

Appendix C.

# **Countermeasure Toolbox**

# CURB RADIUS REDUCTION \\

## INTERSECTION DESIGN

Motorists' awareness of bicyclists during right-turns can be improved by creating a safer intersection design. Larger curb radii typically result in high-speed turning vehicles. Smaller radii can improve safety because they require motorists to reduce vehicle speed by making sharper turns.



### ADDITIONAL CONSIDERATIONS

Potential operational impacts include:

- » Slowed turning movements
- » Reduced cycle lengths due to shorter pedestrian crossing distance
- » Wide turns by largest vehicles

### RELATIVE COST

**\$18 TO \$23 PER LINEAR FOOT**

### TYPICAL APPLICATION

- » Corridor
- » Intersection
- » Midblock

- » All streets
- » Arterials
- » Collectors
- » Local
- » Where rail is present
- » Over natural barriers

- » Urban roadways
- » Rural roadways

### DEMONSTRATED SAFETY EFFECTIVENESS

- » Proven (FHWA)
- » Promising
- » Not Available

### COLLISION TYPE ADDRESSED

#### PEDESTRIAN

- » Through vehicle
- » Through vehicle at signal
- » Right-turning vehicle
- » Right-turning vehicle at signal
- » Left-turning vehicle
- » Left-turning vehicle at signal
- » Other

#### BICYCLIST

- » Right-turning/merging vehicle
- » Left-turning/merging vehicle
- » Motorist drove out
- » Cyclist rode out
- » Motorist failed to yield
- » Cyclist failed to yield

### DESIGN GUIDANCE RESOURCES

- » Caltrans Standards (Plan A88A)
- » City of Santa Ana Standards (Plan 1101, 1122, and 1127)

# BIKE LANE \\ ROADWAY DESIGN

Bike lanes are striped on-street lanes next to mixed purpose lanes that carry cars and other motorized vehicles. With bike lanes, motorists can safely pass people on bicycles without having to change lanes. Bike lanes may be separated by a single striped line or a striped or hatched buffer that provides more separation between moving traffic. The stripes, in combination with narrower vehicle lanes can slow traffic.



## ADDITIONAL CONSIDERATIONS

Potential operational impacts include:

- » May reduce vehicle lane capacity and speed
- » Reduced signal delay for bicyclists
- » Decreased vehicle and bicycle conflict points

## RELATIVE COST

**\$133,000 PER MILE**

## TYPICAL APPLICATION

- » Corridor
  - » Intersection
  - » Midblock
- 
- » All streets
  - » Arterials
  - » Collectors
  - » Local
  - » Where rail is present
  - » Over natural barriers

- » Urban roadways
- » Rural roadways

## DEMONSTRATED SAFETY EFFECTIVENESS

- » Proven (FHWA)
- » Promising
- » Not Available

## COLLISION TYPE ADDRESSED

### PEDESTRIAN

- » Through vehicle
- » Through vehicle at signal
- » Right-turning vehicle
- » Right-turning vehicle at signal
- » Left-turning vehicle
- » Left-turning vehicle at signal
- » Other

### BICYCLIST

- » Right-turning/merging vehicle
- » Left-turning/merging vehicle
- » Motorist drove out
- » Cyclist rode out
- » Motorist failed to yield
- » Cyclist failed to yield

## DESIGN GUIDANCE RESOURCES

- » Caltrans Standards (Plan A24C/D)
- » California Manual on Uniform Traffic Control Devices (2014, Chapter 9A, 9B, 9C)
- » City of Santa Ana Standards (Plan 1125B)

# PROTECTED BIKE LANES \\

## ROADWAY DESIGN

Protected bike lanes provide an attractive and safe bicycle facility for people with a range of riding abilities through the physical separation from motor vehicle traffic using on street parking, curb, and delineators or landscaping. Protected bike lanes may be one way or two way, and are sometimes referred to as cycle tracks.



