NACTO Urban Street Design Guide
Presentation overview

• Background on NACTO
• Urban Street Design Guide
• Transit Integration
• Example Implementation
National Association of City Transportation Officials

Mission

NACTO’s mission is to build cities as places for people, with safe, sustainable, accessible and equitable transportation choices that support a strong economy and vibrant quality of life.
National Association of City Transportation Officials

- 23 Member Cities
  - Seattle, WA
- 30 Affiliate Member Cities
  - Vancouver, WA
- 7 Transit Agencies
  - King County Metro
- 5 International Members
Design Principles

Streets Are Public Spaces
Streets are often the most vital yet underutilized public spaces in cities. In addition to providing space for travel, streets play a big role in the public life of cities and communities and should be designed as public spaces as well as channels for movement.

Great Streets are Great for Businesses
Cities have realized that streets are an economic asset as much as a functional element. Well-designed streets generate higher revenues for businesses and higher values for homeowners.

Streets Can Be Changed
Transportation engineers can work flexibly within the building envelope of a street. This includes moving curbs, changing alignments, daylighting corners, and redirecting traffic where necessary. Many city streets were built or altered in a different era and need to be reconfigured to meet new needs. Street space can also be reused for different purposes, such as parklets, bike share, and traffic calming.

Design for Safety
In 2012 in the U.S., over 34,000 people were killed in traffic crashes, which were also the leading cause of death among children aged 5–14. These deaths and hundreds of thousands of injuries are avoidable. Traffic engineers can and should do better, by designing streets where people walking, parking, shopping, bicycling, working, and driving can cross paths safely.

Streets Are Ecosystems
Streets should be designed as ecosystems where man-made systems interface with natural systems. From pervious pavements and bioswales that manage storm-water run-off to street trees that provide shade and are critical to the health of cities, ecology has the potential to act as a driver for long-term, sustainable design.

Act Now!
Implementing projects quickly and using low-cost materials helps inform public decision making. Cities across the U.S. have begun using a phased approach to major redesigns, where interim materials are used in the short term and later replaced by permanent materials once funding is available and the public has tested the design thoroughly.
Phases of Transformation

**EXISTING**
Existing conditions demonstrate how traditional design elements, such as wide travel lanes and undifferentiated street space, have had an adverse impact on how people experience the streetscape.

**INTERIM REDESIGN**
Striping and low-cost materials can realize the benefits of a full reconstruction in the short term, while allowing a city to test and adjust a proposed redesign. (See Interim Design Strategies)

**RECONSTRUCTION**
Full capital reconstructions can take 5–10 years. A complete upgrade might include new drainage and stormwater management provisions, raised bikeways, wider sidewalks, and traffic calming elements.
Urban Street Design Guide
DOWNTOWN 1-WAY STREET

In the mid-20th century, many 2-way downtown streets were converted to 1-way to streamline traffic operations, reduce conflicts, and create direct access points to newly built urban freeways. Today, many of these streets operate significantly below capacity and create swaths...

NEIGHBORHOOD MAIN STREET

Neighborhood main streets are a nexus of neighborhood life, with high pedestrian volumes, frequent parking turnover, key transit routes, and bicyclists all vying for limited space.

TRANSIT CORRIDOR

Transit corridors, including light rail (LRT), streetcar, and bus rapid transit (BRT), promote economic development around high-quality transit service while fostering a pedestrian scale in which walking and biking actively complement public transit. As major generators of pedestrian traffic, heavy...

GREEN ALLEY

The majority of residential alleys have low traffic and infrequent repaving cycles, resulting in back roads with potholes and puddling that are uninviting or unattractive. Green alleys use sustainable materials, pervious pavements, and effective drainage to create an inviting public...
2 way Street

**Option B1 at Transit Stops**
- Sidewalk
- Protected Bike Lane
- Transit Stop
- Travel Lane
- Center Turn Lane
- Travel Lane
- Protected Planting Sidewalk

**Option B2 at Transit Stops**
- Sidewalk
- Protected Bike Lane
- Transit Stop
- Travel Lane
- Travel Lane
- Protected Planting Bike Lane

**Existing Conditions**
On major bus routes, curbside bus stops may be undermined by double-parked vehicles and heavy rush-hour traffic. These obstructions hurt the reliability and on-time performance of transit vehicles.

