COMPLETE STREETS:
A PRACTICAL APPROACH

OR

COMPLETE STREETS:

WHAT YOU NEED TO KNOW

(BUT ARE AFRAID TO ASK)

TSITE WINTER MEETING

FEBRUARY 27, 2018

INTRODUCTION

The primary source of material for this presentation is the UT Center for Transportation Research, TTAP training class, URBAN STREET DESIGN - COMPLETE STREETS.

Primary References:

- *Urban Street Design Guide* by NACTO
- *Urban Bikeway Design Guide* by NACTO

*NACTO is the National Association of City Transportation Officials

INTRODUCTION

So, what exactly are Complete Streets?

"Complete Streets are designed and operated to enable safe access for all users. Pedestrians, bicyclists, motorists and bus riders of all ages and abilities are able to safely move along and across a complete street."

(National Complete Streets Coalition)

INTRODUCTION

Complete Streets is a **design philosophy** that has become a nationwide **movement**. Complete Street concepts are being converted to **policy** in an increasing number of jurisdictions. As of 2018, a total of 27 states, including Tennessee, have adopted some kind of legislation or statement supporting and encouraging Complete Streets.

INTRODUCTION

Today's presentation will focus on material from the TTAP class that I thought was either very interesting, would be new to many of you, and/or might generate some productive thought and discussion.

Shameless Ulterior Motive – Encourage some of you to take the TTAP class when it is offered again in Knoxville in the Fall. (Incentive- 6 PDH)

INTRODUCTION

Relevant statistics from Tennessee:

- The 12th most dangerous state in which to walk (2011 study)
- Ranked 7th in fatalities for people over 65 walking
- Ranked 17th in "Bicycle Friendliness"
- On average, 7 bike riders are killed each year
- Almost 84% of state commuters drive alone to work, with only about 3% of work trips made by walking, riding a bike or by public transit
- Around 3,000 state residents are frequent bike commuters

(Data per Tennessee "Complete Streets Fact Sheet")

DESIGN CONTROLS FOR COMPLETE STREETS

At the outset of any roadway design or redesign, the designers set forth key criteria that govern the ensuing design of the street. These parameters, referred to as **Design Controls**, critically shape design decisions and are therefore very important in the development of the finished product.

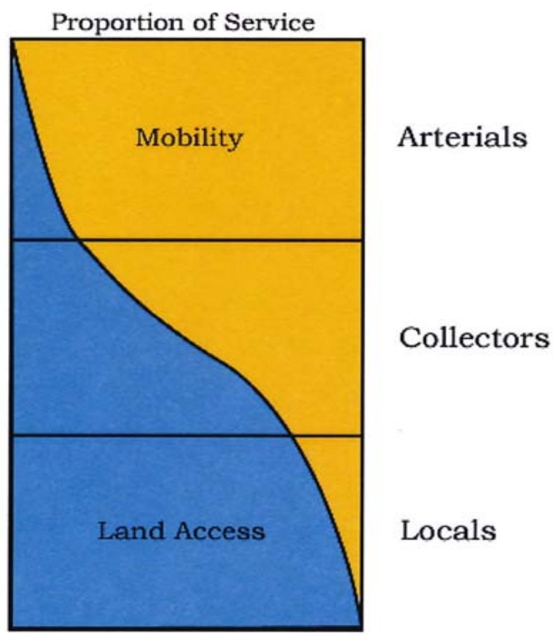
NACTO recommends a little different approach to the application of some of our traditional Design Controls when developing Complete Streets.

DESIGN CONTROLS FOR COMPLETE STREETS

Functional Classification

Traditional relationship of a functionally-classified roadway system in serving Mobility and Access:

Traditional Functional Classification



DESIGN CONTROLS FOR COMPLETE STREETS

The NACTO *Urban Street Design Guide* states;

"Classification schemes, in and of themselves, are rarely adequate as a design tool for the diversity of situations to be encountered on city streets."

They instead recommend that new classification systems be developed, using 2-3 variables such as;

- Street type and usage
- Urban design context and built environment
- Overlays, including modal priorities, special uses, and historic designations

The San Francisco *Better Streets Plan* is one example.

DESIGN CONTROLS FOR COMPLETE STREETS

Design Vehicle

The Design Vehicle is typically selected as the largest vehicle expected to use a roadway with considerable frequency.

In Complete Street design, this selection is especially critical. For example, selecting too large a Design Vehicle could lead to unnecessarily long crosswalk crossing distances for pedestrians.

DESIGN CONTROLS FOR COMPLETE STREETS

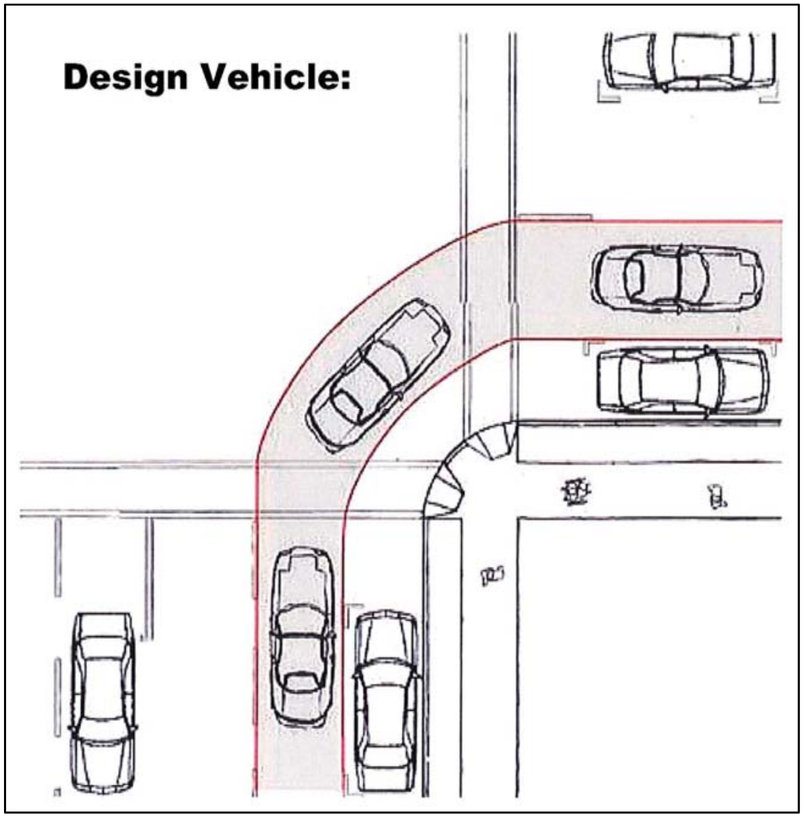
NACTO recommends the use of two types of design vehicles in order to help prevent overdesign of street features.

