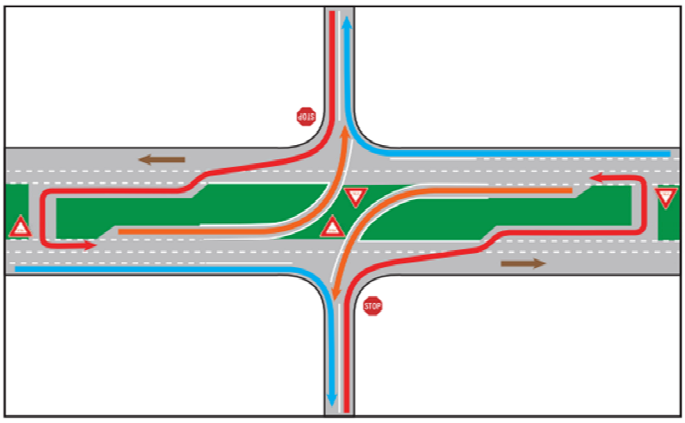
Design Considerations for RCI Intersections

Mark Orton & Taylor Ruble

1

What is an RCI? (Taylor)



2

What is the correct name?

- *What is it actually called?*
  - *J-Turn – Through movements and left turns from side street are rerouted to U-turn (Generic/Common name)*
  - ***RCut – Restricted Crossing U-Turn Intersection (Basically a J-Turn but signalized)***
  - ***RCI – Reduced Conflict Intersection (Basically a J-Turn but not signalized)***
  - ***Boulevard Left– Through movements allowed from all approaches, left turns from all approaches rerouted to U-turns, main intersection and possibly U-turns are signalized***
  - ***MUT – Median U-Turn Intersection – Whole J-Turn family, including RCut, RCI, and Boulevard Left***
  - *Michigan Left – (Nickname for a Boulevard Left)*
  - *Superstreet – (Nickname for a J-Turn)*

BOLD – INDOT Preferred names

3

National Crash Reduction Factors

- *44% Reduction in All Crashes - Convert Unsignalized Rural Intersection to Unsignalized J-Turn (Inman and Haas, 2012)*
- *46% Reduction in All Crashes - Convert Unsignalized Rural Intersection to Unsignalized J-Turn (Hummer Et Al., 2010)*
- ***63% Reduction in Fatal and Injury Crashes - Convert Unsignalized Rural Intersection to Unsignalized J-Turn (Hummer Et Al., 2010)***
- *35% Reduction in all Crashes – Install Rural J-Turn Intersection (Edara Et Al., 2013)*
- ***54% Reduction in Injury Crashes – Install Rural J-Turn Intersection (Edara Et Al., 2013)***
- *15-22% Reduction in All Crashes – Convert Signalized intersection to Signalized Superstreet (Hummer & Rao, 2017)*

http://www.cmfclearinghouse.org/

4

How are Indiana RCIs Operating Overall?

- *Using simple before and after comparison of crashes*
- *Equal number of before years and after years at each site*
- *Based on 7 sites.*
- *Each site has been installed for at least a year*
- *Updated 2021*

68% Reduction in All Crashes

81% Reduction in Fatal and Injury Crashes

https://www.wane.com/news/semi-dump-truck-collide-closing-us-30-at-sr-101/

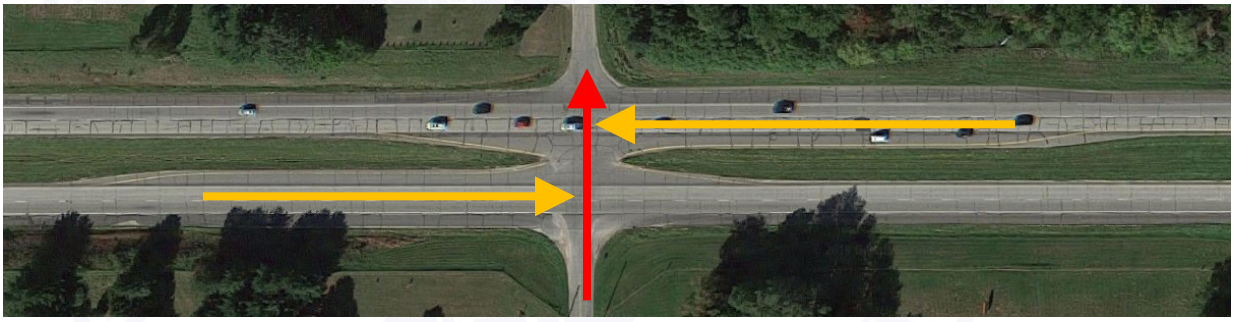
https://www.14news.com/story/13581782/truck-driver-seriously-hurt-in-crash-on-highway-231/