**Recommendation**
Create definition in the roadway using striping, cycle tracks, and narrow travel lanes.
Street Design Elements

**LANE WIDTH**
The width allocated to lanes for motorists, buses, trucks, bikes, and parked cars is a sensitive and crucial aspect of street design. Lane widths should be considered within the assemblage of a given street delineating space to serve all needs.

Read More

**SIDEWALKS**
Sidewalks play a vital role in city life. As conduits for pedestrian movement and access, they enhance connectivity and promote walking. As public spaces, sidewalks serve as the front steps to the city, activating streets socially and economically. Safe, accessible,

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**CURB EXTENSIONS**
Curb extensions visually and physically narrow the roadway, creating safer and shorter crossings for pedestrians while increasing the available space for street furniture, benches, plantings, and street trees. They may be implemented on downtown, neighborhood, and residential streets, large and

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Interim Design Strategies

**MOVING THE CURB**

With limited funding streams, complex approval and regulatory processes, and lengthy construction timetables, cities are often challenged to deliver the results that communities demand as quickly as they would like. Interim design strategies are a set of tools and tactics.

[Read More](#)

**PARKLETS**

With limited funding streams, complex approval and regulatory processes, and lengthy construction timetables, cities are often challenged to deliver the results that communities demand as quickly as they would like. Interim design strategies are a set of tools and tactics.

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**INTERIM PUBLIC PLAZAS**

With limited funding streams, complex approval and regulatory processes, and lengthy construction timetables, cities are often challenged to deliver the results that communities demand as quickly as they would like. Interim design strategies are a set of tools and tactics.

[Read More](#)
Intersections/Design Elements

Large intersections are often over designed and difficult for both motorists and pedestrians to manage. Channelized right turns and other features create unsafe, high-speed turns.

Minimize delay to transit vehicles using transit signal priority. Determine the transit stop placement based upon the location of major destinations, transfer activity, and route alignment. At signalized and unsignalized intersections, far-side transit stops are preferable. Bus bulbs improve transit travel times and provide a dedicated space for waiting passengers.
Who is Using the Street

4100 people walking and on bus

4th and Pine
PM Peak Hour, 6/20/2017

- People walking crossing 4th ave: 2606
- People drivers in cars: 283
- Buses: 29
- People riding bicycle: 29
Who is Using the Street
Traffic Signal Warrants

Section 4C.01 Studies and Factors for Justifying Traffic Control Signals

Warrant 1, Eight-Hour Vehicular Volume
Warrant 2, Four-Hour Vehicular Volume
Warrant 3, Peak Hour
Warrant 4, Pedestrian Volume
Warrant 5, School Crossing
Warrant 6, Coordinated Signal System
Warrant 7, Crash Experience
Warrant 8, Roadway Network
Warrant 9, Intersection Near a Grade Crossing
Pedestrian Crossing “Half” Signals

- Used in Canada, Some US Cities
- Not Permitted by MUTCD
- Approx 100+ Half Signals
- 2015 Portland Study
- 1974 Study (2.5 yrs, 18 locations)
- 1988 Half Signal Effectiveness Study Update
- 2002 Half Signal Data Review
- 2010 Continued Use
Hybrid Beacons

Figure 4F-3. Sequence for a Pedestrian Hybrid Beacon

1. Dark Until Activated
2. Flashing Yellow Upon Activation
3. Steady Yellow
4. Steady Red During Pedestrian Walk Interval
5. Alternating Flashing Red During Pedestrian Clearance Interval
6. Dark Again Until Activated

Legend
SY Steady yellow
FY Flashing yellow
SR Steady red
FR Flashing red
Hybrid Beacons

5. Alternating Flashing Red During Pedestrian Clearance Interval
Transit Rider Crosswalk Signal
Transit Rider Crosswalk Half Signal
Double Half Signals