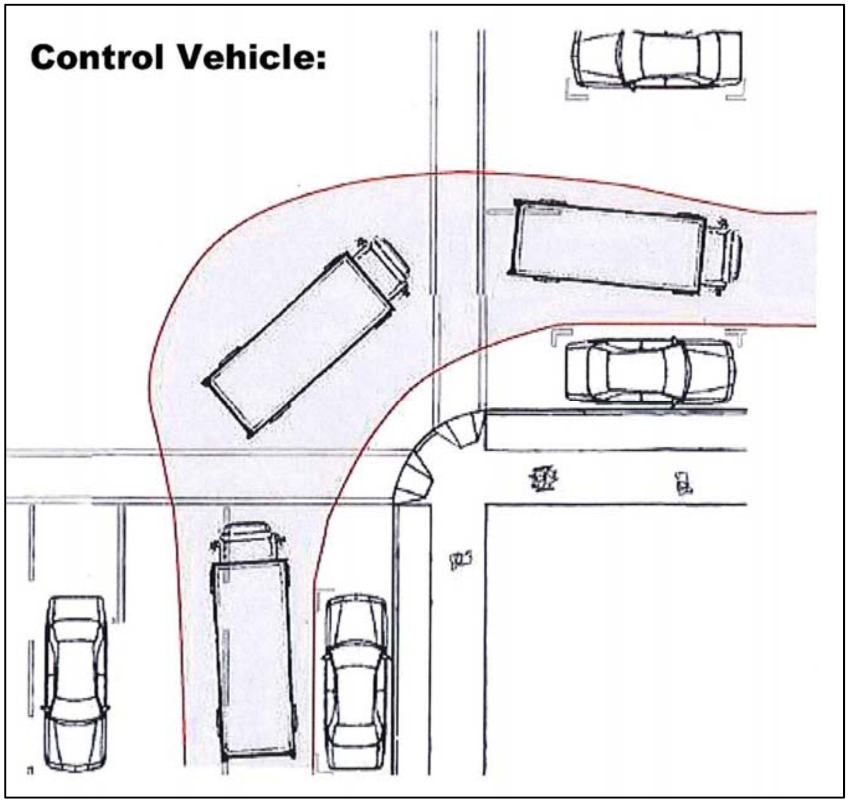
Design Vehicle - A vehicle that must be regularly accommodated without encroaching into the roadside or opposing traffic lanes.

Control Vehicle - A vehicle that must be occasionally accommodated, and encroachment into opposing traffic lanes or minor encroachment into the roadside is considered acceptable. (the larger of the two vehicles)

(see next slide)

DESIGN CONTROLS FOR COMPLETE STREETS





DESIGN CONTROLS FOR COMPLETE STREETS

NACTO *Design Vehicle Recommendations*:

- Adopt a new Design Vehicle for neighborhood & residential streets, the delivery truck (DL-23) (turning radii – inside = 22.5’, outside = 29’)
- Use SU-30 on downtown & commercial streets
- Use BU-40 on designated bus routes
- Use WB-50 on designated truck routes
- Use a Control Vehicle for occasional larger vehicles
- Use crawl speeds as opposed to design speeds for intersection turning radii

DESIGN CONTROLS FOR COMPLETE STREETS

Design Hour (helps determine design volumes)

In traditional roadway design, the Design Hour is typically one or both of the two peak traffic hours of a typical weekday, AM and PM.

NACTO, however, recommends a more flexible approach, one that recognizes that “a street’s uses, demands, and activities are subject to change over the course of a day.” The intent is to “always seek to balance needs and functions of different time periods.”

DESIGN CONTROLS FOR COMPLETE STREETS

The primary NACTO concern with designing simply for the peak traffic hours is that while traffic may be accommodated for a peak hour or two, the roadway may be **overdesigned** for the other 22-23 hours of the day and on non weekdays. This could result in less than optimal operation, especially for non motor-vehicle users.

DESIGN CONTROLS FOR COMPLETE STREETS

NACTO Complete Street Design Hour Recommendations:

- Collect multi-modal data over 2-3 peak traffic hours to better understand how traffic behaves through an entire peak traffic period
- Design for the average of four peak hours, instead of the one peak hour as typically done now
- Use transportation demand management and signal timing to address congestion issues, rather than always relying on capacity increases

(Example from Rivera Beach, Florida)

DESIGN CONTROLS FOR COMPLETE STREETS

Design Year (helps determine design volumes)

- What is the typical design year used in roadway design?
- What are some ways we typically project traffic out to a design year?
  - average growth rates
  - travel demand models

(see next slide)

DESIGN CONTROLS FOR COMPLETE STREETS

Per NACTO, the problem with what we typically do is that both applying percentage growth rates and travel demand models have in recent years been shown to overestimate future volumes.

Let's look at a little history and see if there is truth to this contention, especially on urban streets.

(See next slide)

DESIGN CONTROLS FOR COMPLETE STREETS

Data from TDOT AADT Count Stations in the "Big Four":

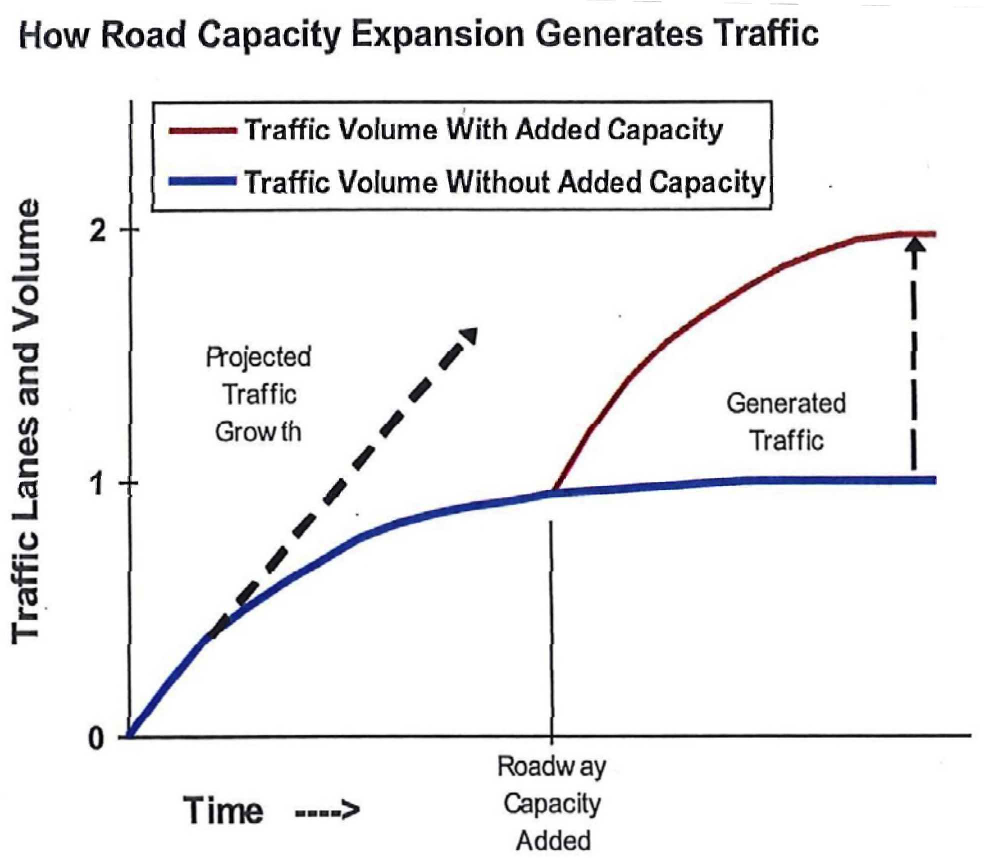
- Broadway in downtown Nashville:
  - 2016 AADT – 31,653
  - 1996 AADT – 33,945
- Central Avenue, just north of downtown Knoxville:
  - 2016 AADT – 8,139
  - 1996 AADT – 10,573
- Market Street in downtown Chattanooga:
  - 2016 AADT – 13,145
  - 1996 AADT – 14,409
- Danny Thomas Blvd. near downtown Memphis:
  - 2016 AADT – 15,018
  - 1996 AADT – 19,496

DESIGN CONTROLS FOR COMPLETE STREETS

The next two slides may help explain why future traffic volumes are so hard to predict.

DESIGN CONTROLS FOR COMPLETE STREETS

Induced Demand or "if you build it they will come"



The result is that the roadway's traffic volumes reach the new capacity far sooner than the original 20 year projection.

DESIGN CONTROLS FOR COMPLETE STREETS

Traffic Evaporation – The opposite of Induced Demand. Roadway capacity is reduced, such as through a road diet, and traffic counts decrease (at least on that roadway) and the anticipated traffic congestion does not occur.