NextLevel INDIANA

5

Crash Patterns Addressed

- "Far Side" right angle (Main Crash Pattern)
- "Near Side" right angle

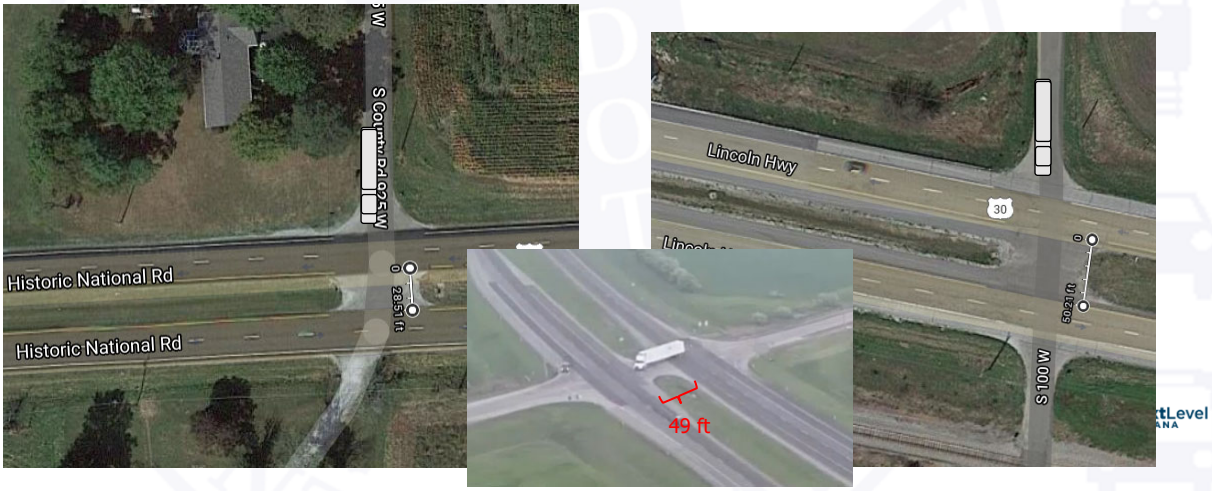


NextLevel INDIANA

6

Not All Vehicles can use "Two-Stage Crossing"

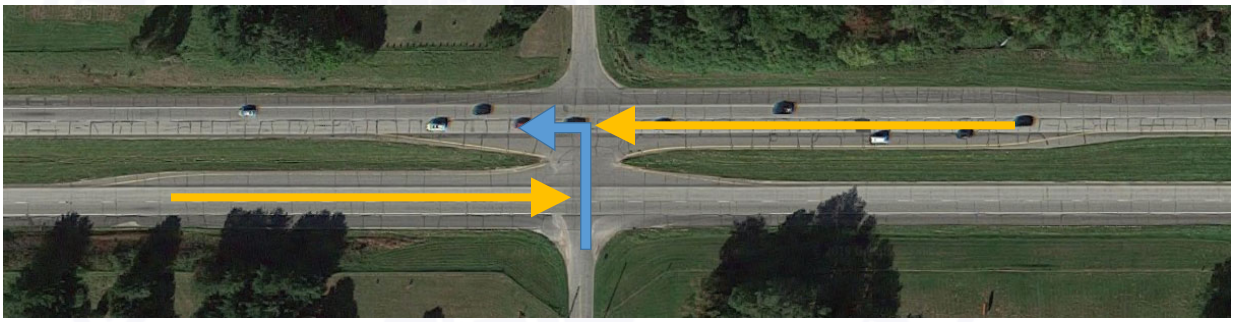
- Semi Trucks do not fit in most medians (72' Example)



7

Crash Patterns Addressed

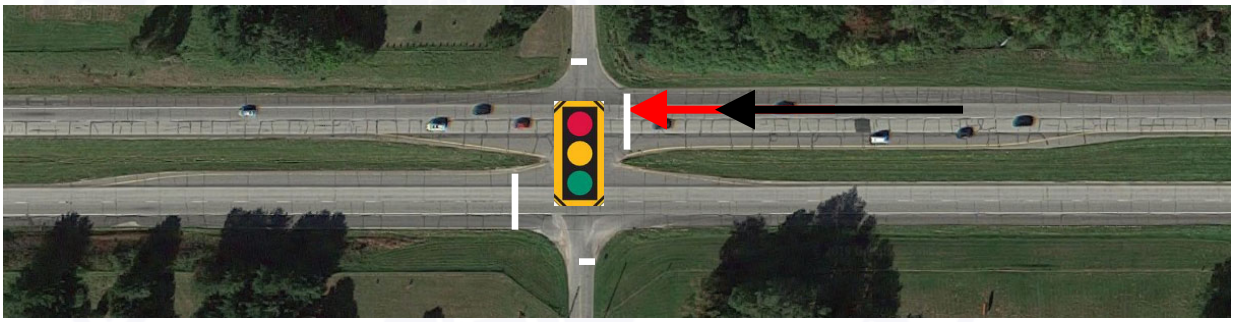
- "Far Side" left turn
- "Near Side" left turn



8

Crash Patterns Addressed

- Signal related rear ends

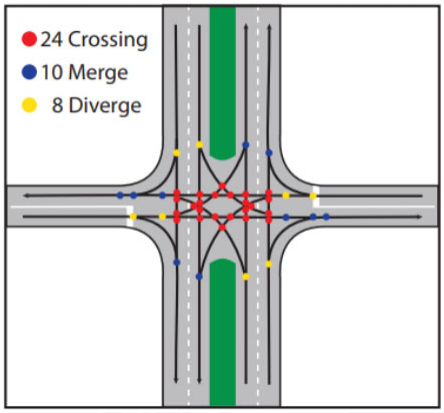


9

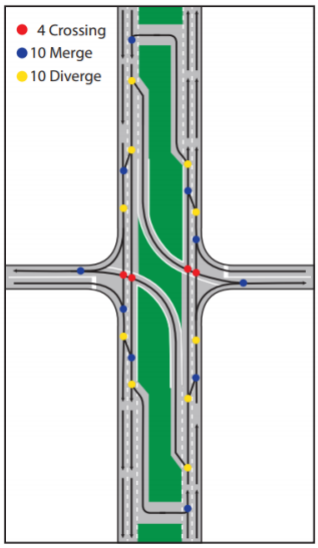
Conflict Point Diagram

- Reduce Conflicts = Reduce Crashes

Conventional Intersection Conflict Points



J-Turn Conflict Points

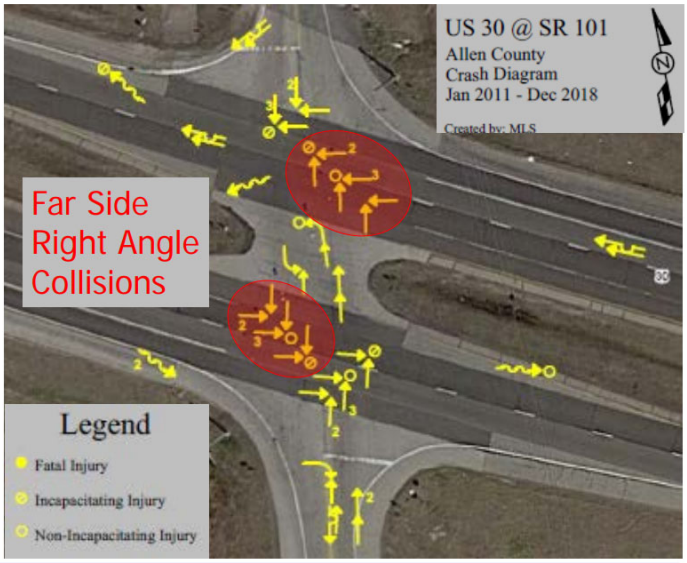


https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=4324&context=roadschool