AURORA AVE N, BETWEEN N 85TH ST AND N 105TH ST

KEY
- MODIFIED CURB RAMPS
- EXISTING CURB RAMPS
- NEW MARKED CROSSWALKS
- NEW PEDESTRIAN SIGNALS
- NEW MEDIAN
- AREA OF FOCUS FOR PUBLIC ART
- FUTURE NEIGHBORHOOD GREENWAY
- EXISTING NEIGHBORHOOD GREENWAY
- EXISTING TRAFFIC SIGNAL

AURORA AVE N AND N 92ND ST
Double Half Signals
Pedestrian Pushbutton Practices

Pedestrian Pushbutton Practice
Summary
May 4, 2000

Criteria:

- Remove pedestrian pushbutton (PPB) and operate signal fixed time (so that pedestrian walk signal comes up each cycle) if pedestrians are present at the main street crossing for 75% of the cycles for a majority (12 hours) of the day.

- Operate the signal fixed time during hours of heavy pedestrian use, and actuated (by pushbutton) during other times if pedestrians are present at the main street crossing for 50% of the cycles for a majority (12 hours) of the day.
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**Costs Key**

- $: LESS THAN $50,000
- $$: $50,000 - $100,000
- $$$: $100,000 - $250,000
- $$$$: $250,000 OR MORE

* requires striping only
** requires right-of-way acquisition
4.3.2 TRAFFIC CONTROL
This section describes tools that modify signal timing, phasing, and indications. Traffic control tools can also include changes to existing traffic control regulations to prioritize bus movements and enforce traffic regulations.

4.3.2.1 MOVEMENT RESTRICTION EXEMPTION/ TURN RESTRICTION
4.3.2.6 TRANSIT SIGNAL PRIORITY
4.3.2.11 TRAFFIC SIGNAL INSTALLED FOR BUSES ONLY

4.3.2.2 YIELD TO BUS
4.3.2.7 TRANSIT SIGNAL FACES
4.3.2.12 SIGNAL PHASE MODIFICATION

4.3.2.3 PASSIVE TRAFFIC SIGNAL TIMING ADJUSTMENTS
4.3.2.8 BUS-ONLY SIGNAL PHASE

4.3.2.4 PHASE RESERVICE
4.3.2.9 QUEUE JUMPS

4.3.2.5 REVERSE QUEUE JUMP
4.3.2.10 PRE-SIGNALS
4.3.2.3 PASSIVE TRAFFIC SIGNAL TIMING ADJUSTMENTS

OVERVIEW OF STRATEGY

Existing signal timing plans can be optimized to reduce delay for traffic in general on intersection approaches used by buses or for buses specifically. The signal timing is followed whether or not a bus is present; therefore, the adjustments are considered to be passive.

Reviewing existing signal timing is an activity that can be done on a periodic or ongoing basis. Optimizing traffic signal timing is done to minimize the number of stops or traffic signal delays experienced by vehicles traveling along a street. Changes that result in better operations for general purpose vehicles may also benefit buses, although good signal timing for general purpose vehicles is not necessarily good signal timing for buses.

Signal timing can also be adjusted specifically to benefit buses. Some of these changes, such as shorter cycle lengths or more green time for the approaches used by buses, will also improve operations for many other roadway users. Other changes, such as signal timing designed to allow buses to progress, may benefit some modes while increasing delay for others.

BENEFITS

Adjusting or optimizing signal timing plans to benefit buses in particular or the approaches where buses are traveling reduces the delay that buses experience at signalized intersections.

OPERATIONAL CONSIDERATIONS

When adjusting traffic signal timing plans, consideration of the locations of bus stops between intersections should be made to ensure that the timing plans account for buses serving the stop. Additional information is included in Section 6.4 of the TCRP Report 183.

IMPLEMENTATION GUIDANCE

Develop Internal Process for Identifying Candidate Signals: Both Metro and local jurisdictions can develop an internal process for identifying and reporting signal timing issues that affect bus operations. Local jurisdictions should also consider bus operations when retiming traffic signals. Signal progression for buses is a potential strategy for high-passenger-volume corridors where a net person-delay benefit may be feasible. It can also be considered in local jurisdictions that wish to prioritize non-automobile traffic.