### ADDITIONAL CONSIDERATIONS

Potential operational impacts include:

- » Potential decrease in lane capacity
- » Reduced vehicle speeds
- » Careful design required on approach to and at intersections

### RELATIVE COST

**\$536,000 TO \$4,000,000 PER MILE**

### TYPICAL APPLICATION

- » **Corridor**
  - » **Intersection**
  - » **Midblock**
- 
- » **All streets**
  - » **Arterials**
  - » **Collectors**
  - » **Local**
  - » **Where rail is present**
  - » **Over natural barriers**
- 
- » **Urban roadways**
  - » **Rural roadways**

### DEMONSTRATED SAFETY EFFECTIVENESS

- » **Proven (FHWA)**
- » **Promising**
- » **Not Available**

### COLLISION TYPE ADDRESSED

#### PEDESTRIAN

- » **Through vehicle**
- » **Through vehicle at signal**
- » **Right-turning vehicle**
- » **Right-turning vehicle at signal**
- » **Left-turning vehicle**
- » **Left-turning vehicle at signal**
- » **Other**

#### BICYCLIST

- » **Right-turning/merging vehicle**
- » **Left-turning/merging vehicle**
- » **Motorist drove out**
- » **Cyclist rode out**
- » **Motorist failed to yield**
- » **Cyclist failed to yield**

### DESIGN GUIDANCE RESOURCES

- » Caltrans Standards (Plan A24C/D)
- » California Manual on Uniform Traffic Control Devices (2014, Chapter 9A, 9B, 9C)
- » City of Santa Ana Standards (Plan 1125B)



# CORRIDOR ACCESS MANAGEMENT \\

## ROADWAY DESIGN

Corridor access management can reduce the frequency and magnitude of conflict points at intersections and driveways by altering access patterns. Access management can be achieved through the consolidation of driveways, driveway narrowing, and medians that restrict access to right in and right out turning movements.



### ADDITIONAL CONSIDERATIONS

Potential operational impacts include:

- » Reduced delay due to turning vehicles
- » Reduced rear-end collisions
- » Increase in u-turns at adjacent intersections
- » May limit left-turn access

### RELATIVE COST

**NOT AVAILABLE**

### TYPICAL APPLICATION

- » Corridor
  - » Intersection
  - » Midblock
- 
- » All streets
  - » Arterials
  - » Collectors
  - » Local
  - » Where rail is present
  - » Over natural barriers

- » Urban roadways
- » Rural roadways

### DEMONSTRATED SAFETY EFFECTIVENESS

- » Proven (FHWA)
- » Promising
- » Not Available

### COLLISION TYPE ADDRESSED

#### PEDESTRIAN

- » Through vehicle
- » Through vehicle at signal
- » Right-turning vehicle
- » Right-turning vehicle at signal
- » Left-turning vehicle
- » Left-turning vehicle at signal
- » Other

#### BICYCLIST

- » Right-turning/merging vehicle
- » Left-turning/merging vehicle
- » Motorist drove out
- » Cyclist rode out
- » Motorist failed to yield
- » Cyclist failed to yield

### DESIGN GUIDANCE RESOURCES

- » Caltrans Standards (Plan A87A)
- » City of Santa Ana Standards (Plan 1112)

# LANE WIDTH REDUCTION \\ ROADWAY DESIGN

Narrow travel lanes communicate to drivers that they need to be more careful in passing other vehicles. Narrow travel lanes that still accommodate the types of traffic expected on the street improve safety and comfort for pedestrians, cyclists, transit riders, and motor vehicles by slowing speeds. In some cases the combined effect of narrowing lanes by 1-2' across a roadway opens up the possibility of installing bike lanes.