How can this be?

Possible explanations:

- Displaced traffic absorbed by surrounding streets
- Some drivers shift to other travel modes
- Trips are altered thru time changes, carpooling etc.

(Discuss example: Bridge closure in Toledo, Ohio)

DESIGN CONTROLS FOR COMPLETE STREETS

NACTO recommends supplementing existing traffic models with other strategies, such as "Induced Demand Projection," to improve future year traffic volume estimates. See the *Urban Street Design Guide* for detailed discussion.

My Conclusion:

Both Induced Demand and Traffic Evaporation accurately describe what can happen when roadway capacity is modified. The fact is that future traffic volume changes involve a complexity of factors, including the human element, and thus tend to be very difficult to predict. In the end, no matter how complex the methods, our estimates are really just educated guesses.

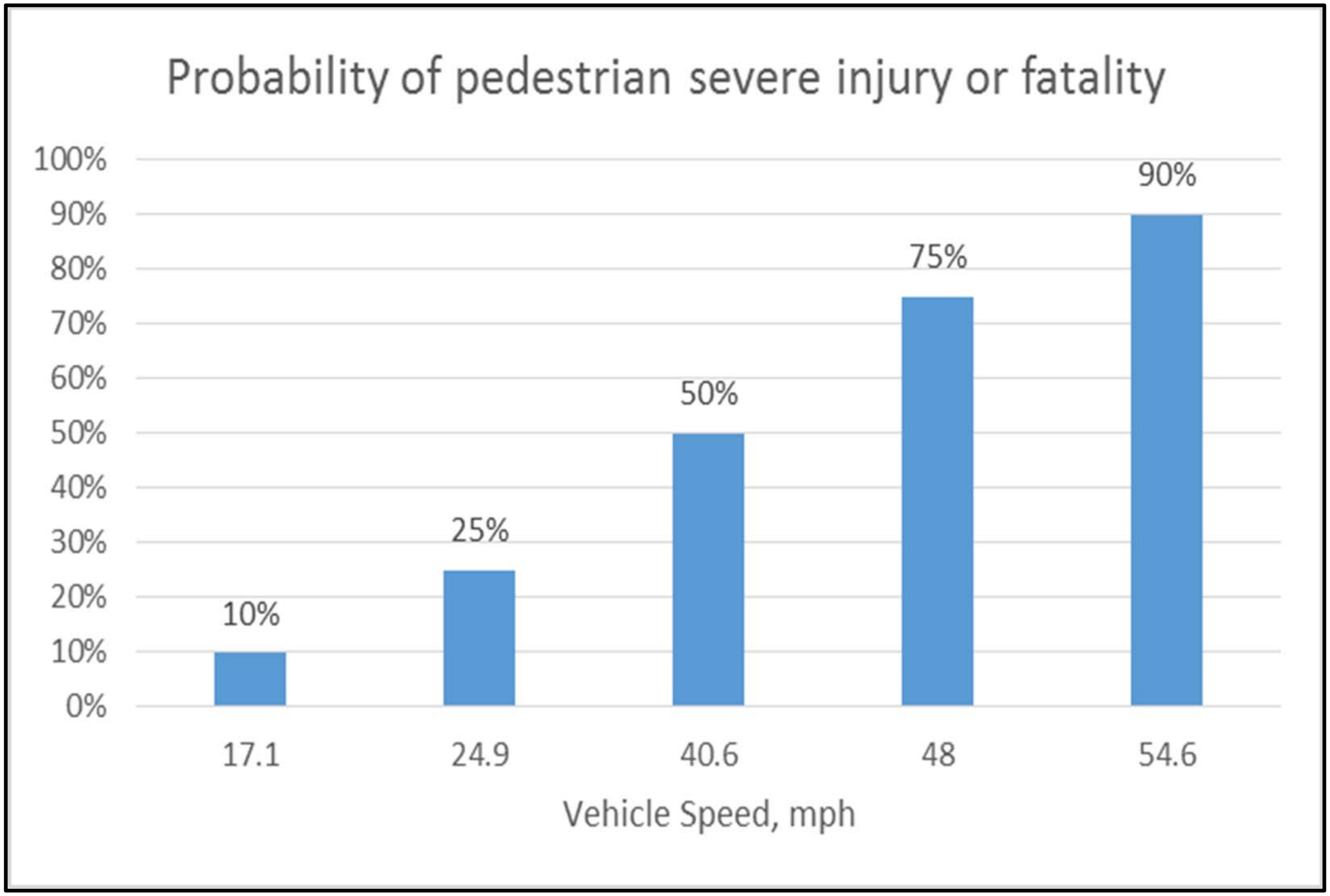
DESIGN CONTROLS FOR COMPLETE STREETS

Design Speed

NACTO states that "Speed plays a critical role in the cause and severity of crashes. There is a direct correlation between higher speeds, crash risk, and the severity of injuries."

One study by the National Center for Biotechnology Information (NCBI) provided the statistics on the next slide for the average risk of a struck pedestrian being severely injured or killed.

DESIGN CONTROLS FOR COMPLETE STREETS



Source: National Center for Biotechnology Information (NCBI)

DESIGN CONTROLS FOR COMPLETE STREETS

Other factors mentioned by NACTO that support slower design speeds:

- Driver peripheral vision narrows significantly at higher speeds.
- Higher design speeds mandate larger curb radii, wider travel lane widths, on-street parking restrictions, and clear zones.
- Lower design speeds help reduce observed speeding behavior, which in turn helps provide a safer place for people to walk, park, and drive.

DESIGN CONTROLS FOR COMPLETE STREETS

The NACTO *Urban Street Design Guide* introduces a new type of speed, the “Target Speed.” This is the speed that you **intend** for drivers to go.

NACTO Design Speed Recommendations:

- Design Speed should be based on an established Target Speed, typically yielding 85^{th} percentile speeds between 10 and 30 mph.
- The maximum recommended Target Speed for an urban arterial street is 35 mph, but may be a little higher if the street is outside the built up area and/or has highway like conditions.

(continued on next slide)

DESIGN CONTROLS FOR COMPLETE STREETS

- The maximum recommended Target Speed for an urban collector or local street is 30 mph.
- Use design criteria that are at or below the Target Speed of the street.
- Implement traffic calming as appropriate to bring the Design Speed in line with the Target Speed.
- Consider 20 mph speed zones in neighborhoods to make things safer for children at play and for other unpredictable behavior.

(I would add 5 mph to all their speed recommendations)