Develop Signal Timing Plan: Collect data and model the changes to traffic operations of the signal timing modifications.

Implement and Adjust: Implement the signal timing modifications and monitor traffic operations. If further modifications to the signal timing plan are needed, adjustments of the signal timing plan can be made.

LOCAL APPLICATIONS

1. **NE 4th Street and 112th Avenue NE**: Signal timing was adjusted to extend the southbound left-turn phase, allowing coaches to effectively clear the intersection, resulting in less transit delay and mitigation of possible pedestrian/vehicle conflict.

2. **NE 29th Street and 148th Ave NE**: The green time for eastbound traffic was given additional time, allowing coaches to successfully complete the movement during periods of high traffic volumes. Maximum delay times observed at the location decreased by 27 percent.
4.3.2.4 PHASE RESERVICE

OVERVIEW OF STRATEGY

Modifying signal phasing so that a traffic signal phase is served twice during a traffic signal cycle; for example, a left-turn phase that is served both at the start and the end of the green phase for through traffic. Additional information is included in Section 6.5 of the TCRP Report 183.

BENEFITS

Bus delay will be reduced, as will the delay experienced by other vehicles sharing the intersection approach.

Buses will experience additional green time at signals, which can reduce bus travel time variability.

OPERATIONAL CONSIDERATIONS

The adequate amount of cycle time must be available to allow for a signal reservice. During peak traffic periods, there may not be enough cycle time to allow a reservice while also maintaining an acceptable level of service at busier intersections.

IMPLEMENTATION GUIDANCE

Identify Candidate Signals: Identify signals that would be good candidates for this tool, which has the greatest potential application to signalized intersections where buses turn left.

Analysis Approach: Collect traffic data and run intersection level of service to understand outcome of the proposed operational changes to both transit and general purpose traffic as needed.

Implement Signal Modification: Implement signal reservice strategy and monitor traffic operations.

LOCAL APPLICATIONS

1. **12th Avenue East and East John Street**: A signal reservice was implemented at 12th Avenue East and East John Street.

2. **Elliott Avenue West and West Mercer Place**: A signal reservice was implemented at Elliott Avenue West and West Mercer Place.
4.3.2.6 TRANSIT SIGNAL PRIORITY

OVERVIEW OF STRATEGY

Traffic signal timing is altered in response to a request from a bus so that the bus experiences no delay or reduced delay passing through an intersection.

Transit signal priority can be implemented in a number of ways, including green extension, red truncation (early green), phase insertion, sequence change, and phase skipping. Additional information about the specific types of transit signal priority is described in the National Cooperative Highway Research Program (NCHRP) Report 812: Signal Timing Manual and Section 6.7 of the TCRP Report 183.

BENEFITS

Transit signal priority can be used to reduce the amount of delay that buses experience at traffic signals. When implemented along corridors, transit signal priority can improve travel time variability.

OPERATIONAL CONSIDERATIONS

Transit signal priority can be applied to intersections with level of service C or worse. All Metro buses have equipment necessary to operate on the King County Transit Signal Priority system. King County is currently developing a next-generation transit signal priority system that will leverage center-to-center (C2C) connections and existing city-owned communications networks. A Center-to-Infrastructure (C2I) option will also be available, which will rely on King-County owned roadside and communication equipment.

IMPLEMENTATION GUIDANCE

Consider Other Tools: Evaluate the possibility of implementing other lower-cost, quicker-to-implement strategies such as stop relocation, stop consolidation, and passive traffic signal timing adjustments.

Evaluate Transit Signal Priority Feasibility: Collect traffic demand data (buses, automobiles, bicyclists, and pedestrians) and existing signal timing to develop and evaluate an initial transit signal priority timing plan. A simulation study can be completed to evaluate corridor operations with and without transit signal priority. If transit signal priority is a new strategy, the required infrastructure will need to be planned and designed.

Monitor Traffic Operations: After a signal timing plan has been implemented in the field, monitor traffic operations for both general purpose traffic and transit and determine if modifications are needed.

LOCAL APPLICATIONS

1. Burnett Avenue S and S 2nd Street: Metro implemented transit signal priority improvements, which reduced transit delay and alleviated queuing of general purpose traffic.