10

Example: US 30 at SR 101 – Fort Wayne

- *Crash History 2011-2017*
  - *32 Total Crashes*
    - *16 Injury Crashes*
    - *19 Right Angle Crashes*
    - *12 Far Side Right Angle*

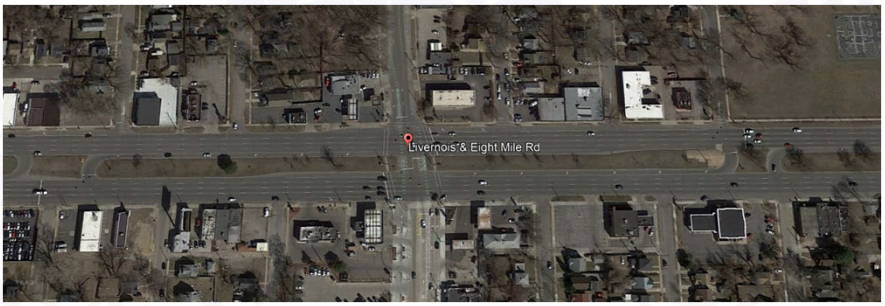


https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=4324&context=roadschool

11

History of Restricted Cross U-Turn Intersection

In 1960, Telegraph Road (US 24) in Detroit was designed as a ***"Super Highway"*** with "directional crossovers" to eliminate left turns at primary intersections. The crossovers were placed in the median approximately 350-ft from the intersections. Due to the proximity of the crossovers and the volume of the traffic the concept did not work well. Joseph Hobrla, a signal engineer for the MDOT and Joseph Marlow, the district traffic engineer evaluated the issues with Telegraph Road and experimented with 8 Mile Road and Livernois Avenue. They increased the offset of the crossover to 660-ft west of the intersection and the rest is history.



12

History of Restricted Cross U-Turn Intersection

The original concept was introduced by Richard P. Kramer in a paper presented at ITE's 1987 National Conference in the proceedings for *Strategies to Alleviate Traffic Congestion.* Below is a couple of the hand sketches that were included in his pa*per* :

"New Combinations of Old Techniques to Rejuvenate Jammed Suburban Arterials"

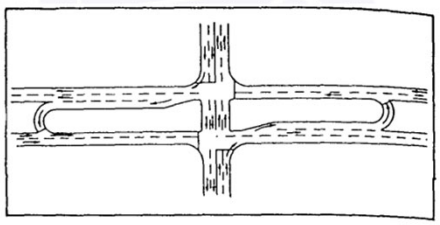


Figure 3.A Indirect Left Turn Through A Crossover

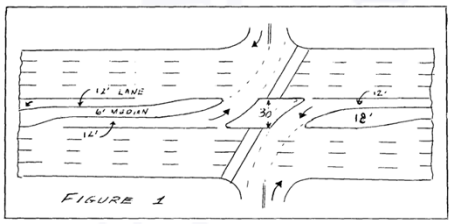


FIGURE 1

NextLevel INDIANA

13

History of Restricted Cross U-Turn Intersection

The concepts are in an urban/suburban context and provide:

1. Direct left crossings from the minor road with a U-turn in the median.
2. Allowing high thru traffic volumes on the major street more green time.
3. Accommodate large vehicles and pedestrians.
4. Provide acceleration lane for right turns from minor roads on the major road and deceleration lanes at the entrance of the U-turn on the major road.

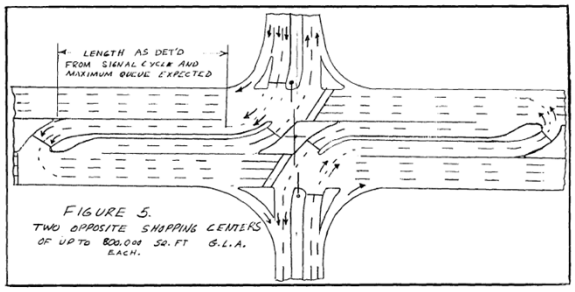


FIGURE 5.
TWO OPPOSITE SHOPPING CENTERS OF UP TO 800,000 SQ. FT. G.L.A. EACH.

If these major traffic generators were instead a collector street

NextLevel INDIANA

14

Design Elements

- The recommended design speed for RCUT intersections in rural areas is 60 mph.
- The length of all auxiliary turn lanes should comply with IDM Figure 46-4I and 4J.
- Minimum median width for a U-Turn ***without*** a loon is 60 feet depending on outside shoulder width. With a median width of 60-ft, the outside shoulder should be at least 10-ft paved. The shoulder in the proximity of the cross over may have to be reconstructed for the increase in truck traffic.
- The islands in the intersection and the approach must be offset at least the width of the adjacent shoulders. (Minimum 4-ft inside, 10-ft outside)
- In rural conditions, all Islands should be traversable. The island in the J-Turn should also be traversable for emergency vehicles.
- The median U-turn should be offset a minimum of 75 feet from the beginning of the taper of the left turn lane.