COMPLETE STREET FUNDAMENTALS

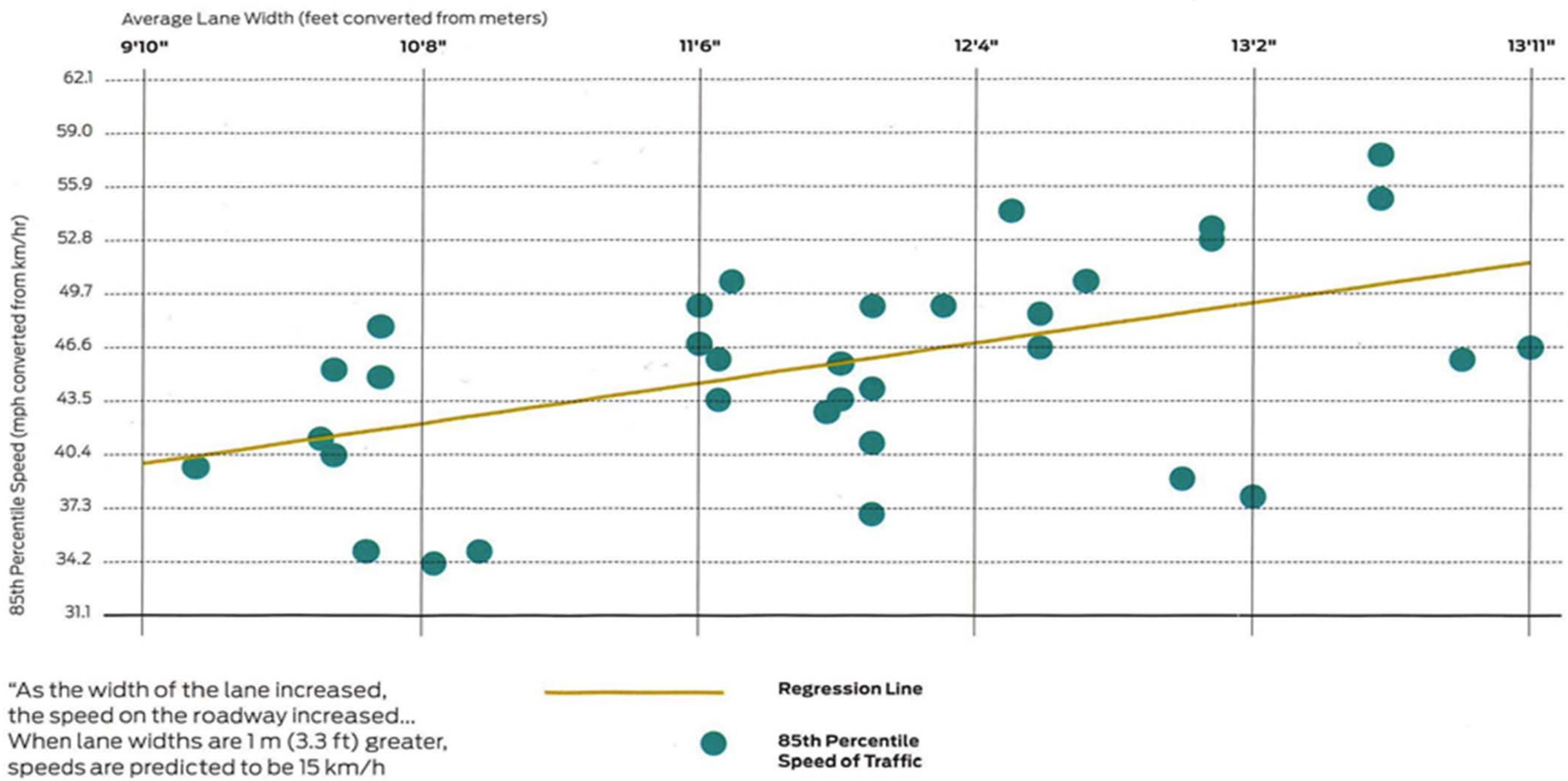
Lane Width as a Fundamental Design Element

NACTO believes that "The width allocated to lanes for motorists, buses, trucks, bikes, and parked cars is a sensitive and crucial aspect of street design."

They also believe that lane width can have a significant effect on traffic speeds, as illustrated on the next slide.

COMPLETE STREET FUNDAMENTALS

Wider travel lanes are correlated with higher vehicle speeds.



"As the width of the lane increased, the speed on the roadway increased... When lane widths are 1 m (3.3 ft) greater, speeds are predicted to be 15 km/h (9.4 mph) faster."

Chart source: Fitzpatrick, Kay, Paul Carlson, Marcus Brewer, and Mark Wooldridge. 2000. "Design Factors That Affect Driver Speed on Suburban Streets." *Transportation Research Record* 1751: 18–25.

COMPLETE STREET FUNDAMENTALS

NACTO Lane Width Observations & Recommendations:

- The "standard" 12 foot traffic lane was developed for higher speed rural conditions.
- Ten(10) foot traffic lanes are appropriate for urban streets and will have a positive impact on street safety.
- Eleven(11) foot traffic lanes are only appropriate for designated truck or transit routes.
- Traffic lanes wider than 11 feet should not be used.
- Lanes as narrow as 9.5 or even 9.0 feet can be effective as thru lanes in conjunction with a wider center left-turn lane (min. 10').
- Extra lane width is often needed for "shy distance" or on the departure lanes at intersections (for turning traffic).

COMPLETE STREET FUNDAMENTALS

Narrow Lane Example – US 441 in Knoxville (5-10 foot lanes)
(Chapman Hwy. south of Henley Street Bridge)

COMPLETE STREET FUNDAMENTALS

Narrow Lane Example – US 441 in Sevierville (6-10 ft. lanes)
(South of Fred C. Atchley Bridge)

COMPLETE STREET FUNDAMENTALS

NACTO also believes that our traditional performance measures (level-of-service, vehicle delay, travel time etc.) are too heavily oriented towards motor-vehicles. They recommend seeking to balance performance for all users by including performance measures that account for the following:

- Pedestrians
- Bicyclists
- Motor Vehicle Users
- Transit Riders
- Emergency Vehicles
- Freight Deliveries

(See the Urban Street Design Guide for details)

COMPLETE STREET PHILOSOPHY

In summarizing the philosophy of the NACTO *Urban Street Design Guide* in regards to fundamental street design, it is one of being Proactive, not Passive.

Proactive design uses geometric elements and environmental queues built into the basic street and roadside fabric, in order to guide users into desired behavior, which includes lower traffic speeds.

OVERVIEW OF COMPLETE STREETS SOLUTIONS

Significant portions of the *Urban Street Design Guide* and the *Urban Bikeway Design Guide* are dedicated to discussing and illustrating how the following are to take place on Complete Streets:

1. Accommodating Pedestrians
2. Accommodating Bicycles
3. Accommodating Transit Vehicles

The remainder of this presentation is an overview of this material, with a focus on noteworthy portions, especially items that are new or have not been applied much in this part of the country.

ACCOMMODATING PEDESTRIANS ON COMPLETE STREETS

NACTO Sidewalk Zones:

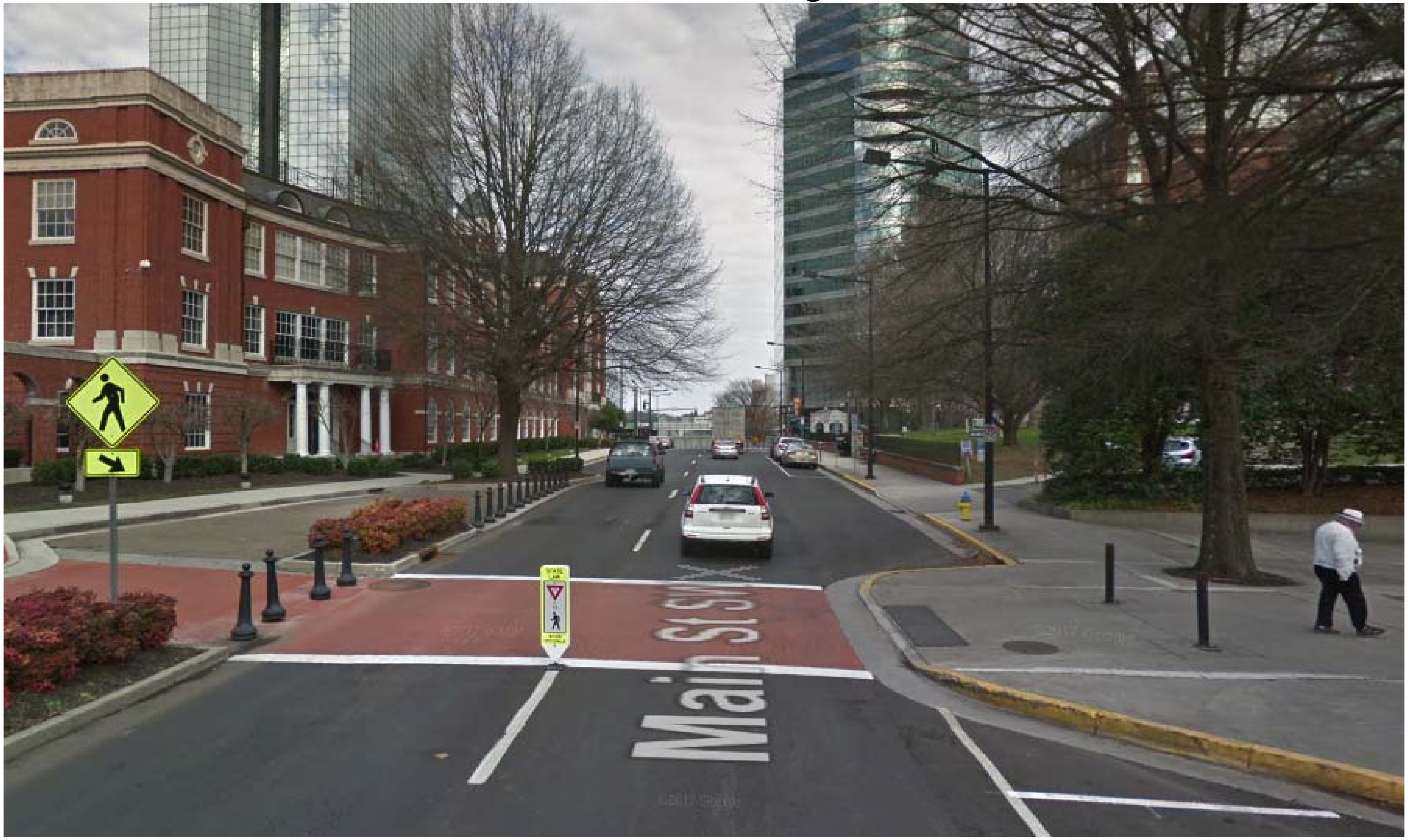
1. Frontage Zone
2. Pedestrian Through Zone
3. Street Furniture Zone
4. Enhancement/Buffer Zone (photo shows a cycle track in this zone)

When there is no Enhancement/Buffer Zone, NACTO calls the roadway curb area a Curb Zone.

Note that other organizations often have different names for some of the zones.