2. Longacres Way and W Valley Highway: Transit signal priority settings were adjusted to better reflect actual transit operations and to allow transit signal priority to request service more aggressively, which resulted in less transit delay.
4.3.2.7 TRANSIT SIGNAL FACES

OVERVIEW OF STRATEGY

Special transit signal faces are used for controlling bus, streetcar, or light rail operations. Transit signal faces help to distinguish transit priority at intersections. Additional information is included in Section 6.8 of the TCRP Report 183.

BENEFITS

Transit signal faces can help reduce the possibility of road users misinterpreting regular traffic signals used to control transit vehicles as applying to them, leading to potential conflicts. This can reduce the potential for collisions that can occur when motorists or other road users misinterpret a standard signal display meant only for buses as being a green indication for them.

OPERATIONAL CONSIDERATIONS

There are no operational considerations for the fleet, but training could be required for operators to ensure they are familiar with the transit signal faces. Transit signal faces may require a bus-only lane.

IMPLEMENTATION GUIDANCE

Consider Coordination with Other Tools: Transit signal faces are suggested for consideration in conjunction with other tools that support the provision of transit priority, described in the Companion Strategies section.

LOCAL APPLICATIONS

1. Rainier Avenue South and South Dearborn Street: transit signal faces were installed along with other speed and reliability improvements, including turn restrictions, a queue jump, and a bus lane.

2. Westlake Avenue North and Mercer Street: transit signal faces were installed along with other improvements, including a turn restriction, a bus lane, and bus-only signal phase.

3. Fairview Avenue North and Mercer Street: transit signal faces were installed.
4.3.2.8 BUS-ONLY SIGNAL PHASE

OVERVIEW OF STRATEGY

A traffic signal phase included in the traffic signal cycle to serve bus movements that cannot be served, or are not desired to be served, concurrently with other traffic. Bus-only signal phases help support other tools by allowing buses to make nonstandard movements at an intersection. Without bus-only signal phases, some tools might not be feasible while others would be less effective.

BENEFITS

Bus-only signal phases are typically a support strategy and make another strategy feasible or allow another strategy to be used to maximum effectiveness. When used to serve turning movements from unconventional locations, they may reduce travel time or travel time variability, depending on the level of traffic congestion and challenges faced by buses to weave through traffic to position themselves to make a turn from a conventional location. The potential benefit is highly site-specific and would need to be determined by a traffic analysis.

OPERATIONAL CONSIDERATIONS

There could be some training needed for operators on routes with bus-only signal phases if they are making unconventional movements. This would help to reduce any confusion for operators so that speed and reliability benefits could be maximized. A bus-only signal phase may require a bus-only lane.

IMPLEMENTATION GUIDANCE

Understand the need and consider other users: Bus-only signal phases are a potential option when bus turning movements need to be made from unconventional locations. Designs may need to take into consideration conditions where other intersection users need to be warned about the unconventional movement (e.g., “Bus Signal” signs, accessible pedestrian signals, a special sign depicting the bus maneuver, dotted pavement markings), and the conditions listed in the BARRIERS AND SIDE EFFECTS section will need to be checked and potentially addressed prior to proceeding. Guidance for implementing this tool with median bus lanes, right-side bus lanes, and left-side bus lanes is provided in Section 6.9 of the TCRP Report 183.

LOCAL APPLICATIONS

1. **1st Avenue and Denny Way**: A bus-only signal phase was implemented in coordination with the City of Seattle along with a bus lane.

2. **Westlake Avenue North and Mercer Street**: A bus-only signal phase was implemented along with other improvements, including a bus lane, a turn restriction, and transit signal face.
Vibrant Community
Westlake Avenue

- Main North-South Transit Arterial in South Lake Union
  - New Transit Lanes
  - Upgraded Transit Stop Facilities
  - Signal Improvements
  - Widened Sidewalks
  - RapidRide C Line Extension
Combining innovative signals and transit lanes

• Northbound Westlake Avenue transit lane plan includes:
  – Bus stop extensions to accommodate two-three artics at all stops
  – Curb lane queue jump into center-running transit lane
  – Center lane straight-through signal
  – Center lane queue jump into curb lane
  – Several turn restrictions for GP traffic

Speed, reliability, and bus stops
Westlake Avenue

**PROJECT FEATURES**

More bus service means there is room for hundreds of more people.