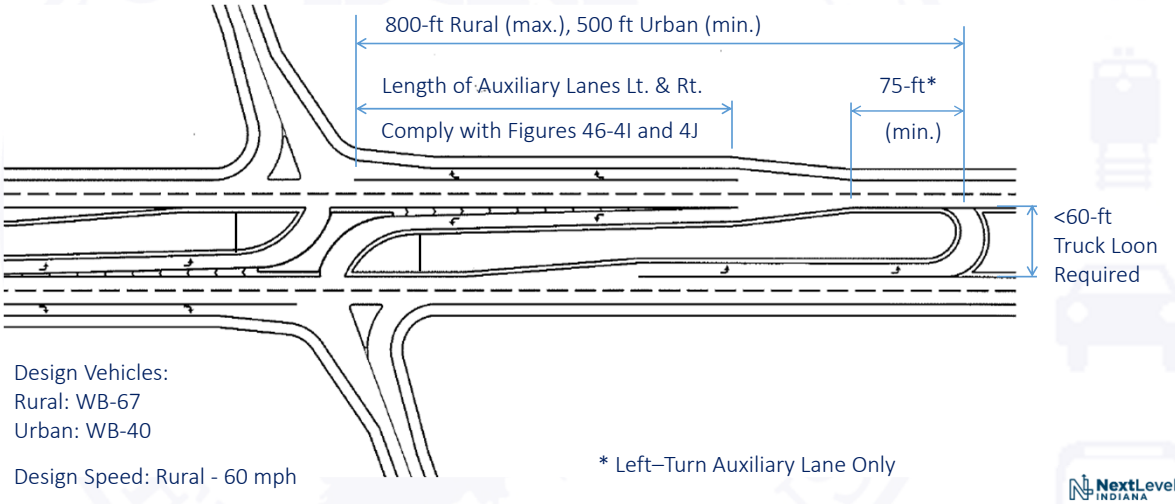
15

Design Elements -continued

- Design Vehicles for rural area should be a WB-67. In urban areas use a WB-40 unless otherwise directed by the District Traffic Engineer.
- Lane widths should be 12 feet. 11 feet may be considered if lane widening is not possible.
- Usable shoulder on loons should be 5 feet, 4 feet paved. Wheel path of the design vehicle ***should not*** encroach on the shoulder.
- The taper to the U-turn access lane should start at approximately the radius point of the minor approach. No drives should be with in 100 feet of the U-turn to avoid merging issues.
- Spacings between the J-turn intersection and the median U-turn less than 500 feet in an urban area or greater than 800 feet in a rural area will need approval from the INDOT District Traffic Engineer.
- Intersection sight distance for the J-turn intersection, both approaches and both MUT crossovers must be in compliance with IDM Section 46.

16

RCUT Layout



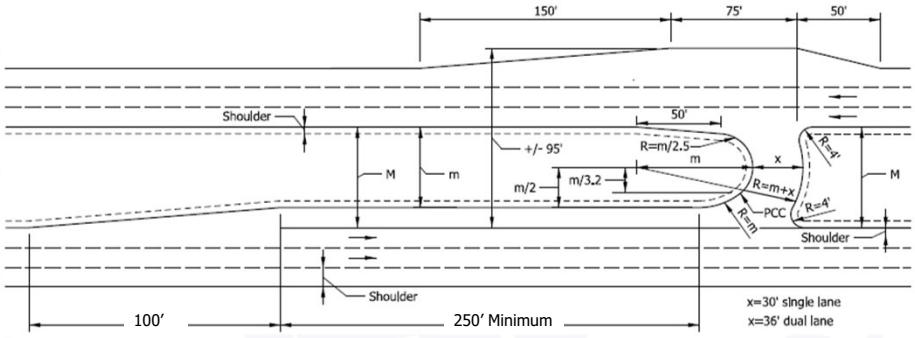
Design Vehicles:
Rural: WB-67
Urban: WB-40

Design Speed: Rural - 60 mph

* Left–Turn Auxiliary Lane Only

17

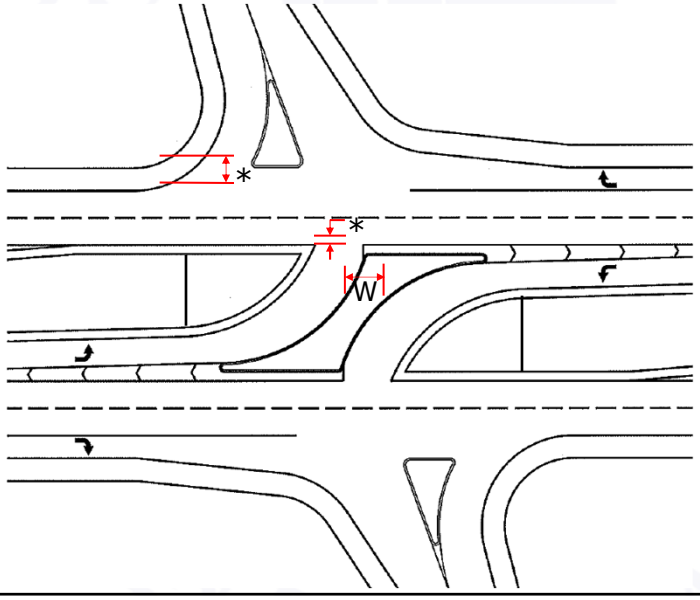
Loon Design



INDOT's preferred Loon Design is modified from the Michigan DOT Standards. It provides for a simplistic layout and is easier to maintain and snowplow. All dimensions and stationing should be rounded **up** to the nearest foot. The shoulder (not shown) should be 5 ft (4-ft paved). The wheel path of the design vehicle should not encroach on the shoulder.

18

"J-Turn" Intersection



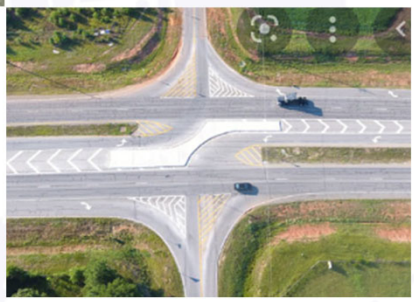
Curb/Island Offset: Match Shoulder Offset (4-ft. inside - 10-ft outside minimum.)

