SUPERSTREETS AND MEDIAN U-TURNS

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1. What are the problems?
2. What is a superstreet and how does it solve the problems?
3. What is a median u-turn intersection and its benefits?
4. How do pedestrians and bicyclists benefit?
5. Are these designs safe?
6. Conclusions
WHAT ARE THE PROBLEMS?

Visualize some of the intersections along Route 123 in Tysons.

What do you see?  Who do you see?

Insert mental image of your intersection here
WHAT ARE THE PROBLEMS?

- Increasing Congestion
- Too Many Crashes
- Mobility for all modes
  - Bicycles, Pedestrians, Transit
- Not Enough Funding
- Time Consuming Projects
- Inability for more right-of-way
- Impacts of projects
  - Environmental, social, economic
Intersections are usually the bottlenecks along high volume roadways.

Congestion cannot always be solved by adding more lanes.
METHODS OF REDUCING CONGESTION

INCREASE SUPPLY – Add more lanes

REDUCE DEMAND – Change modes of travel, Improve network, Move traffic to locations that still have capacity.

IMPROVE TRAFFIC FLOW – Better signal timing, Eliminating weaving issues, Reduce signal phasing
Basic two-phase signal operation

Adding “protected” left-turn phases is common as volumes increase.

NEW DEVELOPMENT ALONG ARTERIAL

Problem: Proliferation of Four-Phase Signals
Adding more phases “steals” time away from the major through movement and can increase intersection delays.

- More phases also add more “lost time”
Adding more phases “increases” the signal cycle length by needing more time for each movement, which causes even more delay.

- Longer Cycle Length
Strategically relocating left turn movements can provide more green time to through traffic.
WHAT IS THE SUPERSTREET & WHERE IS IT APPLICABLE?
SUPERSTREET DISTINGUISHING FEATURES

- Cross street (minor road) traffic turns right, then accesses U-turn to proceed in desired direction.
- Main and U-turn intersections can be either signalized ("Superstreet") or not ("J-Turn")
SIGNALIZED “SUPERSTREET”
SIGNALIZED “SUPERSTREET”
Signalized Superstreet

SR 4 Bypass at Symmes Road in Fairfield, OH
Superstreet variation with closed median at main intersection (left-turns from major highway made via U-turns)
MD 3 @ Waugh Chapel Road in Crofton, MD (1 hour east of Fairfax)

Superstreet variation with closed median at main intersection (left-turns from major highway made via U-turns)
BETTER SIGNAL OPERATIONS

- Superstreets typically operate with only 2-phases allowing more green time to the major street through
- Shorter cycle lengths than comparable conventional intersections may be possible
  - Shorter cycles reduce delay for most vehicles and for pedestrians

Superstreets offer an ability to have different cycle lengths in the two directions of the major street
BETTER SIGNAL OPERATIONS

Average Delay
42 sec  |  34 sec  |  34 sec  |  27 sec

(+ 12 sec added travel time)
BETTER SIGNAL OPERATIONS

Superstreet intersection

Average Delay
34 sec | 4 sec
(+ 12 sec added travel time)

Average Delay
22 sec | 3 sec
(+ 12 sec added travel time)

Average Delay
23 sec | 8 sec
(+ 12 sec added travel time)
BI-DIRECTIONAL PROGRESSION

- Each direction may operate independently
- Directions can be progressed at different speeds and/or signal spacing

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<th>Direction</th>
<th>Parameter</th>
<th>F</th>
<th>E</th>
<th>D</th>
<th>C</th>
<th>B</th>
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<td>Distance from previous signal, ft</td>
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<td>Offset to start of green, sec</td>
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<td>46</td>
<td>26</td>
<td>12</td>
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<td>12</td>
<td>29</td>
<td>50</td>
<td>62</td>
<td>74</td>
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Note: Assumed progression speed of 50 feet per second (34 mph) in both directions
WHAT IS THE MEDIAN U-TURN (MUT) & WHERE IS IT APPLICABLE?
MUT – Median U-Turn

(aka Michigan Left)

- At-grade intersections with *indirect* left turns using a U-turn movement in a wide median and/or loon
- The MUT eliminates direct left turns on both intersecting streets, reducing the number of signal phases and conflict points at the main intersection
Vehicles on the major street (or the street with the median) that want to turn left are directed through the main intersection to a U-turn movement at a downstream directional crossover (usually signalized), and proceed back to the main intersection to then turn right onto the minor street.
Vehicles on the minor street that wish to turn left at the major street are directed to turn right, make a U-turn movement at the same crossover, and then proceed through the main intersection.
BASIC SIGNAL PHASING

Phase 1 – Major Street Through
Phase 2 – Minor Street Through and U-turns
The MUT removes left-turn phasing, which results in fewer clearance intervals in the intersection cycle and to operate well with a shorter cycle length than a comparable multi-phase cycle.
Median U-Turn Intersection

US 29 and MD 193 (University Blvd)
Four Corners (Silver Spring), MD
Median U-Turn Corridors
OK – but ...
What if I’m dealing with an existing arterial that doesn’t have a median?
U-TURN INTERSECTIONS: THRU TURN

- Similar to MUT in that direct left-turns are eliminated from main intersection
- Substitutes a paved bump-out or “loon” beyond the outside lane (or coinciding with a sidestreet tee intersection or driveway) for the wide median of a MUT
Advance Signing at ThrU-turn
WHY THE BAD REPUTATION FOR PEDESTRIANS AND BICYCLES FOR SUPERSTREETS?