## ADDITIONAL CONSIDERATIONS

Potential operational impacts include:

- » Reduction below 10' may decrease lane capacity

## RELATIVE COST

**\$1,000 TO \$3,000 PER BLOCK**

### TYPICAL APPLICATION

- » **Corridor**
- » **Intersection**
- » **Midblock**

- » **All streets**
- » **Arterials**
- » **Collectors**
- » **Local**
- » **Where rail is present**
- » **Over natural barriers**

- » **Urban roadways**
- » **Rural roadways**

### DEMONSTRATED SAFETY EFFECTIVENESS

- » **Proven (FHWA)**
- » **Promising**
- » **Not Available**

### COLLISION TYPE ADDRESSED

#### PEDESTRIAN

- » **Through vehicle**
- » **Through vehicle at signal**
- » **Right-turning vehicle**
- » **Right-turning vehicle at signal**
- » **Left-turning vehicle**
- » **Left-turning vehicle at signal**
- » **Other**

#### BICYCLIST

- » **Right-turning/merging vehicle**
- » **Left-turning/merging vehicle**
- » **Motorist drove out**
- » **Cyclist rode out**
- » **Motorist failed to yield**
- » **Cyclist failed to yield**

### DESIGN GUIDANCE RESOURCES

- » Caltrans Standards (Plan A20-A24)
- » City of Santa Ana Standards (Plan 1125B)

# BICYCLE BOULEVARD \\ ROADWAY DESIGN

Shared lane markings, wayfinding signs, and traffic calming communicate to residents and through traffic that the vulnerable roadway users on these streets are a priority. Bioswales and landscaping amenities enhance water retention capabilities and shade. Bicycle Boulevards are installed on streets that are already low volume and low speed (or could easily be) and enhanced crossings are utilized at higher order streets to maintain connectivity.



## ADDITIONAL CONSIDERATIONS

Potential operational impacts include:

- » Possible increased vehicle traffic demand on parallel streets
- » Reduced vehicle speeds and increased travel times for diverted traffic

## RELATIVE COST

**\$700,00 PER MILE**

## TYPICAL APPLICATION

- » Corridor
  - » Intersection
  - » Midblock
- 
- » All streets
  - » Arterials
  - » Collectors
  - » Local
  - » Where rail is present
  - » Over natural barriers
- 
- » Urban roadways
  - » Rural roadways

## DEMONSTRATED SAFETY EFFECTIVENESS

- » Proven (FHWA)
- » Promising
- » Not Available

## COLLISION TYPE ADDRESSED

### PEDESTRIAN

- » Through vehicle
- » Through vehicle at signal
- » Right-turning vehicle
- » Right-turning vehicle at signal
- » Left-turning vehicle
- » Left-turning vehicle at signal
- » Other

### BICYCLIST

- » Right-turning/merging vehicle
- » Left-turning/merging vehicle
- » Motorist drove out
- » Cyclist rode out
- » Motorist failed to yield
- » Cyclist failed to yield

## DESIGN GUIDANCE RESOURCES

- » California Manual on Uniform Traffic Control Devices (2014, Chapter 9A, 9B, 9C)
- » City of Santa Ana Standards (Plan 1105, 1125B, 1504A/B, 1505)
- » NACTO Urban Bikeway Design Guide



# PEDESTRIAN PLAZAS \\

## ROADWAY DESIGN

Pedestrian plazas created in the public right of way create a sense of place for people to linger or gather adjacent to commercial or mixed purpose land uses. They can be accomplished through land dedication, street closure or lane closures and may be temporary or permanent in nature.



