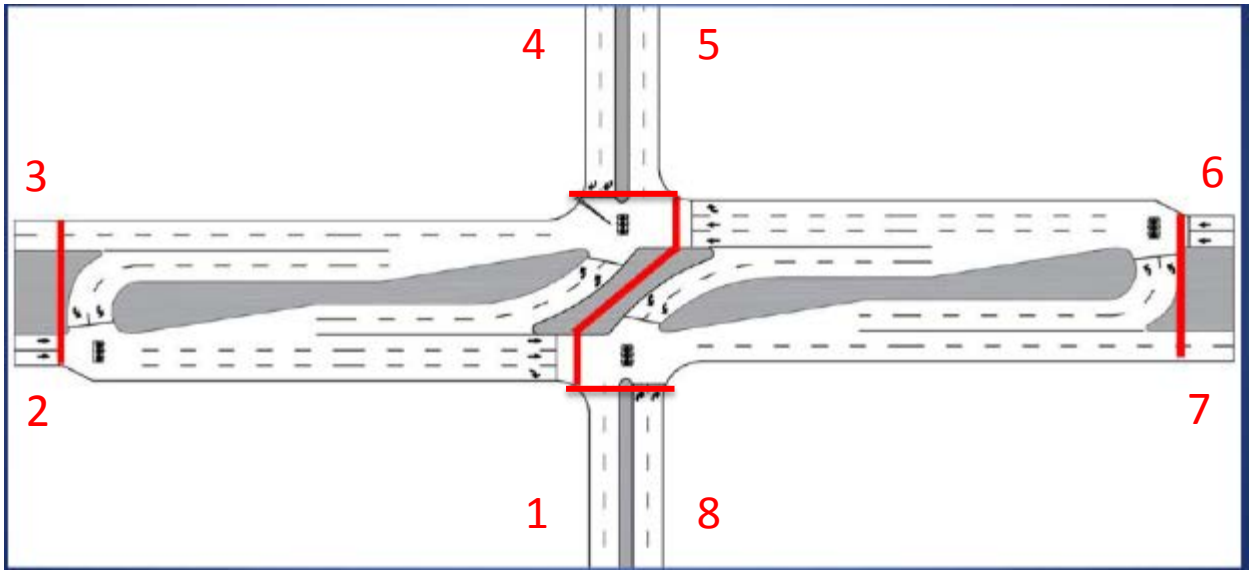
Pedestrian and Bicycle Crossing – Midblock Detail

Woodward Avenue, Birmingham, MI

Pedestrian Routes

Of 48 possible pedestrian routes…

- 34 better with superstreet
- 8 same with superstreet
- Only 6 worse with superstreet (1 to 4, 4 to 1, 4 to 8, 5 to 8, 8 to 4, and 8 to 5)