"W" Minimum Width of Island is 6-ft in rural areas w/o pedestrian traffic.

19

J-Turn Intersection Examples

Maryland

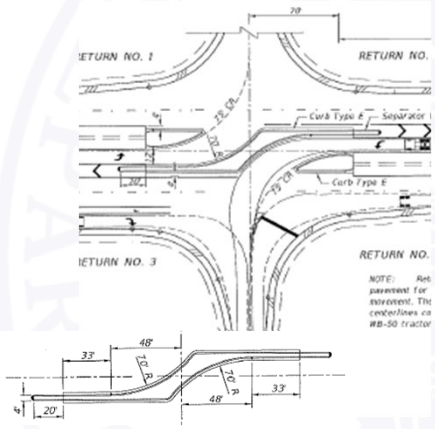


Georgia

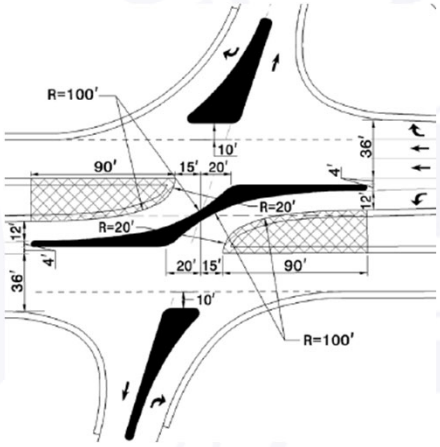
North Carolina

20

J-Turn Intersection Center Curb Design



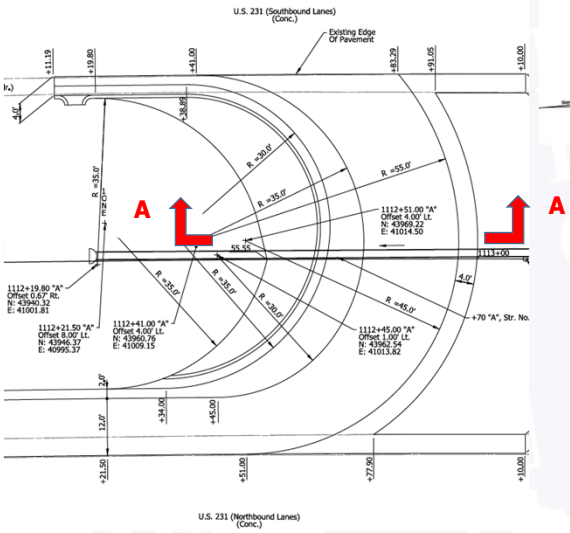
Florida DOT

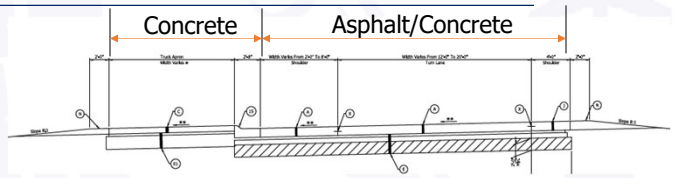


North Carolina DOT

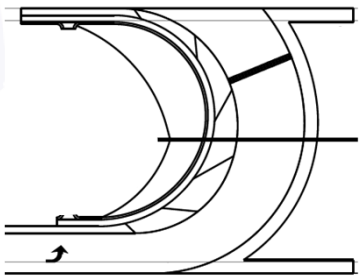
21

Median U-Turn Details



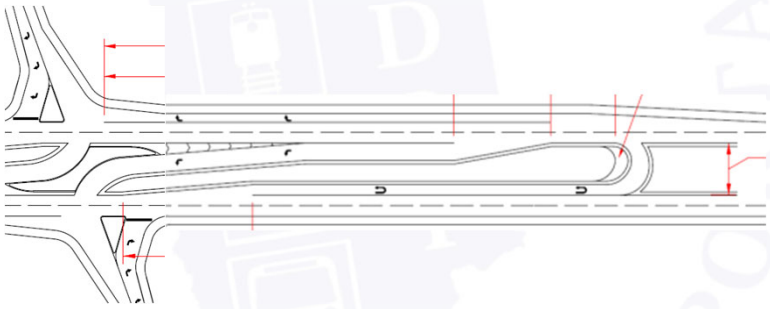


Section **A-A**



22

Placement of Drives (Taylor)

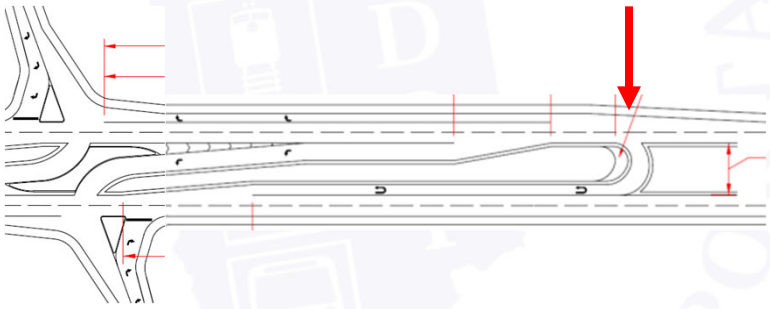


All drives within vicinity of an RCI must be Right-in, Right-out

23

Placement of Drives (Taylor)

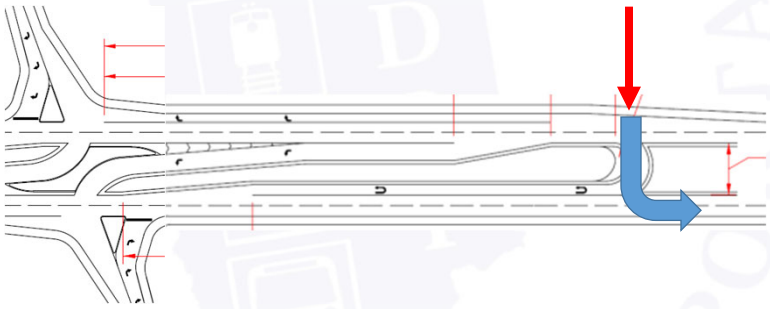
Very Poor Driveway Placement



24

Placement of Drives (Taylor)