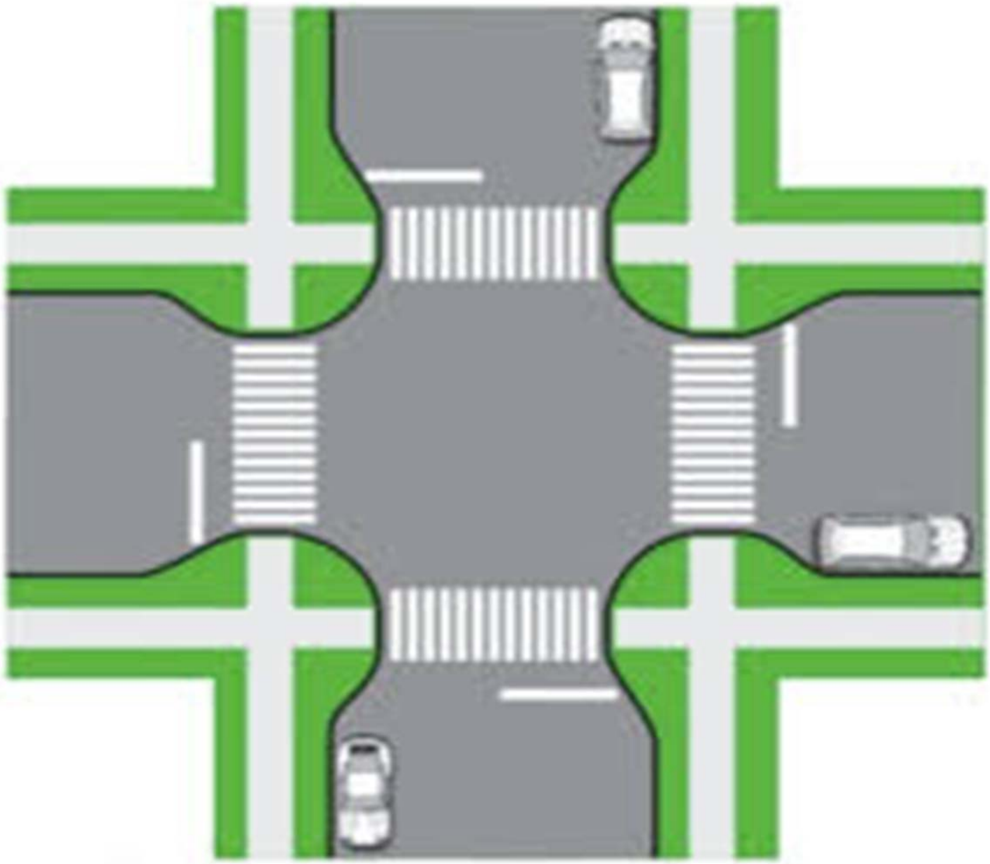
ACCOMMODATING PEDESTRIANS ON COMPLETE STREETS

Curb Extensions for Crosswalk along Main Street in Knoxville



ACCOMMODATING PEDESTRIANS ON COMPLETE STREETS

Sketch of Intersection with Four Bulb-outs

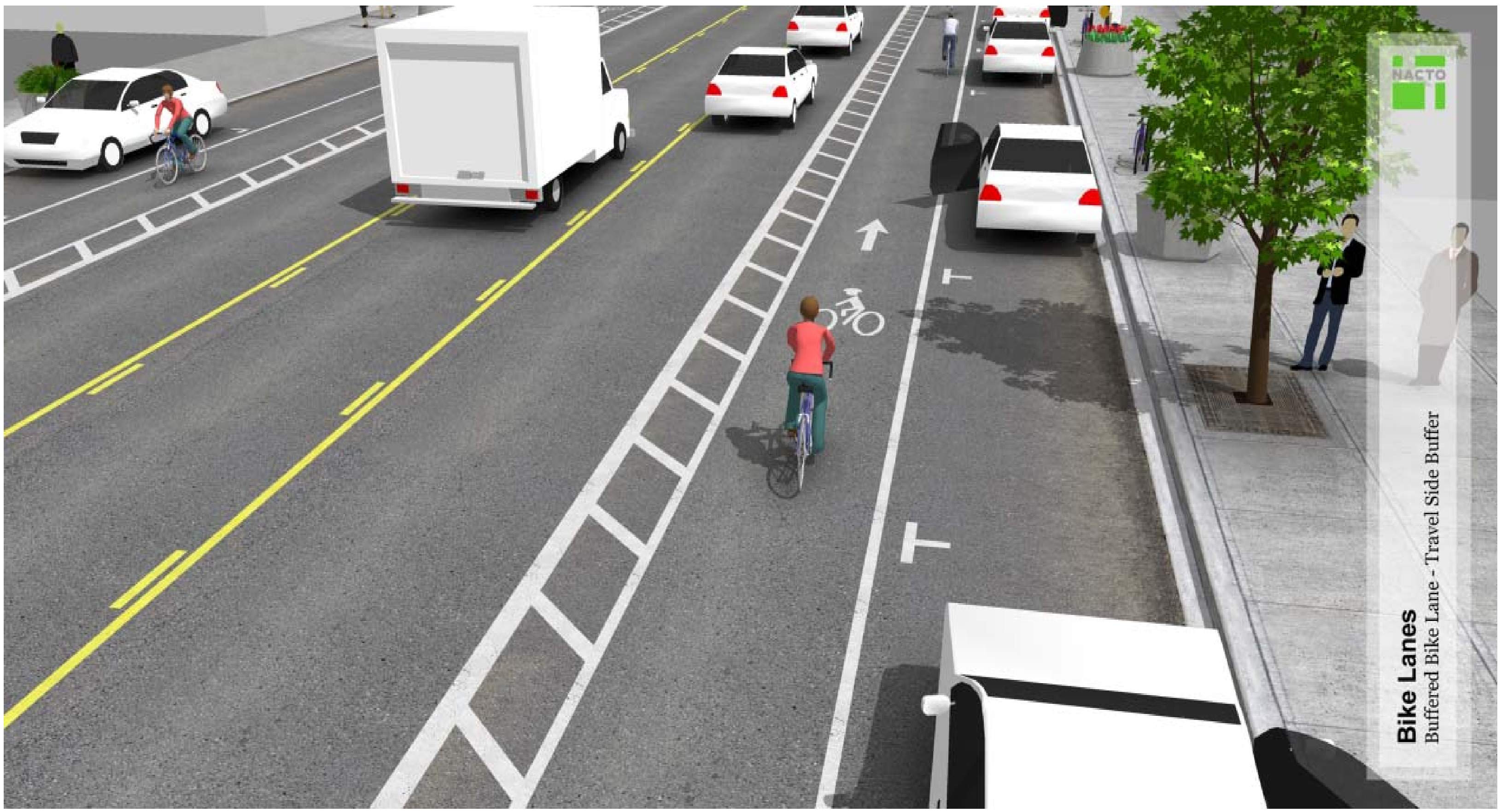


ACCOMMODATING BICYCLES ON COMPLETE STREETS

Conventional Bike Lanes

ACCOMMODATING BICYCLES ON COMPLETE STREETS

Buffered Bike Lanes



ACCOMMODATING BICYCLES ON COMPLETE STREETS

Contra-Flow Bike Lanes

ACCOMMODATING BICYCLES ON COMPLETE STREETS

<u>Left-Side Bike Lanes</u>

Works for one way streets and streets with very wide medians.

ACCOMMODATING BICYCLES ON COMPLETE STREETS

<u>One-Way Protected Cycle Tracks</u>

Bikeways at street level with some type of physical protection from passing traffic

ACCOMMODATING BICYCLES ON COMPLETE STREETS

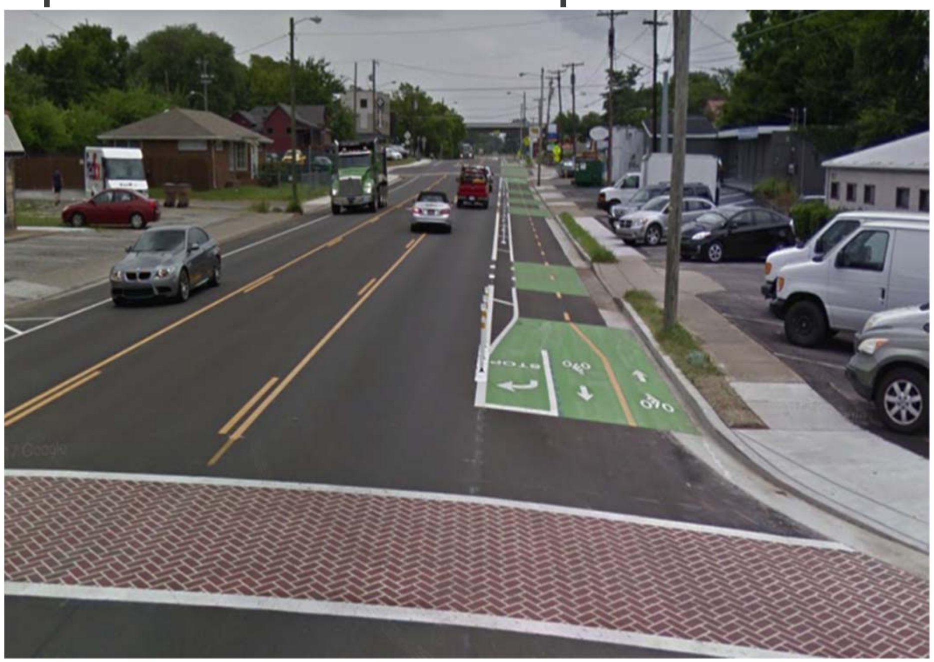
<u>Raised Cycle Tracks</u>

Vertically separated from motor vehicles; often at or near the same level as sidewalk, but clearly separate from it

ACCOMMODATING BICYCLES ON COMPLETE STREETS

Two-Way Cycle Tracks

Allows bike movement in both directions on one side of a street; either street level and protected with a barrier or raised to provide vertical separation



51st Ave. North in Nashville

ACCOMMODATING BICYCLES ON COMPLETE STREETS

Colored Pavement

Colored pavement within a bike lane increases the visibility of the lane, identifies potential conflict areas, and reinforces priority to bicyclists. Colored pavement can be used along the length of a bike lane or cycle track, or as a spot treatment in a bike box, conflict area, or intersection crossing marking. (NACTO)

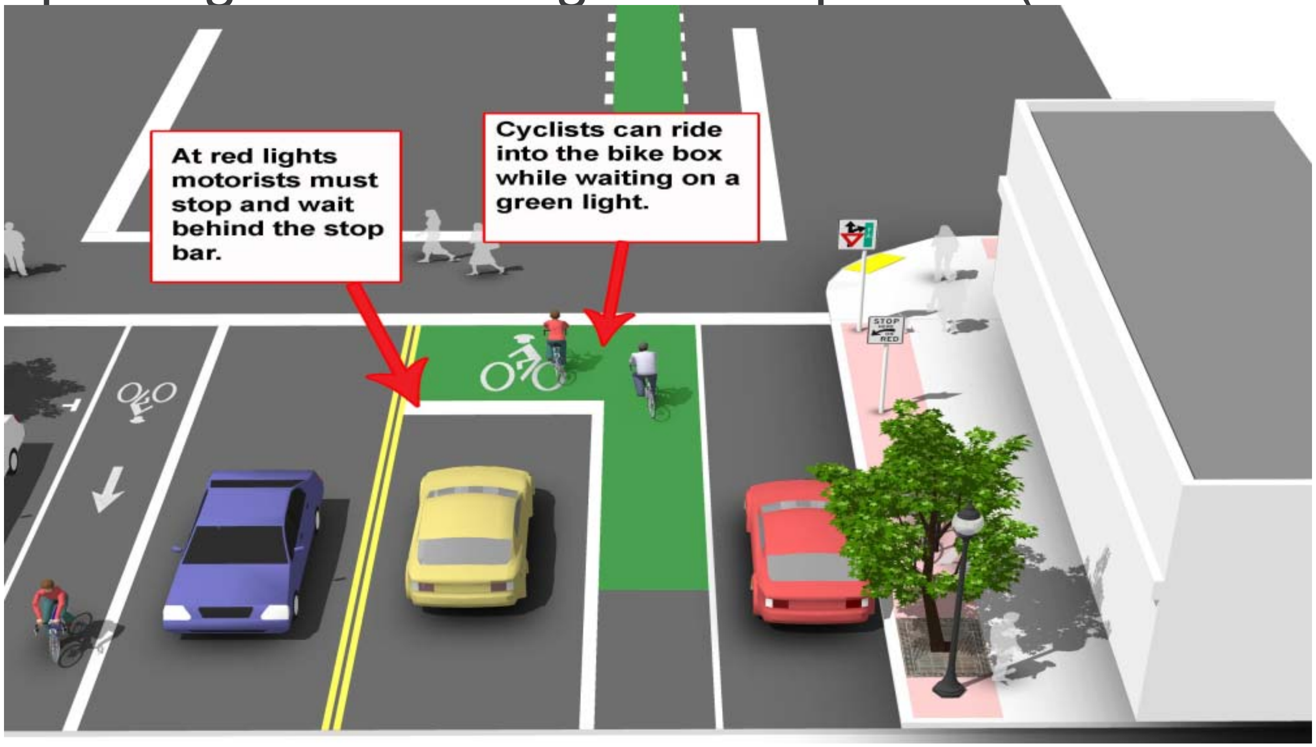
The color most typically used is green.