- Initial superstreets installed in locations without pedestrian/bicycle facilities
- Many positive features for pedestrians and cyclists...
  - Safer for all users
  - Less delay for the majority of movements
- ...but the design is not perfect for crossing the major road
  - Multi-stage crossing for some movements
  - Optimal bicycle crossing is being shown to use pedestrian crossing
- Superstreets have not met their full potential yet
  - Use of u-turn locations for crossings
  - More research on pedestrian and bicycle issues
- Superstreet should provide major improvements for pedestrians and bicycles along a corridor like Route 123
Pedestrian crosswalks and pathways in a superstreet

Question: Will pedestrian crossings take longer in a superstreet?
BETTER SIGNAL OPERATIONS FOR PEDESTRIANS TOO?

Superstreet intersection

Average Delay
34 sec (1st stage) | 4 sec
0 - 75 sec (2nd stage)

Average Delay
22 sec (1st stage) | 3 sec
0 - 50 sec (2nd stage)

Average Delay
23 sec (1st stage) | 8 sec
0 - 50 sec (2nd stage)
PEDESTRIAN “Z” CROSSING

Superstreet in Huntersville, NC
NC 73 @ Holly Point Drive
PEDESTRIAN “Z” CROSSING

Superstreet intersection in operation near San Antonio, TX
PEDESTRIAN “Z” CROSSING

Superstreet intersection in operation in Crofton, MD
PEDESTRIAN-VEHICLE CONFLICT POINTS

Superstreet Intersection
8 conflict points

Conventional Intersection
24 conflict points
BICYCLE – MINOR STREET THROUGHS

- Preferred option
- Potential option (if no crosswalk)
- Legal but undesirable option
PEDESTRIAN CROSSINGS

- Major Road Crossing
  - 1 or 2 Stages
  - Median Refuge
- Minor Road Crossing
  - 1 Stage
At a MUT, the left turns are removed from the main intersection (and shifted to the U-turns located away from the intersection), thus removing pedestrian exposure to left-turning vehicles.

Although the number of pedestrian conflict points at a MUT is reduced, since left-turn demand movements are consolidated into right-turn movements, the total number of vehicles crossing the crosswalk is the same. Consideration of treatments such as a Leading Pedestrian Interval or right turn on red (RTOR) prohibitions may mitigate the conflicts.
The two-phase signal at a MUT typically allows a shorter signal cycle length compared to a comparable conventional intersection, but with similar green times for pedestrians and vehicles. This benefits pedestrians by creating more pedestrian phases per hour along with less “don’t walk” time between “walk” times (i.e., less wait time between walk signals).
Adding pedestrian signal will not interfere with signal progression!!!
BICYCLE – LEFT TURN OPTIONS

= Preferred option
= Potential option
= Legal but undesirable option
CONFLICT POINTS

Traditional Intersection:
32 Conflict Points
16 Crossing Conflicts

True apple to apple comparison, superstreets only has 12 conflict points with 2 crossing, all other conflicts are due to multi-lanes
VEHICLE-VEHICLE CONFLICT POINTS

Crossing conflicts reduced from 16 to 4
Merging and diverging conflicts are each reduced from 8 to 6
SAFETY PERFORMANCE STUDIES

MUT intersections show safety performance improvements compared to conventional intersections for most crash types and injury severities.

<table>
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<tr>
<th>Dataset</th>
<th>Rate Type</th>
<th>Group</th>
<th>Mean Crash Rates (Crashes/MVE)</th>
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<td>All</td>
<td>MUT (Reduction)</td>
<td>1.554 (14%)</td>
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<td>Conventional</td>
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<tr>
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<tr>
<td>Intersection</td>
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<td>Injury</td>
<td>PDO</td>
<td>MUT (Reduction)</td>
<td>0.407 (30%)</td>
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<tr>
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<td>Conventional</td>
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<td>0.58</td>
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Source: FHWA Median U-Turn Informational Guide
CONCLUSIONS

SUPER STREET
AND MEDIAN
U-TURNS
BENEFITS OF SUPERSTREETS AND MEDIAN U-TURNS

SAFETY
• Fewer conflict points
• Significant Before/After Crash Reductions

MOBILITY
• Less delay
• Reduced congestion

VALUE
• Less ROW / construction costs
• Implemented quicker
• Better access for residents & businesses
METHODS OF REDUCING CONGESTION

INCREASE SUPPLY – Add more lanes, where possible

REDUCE DEMAND – Change modes of travel, Improve network, Move traffic to locations that still have capacity.

IMPROVE TRAFFIC FLOW – Better signal timing, Eliminating weaving issues, Reduce signal phasing
RESOURCES

For easy access ...
safety.fhwa.dot.gov/intersection/
QUESTIONS

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