Very Poor Driveway Placement

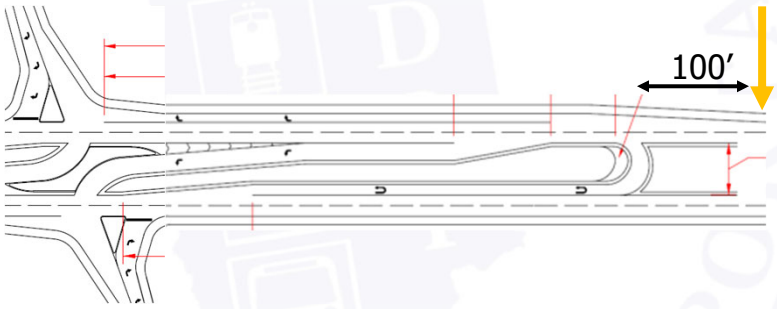


Risk of left turns through median opening

25

Placement of Drives (Taylor)

Poor Driveway Placement

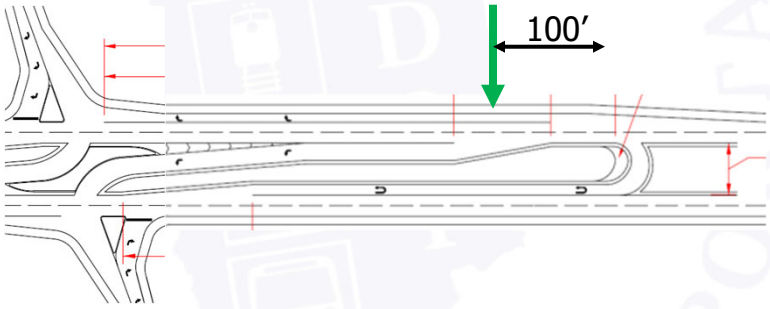


Cannot use U-turn to access drive

26

Placement of Drives (Taylor)

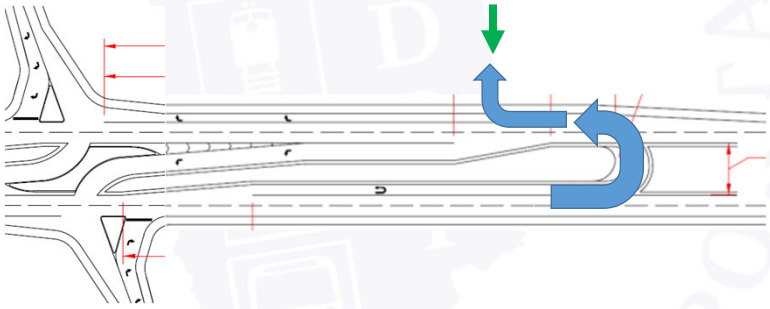
Better Driveway Placement



27

Placement of Drives (Taylor)

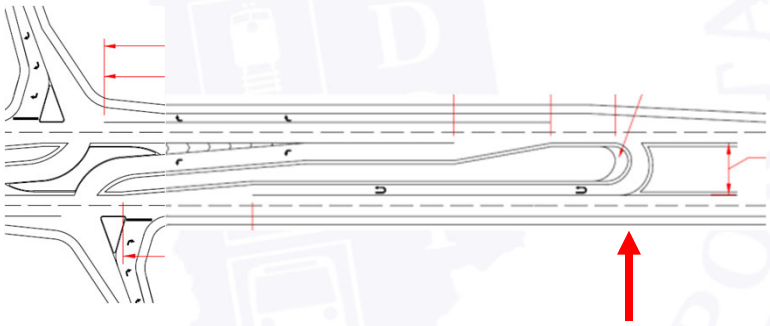
Better Driveway Placement



Can use both U-turns

28

Placement of Drives (Taylor)

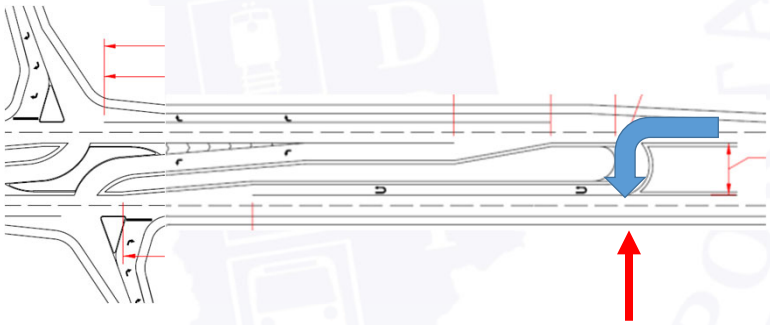


Very Poor Driveway Placement

29

Placement of Drives (Taylor)

Risk of left turns through median opening

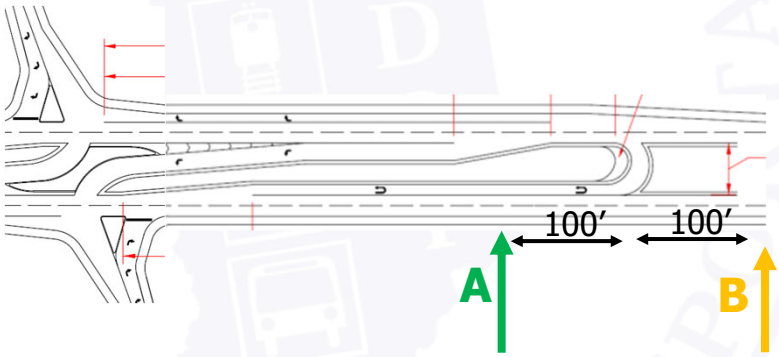


Very Poor Driveway Placement

30

Placement of Drives (Taylor)