FHWA requires Interim Approval for Optional Use of Green Colored Pavement for Bike Lanes. (IA-14)

ACCOMMODATING BICYCLES ON COMPLETE STREETS

Bike Boxes

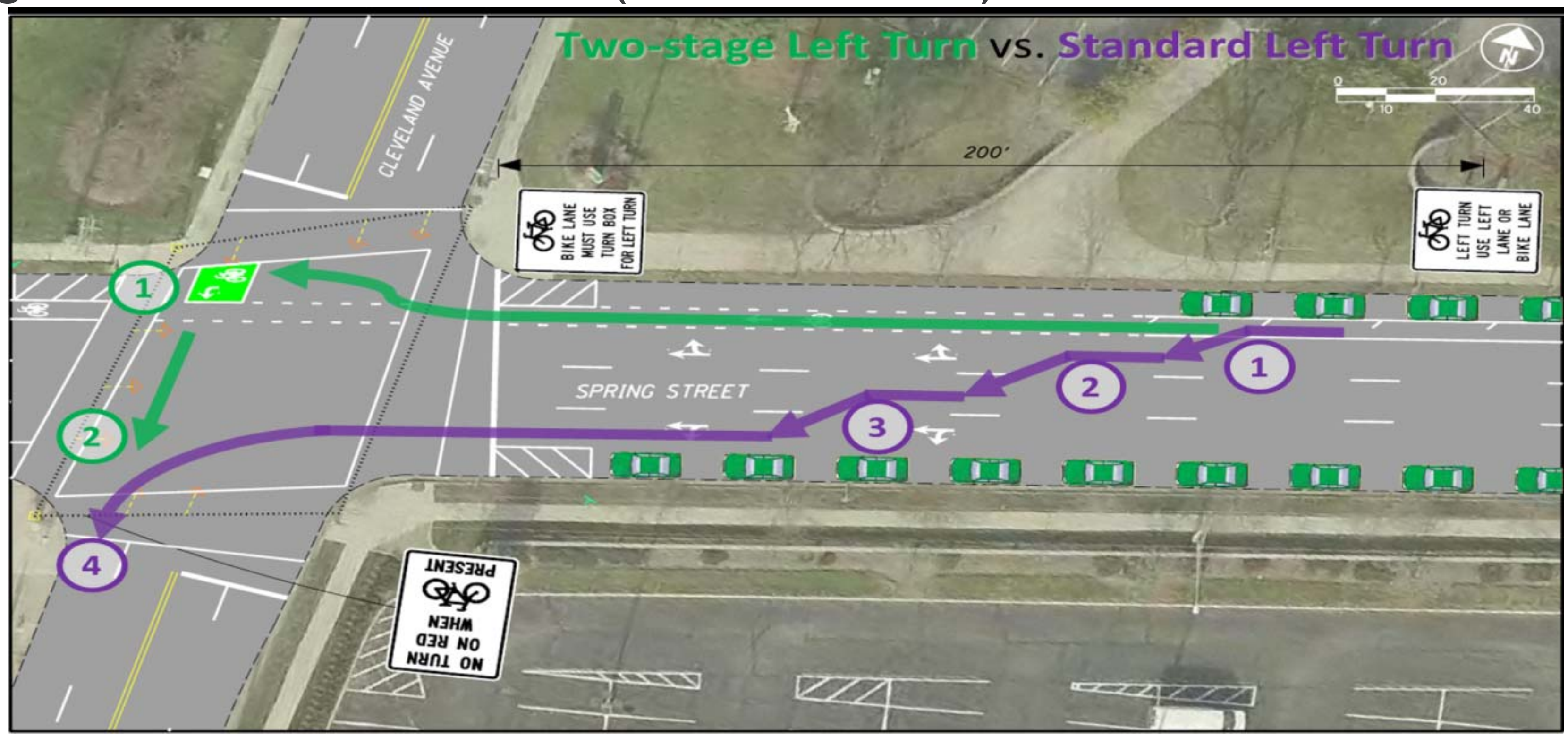
A designated area at the head of a traffic lane at a signalized intersection providing bikes with a safe and visible way to get ahead of queuing traffic during the red phase. (FHWA IA-18)



ACCOMMODATING BICYCLES ON COMPLETE STREETS

<u>Two-Stage Turn Queue Boxes</u>

Provides bikers a safe way to make a left-turn at multi-lane signalized intersections. (FHWA IA-20)



THE UNIVERSITY OF TENNESSEE KNOXVILLE

ACCOMMODATING BICYCLES ON COMPLETE STREETS

Combined Bike Lane/Turn Lane w/ Mixing Zone

ACCOMMODATING BICYCLES ON COMPLETE STREETS

Bicycle Boulevards

"Bicycle boulevards are streets with low motorized traffic volumes and speeds, designated and designed to give bicycles travel priority."(NACTO)

- Priorities are reversed on these streets, with bicycles having the top priority
- Speed limits are typically 15 or 20 on bicycle boulevards
- Signs, markings, and/or traffic calming are used to lower speeds and discourage motor vehicles

ACCOMMODATING BICYCLES ON COMPLETE STREETS

Basic Bicycle Boulevard

Bicycle Boulevard

ACCOMMODATING BICYCLES ON COMPLETE STREETS

Bicycle Blvd. Sign and Speed Limit Sign

Bicycle Blvd. Sign w/ Std. “Full Lane” Sign

ACCOMMODATING BICYCLES ON COMPLETE STREETS

Bicycle Boulevard Crossover/Median Refuge at major street; allows bikes but prevents motor vehicles from crossing

Another Bicycle Boulevard Intersection Entry limiting crossover access to bicycles only