### ADDITIONAL CONSIDERATIONS

Potential operational impacts include:

- » Potential decrease in lane capacity
- » Potential increase in pedestrian demand
- » Eliminates specific turning movement and in road conflicts, depending on location

### RELATIVE COST

**\$100,000 TO SEVERAL MILLION EACH**

### TYPICAL APPLICATION

- » **Corridor**
- » **Intersection**
- » **Midblock**

- » **All streets**
- » **Arterials**
- » **Collectors**
- » **Local**
- » **Where rail is present**
- » **Over natural barriers**

- » **Urban roadways**
- » **Rural roadways**

### DEMONSTRATED SAFETY EFFECTIVENESS

- » **Proven (FHWA)**
- » **Promising**
- » **Not Available**

### COLLISION TYPE ADDRESSED

#### PEDESTRIAN

- » **Through vehicle**
- » **Through vehicle at signal**
- » **Right-turning vehicle**
- » **Right-turning vehicle at signal**
- » **Left-turning vehicle**
- » **Left-turning vehicle at signal**
- » **Other**

#### BICYCLIST

- » **Right-turning/merging vehicle**
- » **Left-turning/merging vehicle**
- » **Motorist drove out**
- » **Cyclist rode out**
- » **Motorist failed to yield**
- » **Cyclist failed to yield**

### DESIGN GUIDANCE RESOURCES

- » NACTO Urban Street Design Guide
- » LA People St Manual
- » NYC DOT Street Design Manual (Chapter 2.1.4a-b)



# ROAD BUFFET \\ ROADWAY DESIGN

Road buffets are used to reallocate the available pavement between curbs to accommodate expected traffic volumes and users in fewer mixed purpose motor vehicle lanes. A typical road buffet reduces the number of through lanes while maintaining capacity at the intersection for the target level of service for all modes. With a goal of increasing available transportation choices on a street, the reduction of lanes allows for bike lanes, pedestrian refuge islands, transit stops, or parking. Road buffets (also known as road diets) are a proven safety countermeasure.



## ADDITIONAL CONSIDERATIONS ‡

Potential operational impacts include:

- » Potential increased vehicular delay on minor-street due to fewer gaps
- » Potential delay at signalized or stop controlled intersections
- » Reduced vehicle speeds

## RELATIVE COST

**\$25,000 TO \$40,000 PER MILE**

## TYPICAL APPLICATION

- » Corridor
- » Intersection
- » Midblock

- » All streets
- » Arterials
- » Collectors
- » Local
- » Where rail is present
- » Over natural barriers

- » Urban roadways
- » Rural roadways

## DEMONSTRATED SAFETY EFFECTIVENESS

- » Proven (FHWA)
- » Promising
- » Not Available

## COLLISION TYPE ADDRESSED

### PEDESTRIAN

- » Through vehicle
- » Through vehicle at signal
- » Right-turning vehicle
- » Right-turning vehicle at signal
- » Left-turning vehicle
- » Left-turning vehicle at signal
- » Other

### BICYCLIST

- » Right-turning/merging vehicle
- » Left-turning/merging vehicle
- » Motorist drove out
- » Cyclist rode out
- » Motorist failed to yield
- » Cyclist failed to yield

## DESIGN GUIDANCE RESOURCES

- » Caltrans Standards (Plan A20-A24)
- » City of Santa Ana Standards (Plan 1125B)

‡ Use of this countermeasure on MPAH-designated roadways is permitted on all roadway classifications. It requires coordination with OCTA staff to demonstrate accommodation for future traffic volumes. This countermeasure is subject to planned carrying capacity; lanes can be reconfigured temporarily, but subject to restoration upon future demand. Board consideration required for exceptions due to overriding and safety concerns.

# ADVANCE STOP OR YIELD BARS \\ CROSSING ENHANCEMENTS

Stop and yield signs placed well in advance of crosswalks increases visibility of pedestrians from adjacent lanes, reducing the possibility of a multiple threat collisions. The advance markings also increases the vulnerable roadway user's understanding that the driver intends to stop to permit the crossing.