**Benefits:** Increased mobility, affordable transportation options

Dedicated transit lanes allow streetcars and buses to bypass traffic, reducing delay and making for a smoother, more predictable ride.

**Benefits:** Faster, more reliable service

Wider sidewalks and longer bus stops allow buses to board passengers without having to pull out and back into traffic. They also provide space for more buses and streetcars, shelters and real-time information kiosks.

**Benefits:** Faster, more reliable service, rider comfort, sidewalk space

**BY THE NUMBERS**

**Service**
40 buses and streetcars can move up to 2,800 people between 5 and 6 PM on Westlake alone

**Reliability**
Doubling the number of people using transit along Westlake Ave N between 5 and 6 PM is the equivalent of adding another travel lane

**Growth**
65,000 people live in Center City Seattle and 25 new jobs a day are being added
Westlake Avenue

• C Line ridership is up 27%, about 2,300 new daily rides
• D Line ridership is up 23%, over 2,600 new daily rides
• Rt 40 ridership is up 23%, over 2,000 new daily rides
• C Line on-time performance increased from 80.7% to 84.9%.
• D Line on-time performance increased from 81.4% to 86.7%.
• Average morning travel times between Westlake Ave N & 8th Ave N and 3rd Ave & Virginia St dropped by 1.23 minutes (1 minute, 14 seconds); a 10% decrease in travel times.

• Average afternoon travel times between Westlake Ave N & 8th Ave N and 3rd Ave & Virginia St dropped by 0.83 minutes (50 seconds); a 5% decrease in travel times.
Better Transit Stop Environment, Q Jump
Better Transit Stop Environment, Q Jump
Better Transit Stop Environment, Q Jump
Better Transit Stop Environment, Q Jump
Seattle Streets Illustrated Map

- [http://streetsillustrated.seattle.gov/street-types/street-type-map](http://streetsillustrated.seattle.gov/street-types/street-type-map)
Seattle Streets Illustrated Map

- Downtown Principal Arterial (2nd Avenue)
Seattle Streets Illustrated Map

- 2nd Avenue and University St (Demonstration Project)
Seattle Streets Illustrated Map

- 2nd Ave and Pike St - Extension
Bus Ridership Comparison

Change in bus ridership in U.S. urbanized areas since 2004

Seattle
Seattle’s Growth Strategy

- Focus growth to more efficiently serve it
  - Urban centers
  - Manufacturing & industrial centers
  - Urban villages

- 80% of city growth in centers/villages since 1994

- Future Comprehensive Plan growth targets 2016-2035
  - 70,000 additional housing units
  - 115,000 additional jobs
Employment Density Comparison

Figure 8. What 200,000 jobs looks like: Downtown Seattle vs. Eastside
Source: Based on Puget Sound Regional Council Covered Employment Estimates, 2011

From 2010 to 2016, downtown Seattle added 45,000 jobs. During this time, 95% of the gain in net commute trips has been absorbed by non-drive alone modes.

Downtown Daily Commute Trends

<table>
<thead>
<tr>
<th>Mode</th>
<th>2010</th>
<th>2016</th>
<th>Change</th>
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<tbody>
<tr>
<td>Transit</td>
<td>85,446</td>
<td>116,831</td>
<td>+31,385</td>
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<tr>
<td>Non-Motorized</td>
<td>26,058</td>
<td>35,074</td>
<td>+9,016</td>
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<tr>
<td>Rideshare</td>
<td>19,392</td>
<td>21,736</td>
<td>+2,344</td>
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<tr>
<td>Drive Alone</td>
<td>71,104</td>
<td>73,359</td>
<td>+2,255</td>
</tr>
</tbody>
</table>

* non-motorized commutes consists of walk, bike, carpool, and flex schedules.
Street Right of Way
Bell Street
A STAGE FOR EVENTS LARGE AND SMALL
Questions?