ACCOMMODATING TRANSIT VEHICLES ON COMPLETE STREETS

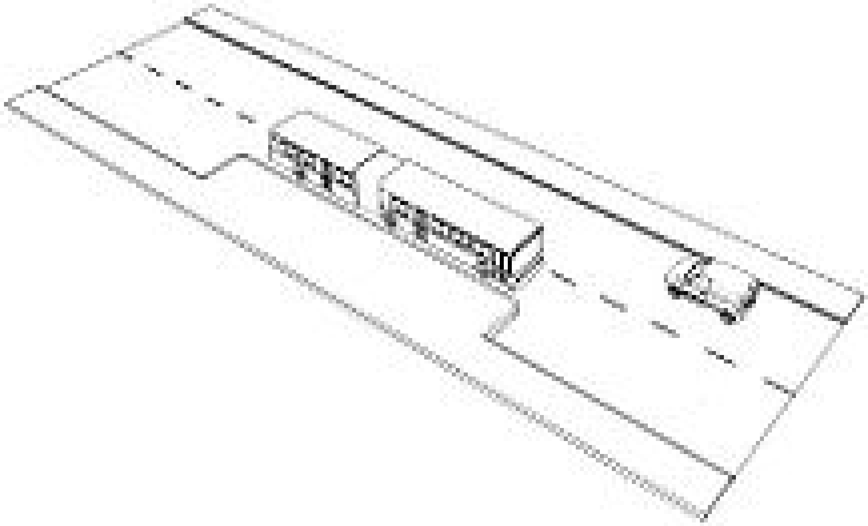
Dedicated Curbside/Offset Bus Lanes

Dedicated Curbside Bus Lane

Dedicated Offset Bus Lane

ACCOMMODATING TRANSIT VEHICLES ON COMPLETE STREETS

Bus Bulb for Offset Bus Lane



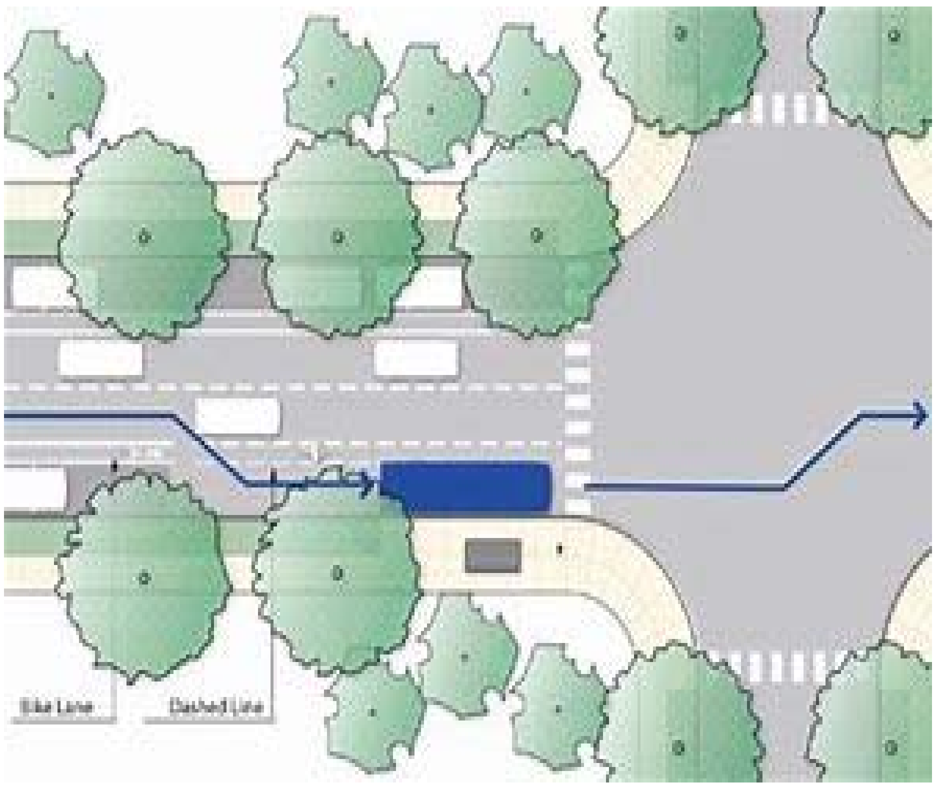
ACCOMMODATING TRANSIT VEHICLES ON COMPLETE STREETS

Contra-Flow Bus Lanes

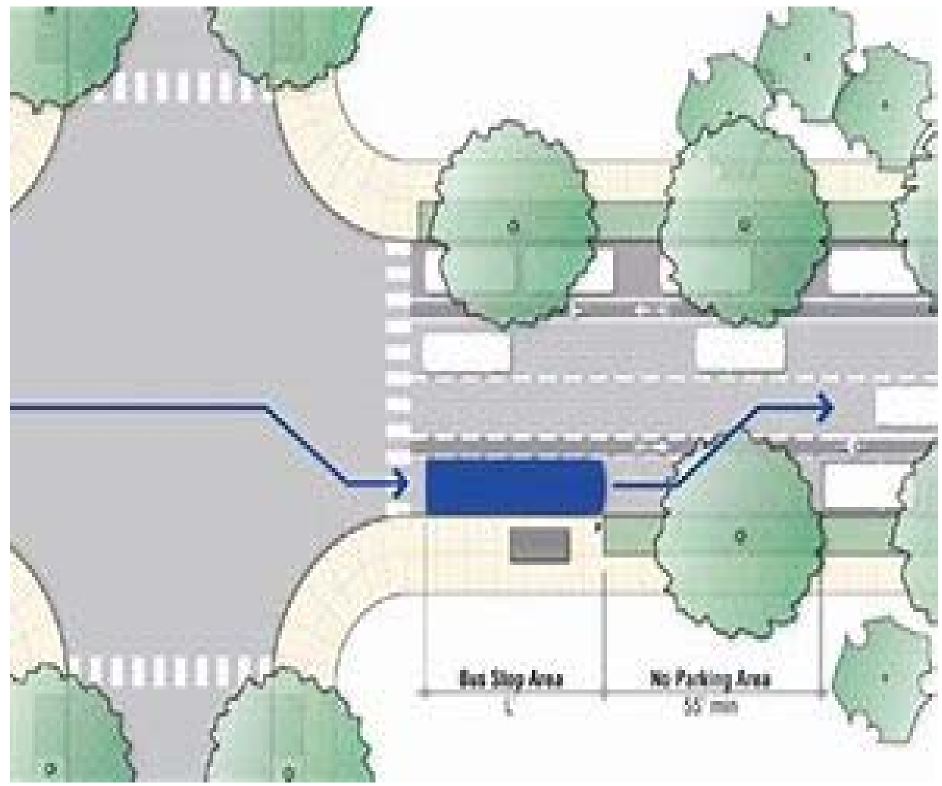
Major benefit is to enable connectivity and shorten travel times for bus routes.

ACCOMMODATING TRANSIT VEHICLES ON COMPLETE STREETS

Near Side Bus Stop



Far Side Bus Stop



ACCOMMODATING ALL MODES ON COMPLETE STREETS

NACTO Traffic Signal Recommendations:

- Short signal cycle lengths
- Signal coordination set to slow traffic
- Countdown pedestrian signals (now standard)
- Leading pedestrian signal intervals of 3 to 7 seconds
- Single signal cycle pedestrian crossings
- Pedestrian pushbuttons carefully placed next to curb ramps
- Audible pushbuttons (w/instructions)
- Bus/Transit Priority signalization is very helpful for transit
- Bike detection & signal faces (FHWA IA-16) (where justified)

INFORMATION ITEM

Rectangular Rapid Flashing Beacons
(no longer legal for installation due to a patient issue)

COMPLETE STREETS
CONCLUSION AND WRAP-UP

My Closing Comments and Recommendations:

1. Complete Streets is a nationwide trend that is here to stay.
2. Every new urban and suburban street project should be considered for a Complete Streets solution. However, due to ROW and/or budget limitations, most streets will not fully be a Complete Street, especially in existing already developed areas.
3. Sidewalks should be provided on all streets in urban and suburban areas (subdivisions are debatable).
4. The practical solution may involve more of a corridor by corridor evaluation and solution.

   For example; one street could include a major emphasis on transit, while a nearby parallel street could have bike lanes, cycle tracks or be a bike boulevard.

(continued on next slide)

COMPLETE STREETS
CONCLUSION AND WRAP-UP

5. The implications of ongoing and future transportation trends need to be considered, as these may “alter the landscape.” Autonomous vehicles, ride-share (Uber, Lyft etc.), bike-share, car-share (Zipcar, Streetcar etc.), and who knows what else, will clearly have major impacts in the future.
6. Do not forget motor vehicles! While encouraging freedom in modal choice by providing infrastructure for other modes is sensible and a very American thing to do, the fact is that for the foreseeable future, automobile travel will still be the primary travel mode. In fact, autonomous vehicles and other trends will very likely encourage more automobile travel. Therefore, the idea promoted by some, that we should force people from their cars by creating congestion, would seem shortsighted and in my opinion irresponsible.

COMPLETE STREETS
CONCLUSION AND WRAP-UP

Final Questions or Comments?

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(Remember the Fall TTAP Complete Streets class. I am also teaching a TTAP Roundabouts class here in Knoxville on May 10.)