Pedestrian Delay

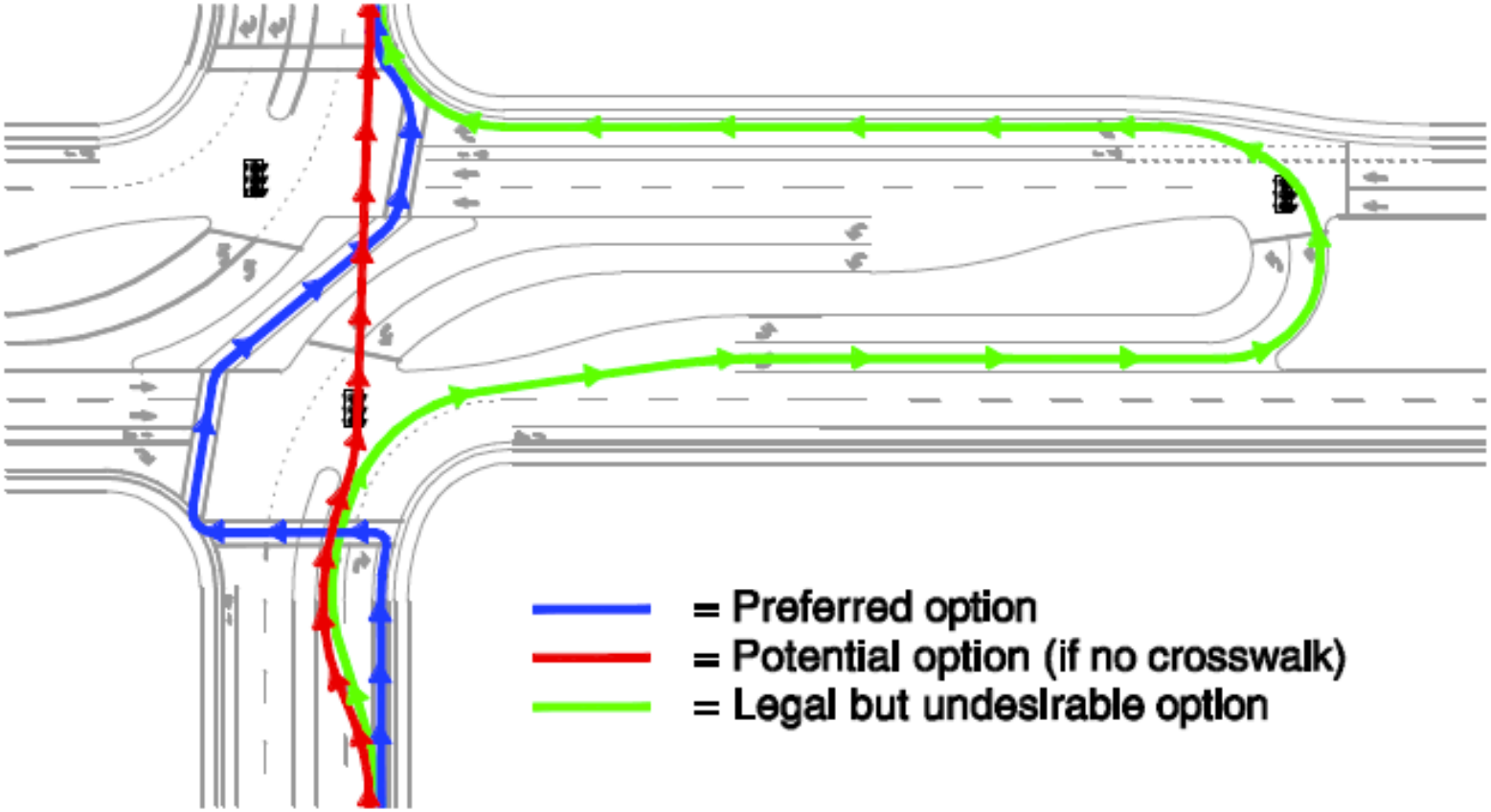
- Delay at signal = 0.5 * red time
- Red time depends on cycle length
- Superstreet cycle ~ 100 sec

  Conventional cycle ~ 200 sec
- Superstreet ped delay crossing major = 80 sec, crossing minor = 20 sec
- Conventional ped delay crossing major = 90 sec, crossing minor = 80 sec

Superstreet Intersections

NC 73 at Holly Point Drive, Huntersville

Bicycle Minor Street Crossing Options



Direct Bicycle Crossing

NC 24, Steadman

Superstreet vs. Conventional Intersections

Parameter	Superstreet	Conventional
Signal phases	Two	Eight
Crossing distance	~ 40-50 feet at a time	~ 120-140 feet
Stages	Two	One
Speeds	Controlled by signal progression	“Controlled” by speed limit
Queues	Moderate	Long
Buses	Flowing	Stuck in traffic

Pedestrian and Bicycle Access

Action	Beneficiary	
	Businesses and neighbors	Pedestrians
Signalize crossover	√	√
Signalize side street or driveway	√	√
Use shorter signal cycle	√	√
Establish slower progression speed	√	√
Establish signalized midblock crosswalk	√	√
Create offset intersection to allow straight crosswalk	√	√
Use reverse superstreet for heavy side street left turn	√	
Move U-turn crossover closer to main intersection	√	
Allow U-turns at left turn crossover	√	
Allow left turns at U-turn crossover (e.g., line up U-turn crossover with side street or driveway)	√	
Use flashing yellow arrow instead of red at crossover signal	√	

Why Choose a Superstreet?

Performance Goals	Traditional	Superstreet
Improves safety by reducing conflict points		✓
Saves travel time		✓
Reduces congestion		✓
Reach businesses safely without delay		✓
Accommodates growth		✓
Safer for pedestrians and bicyclists		✓

Support the Superstreet

- Many people will dislike it at first, but …
- They will learn the new pattern quickly
- Better for cars
- Better for buses
- Better for pedestrians
- Will serve well for many years
- We appreciate your support

Becoming the Default Arterial Design in North Carolina