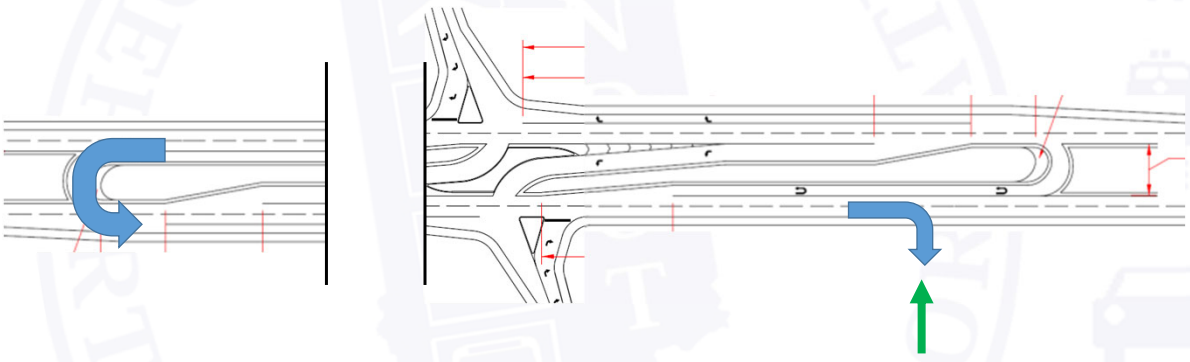
A. is better than B. since A. can use both U-turns



Better Driveway Placement

31

Placement of Drives (Taylor)

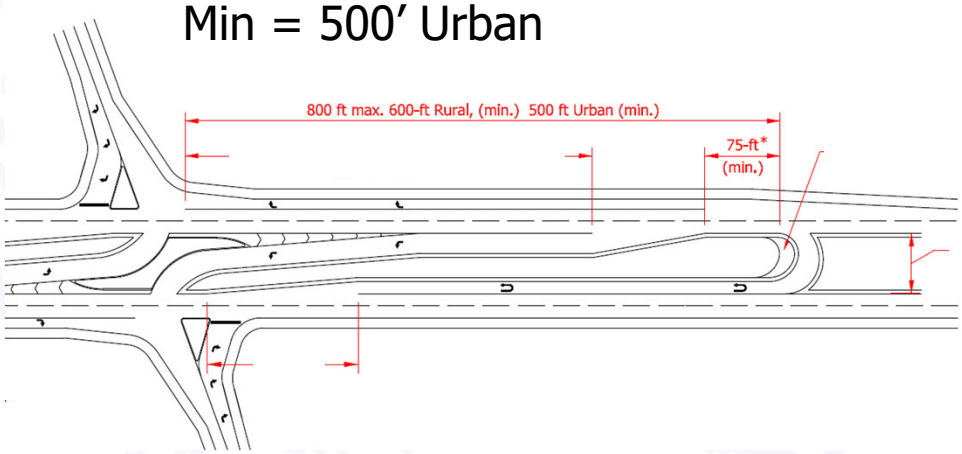


Better Driveway Placement

32

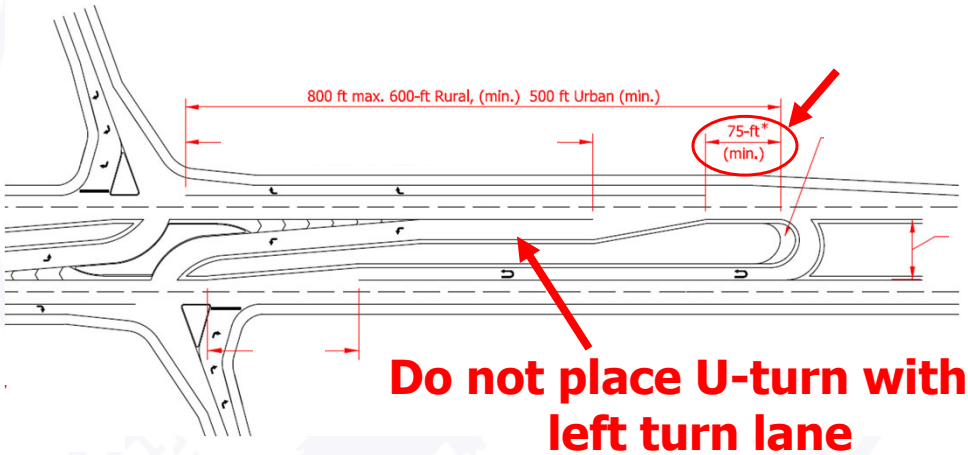
U Turn Placement (Taylor)

Max = 800’ (exceptions for geometric issues)
Min = 600’ Rural
Min = 500’ Urban



33

U Turn Placement (Taylor)



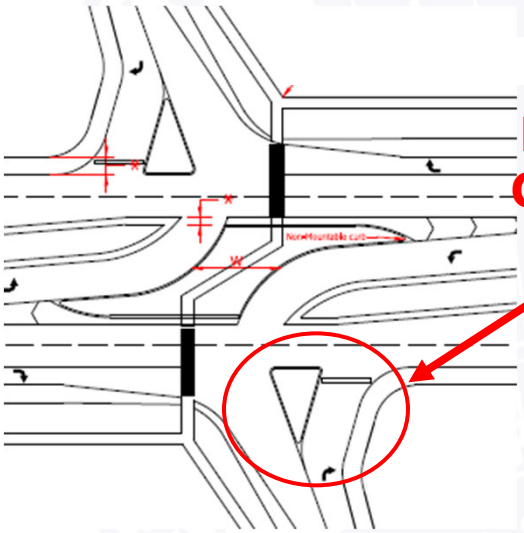
Do not place U-turn within left turn lane

34

Example: US 41 at SR 114 – Morocco

35

Side Street Right Turn (Taylor)

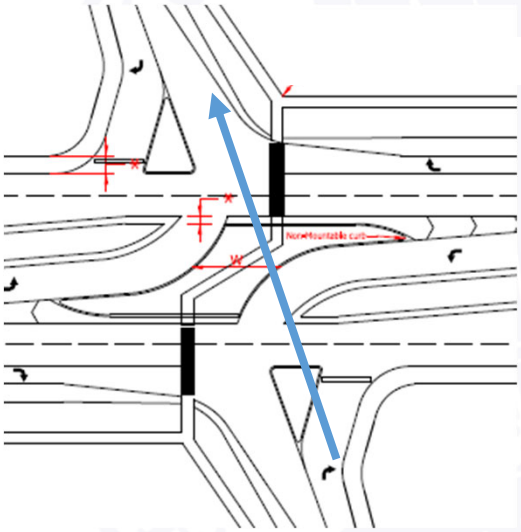


Raised Island Channalization

Avoid "Turning Roadway"
Keep angle close to 90 deg.

36

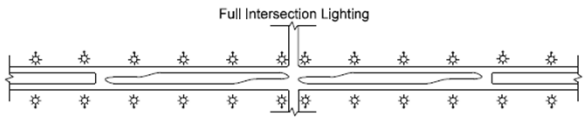
Side Street Right Turn (Taylor)



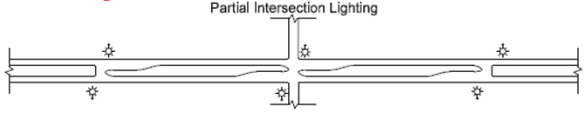
Prevent accidental crossing of intersection.

37

Lighting (Taylor)



Minimum ↘

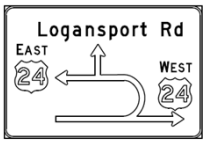


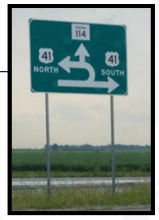
Provide full lighting in areas where the roadway already has lighting or at District request.

38

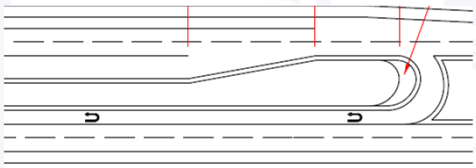
Signage and Markings (Taylor)

Advance guide signs are critical:

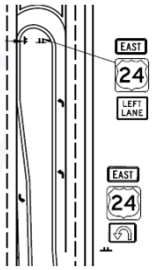




Use U-turn marking at U-turns:



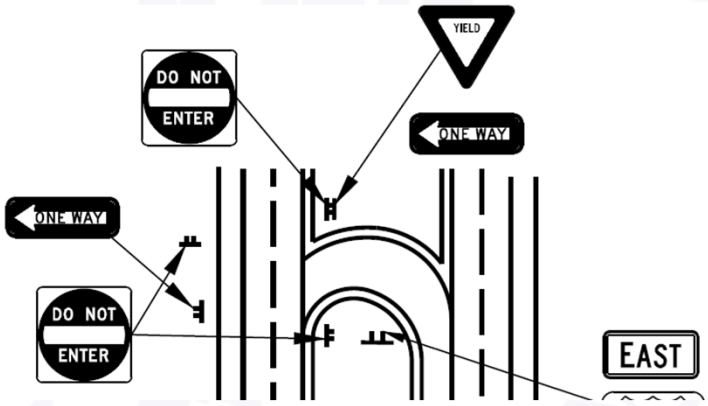
Route designation signs needed at U-turns:



39

Signage and Markings (Taylor)

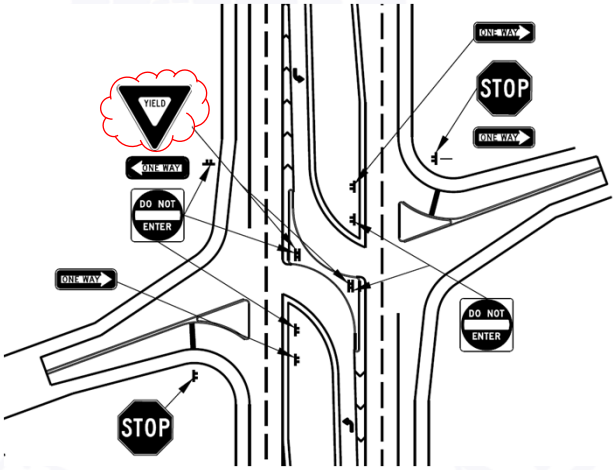
In rural settings, U-turn is typically yield controlled, but can be stop controlled.



40

Signage and Markings (Taylor)

In rural settings, the mainline left turn is typically Yield-controlled, but can be stop-controlled.



41

Public Involvement (Taylor)

Public Involvement can make or break an alternative intersection project.

Things to focus on:

- Show graphics of Trucks and Farm Equipment using the U-turn

41

Public Involvement (Taylor)

Public Involvement can make or break an alternative intersection project.

Things to focus on:

- Emphasize problems with existing intersection & how RCI will address them.
- Emphasize conflicts and confusion.
- Emphasize human factor, Injuries and Fatalities w/ causes.
- Bring business owners from area in FIRST.

43

Design Submittals For All RCI Projects

IDM Chapter 14 is being revised to require a pre-Stage 1 submittal. This will include but is not limited to the following:

- Engineers/Scoping Report
- Traffic Analysis in accordance with the INDOT Intersection Traffic Analysis Procedures.
- Plans showing existing & proposed pavement, alignments, utilities and property lines.
- Typical sections
- Tapers, auxiliary lanes, median and approach treatments clearly dimensioned and stationed.
- Profile grades and preliminary cross sections with proposed templates.

The submittal will be directed to Corridor Development to initiate reviews with Highway Design Review, District Traffic Engineer, Project Manager and the designer.

44

Questions

Contact Information:
Taylor Ruble Truble@indot.in.gov
Mark Orton Morton@indot.in.gov

45