## ADDITIONAL CONSIDERATIONS

Potential operational impacts include:

- » Increased start up time for vehicles

## RELATIVE COST

**\$10 PER SQUARE FOOT**

### TYPICAL APPLICATION

- » Corridor
  - » Intersection
  - » Midblock
- 
- » All streets
  - » Arterials
  - » Collectors
  - » Local
  - » Where rail is present
  - » Over natural barriers
- 
- » Urban roadways
  - » Rural roadways

### DEMONSTRATED SAFETY EFFECTIVENESS

- » Proven (FHWA)
- » Promising
- » Not Available

### COLLISION TYPE ADDRESSED

#### PEDESTRIAN

- » Through vehicle
- » Through vehicle at signal
- » Right-turning vehicle
- » Right-turning vehicle at signal
- » Left-turning vehicle
- » Left-turning vehicle at signal
- » Other

#### BICYCLIST

- » Right-turning/merging vehicle
- » Left-turning/merging vehicle
- » Motorist drove out
- » Cyclist rode out
- » Motorist failed to yield
- » Cyclist failed to yield

### DESIGN GUIDANCE RESOURCES

- » Caltrans Standards (Plan A24D)
- » City of Santa Ana Standards (Plan 1505)
- » California Manual on Uniform Traffic Control Devices (2014, Chapter 3B.16)

# CURB EXTENSIONS \\ CROSSING ENHANCEMENTS

Wide roadways can create difficult crossing situations for pedestrians. Not only do pedestrians need more time to cross the roadway, but the roadway width encourages motorists to speed or take turns quickly. Curb extensions improve safety because they increase visibility, reduce speed of turning vehicles, encourage pedestrians to cross at designated locations, shorten the crossing distance, and prevent vehicles from parking at corners.



## ADDITIONAL CONSIDERATIONS ‡

Potential operational impacts include:

- » Reduced lane capacity for turning
- » Slows turning movements for large vehicles
- » Reduced cycle lengths due to shorter pedestrian crossing distance
- » Extended bulbs can be used for in lane transit stops

## RELATIVE COST

**\$10,000 EACH**

## TYPICAL APPLICATION

- » Corridor
  - » Intersection
  - » Midblock
- 
- » All streets
  - » Arterials
  - » Collectors
  - » Local
  - » Where rail is present
  - » Over natural barriers

- » Urban roadways
- » Rural roadways

## DEMONSTRATED SAFETY EFFECTIVENESS

- » Proven (FHWA)
- » Promising
- » Not Available

## COLLISION TYPE ADDRESSED

### PEDESTRIAN

- » Through vehicle
- » Through vehicle at signal
- » Right-turning vehicle
- » Right-turning vehicle at signal
- » Left-turning vehicle
- » Left-turning vehicle at signal
- » Other

### BICYCLIST

- » Right-turning/merging vehicle
- » Left-turning/merging vehicle
- » Motorist drove out
- » Cyclist rode out
- » Motorist failed to yield
- » Cyclist failed to yield

## DESIGN GUIDANCE RESOURCES

- » Caltrans Standards (Plan A87A)
- » City of Santa Ana Standards (Plan 1101)

‡ Use of this countermeasure on MPAH-designated roadways requires coordination with OCTA staff to demonstrate accommodation for existing and future traffic volumes. This countermeasure is subject to traffic calming policy. Board consideration required for exceptions due to overriding and safety concerns.



# MEDIAN REFUGE ISLAND \\ CROSSING ENHANCEMENTS

Median pedestrian and bicycle refuge islands make roadway crossings easier and safer by 1) limiting exposure to through moving vehicles, 2) enabling crossings to commence when there are gaps in traffic from one direction at a time; and 3) providing a safe stopping place in the middle of the roadway for pedestrians who are not able to make the complete street crossing during the pedestrian phase. They may be used at signalized and unsignalized intersections or midblock.



## ADDITIONAL CONSIDERATIONS

Potential operational impacts include:

- » May limit left-turn access
- » Reduced vehicle speeds

## RELATIVE COST

**\$500 TO \$1,000 PER SQUARE FOOT**

### TYPICAL APPLICATION

- » Corridor
  - » Intersection
  - » Midblock
- 
- » All streets
  - » Arterials
  - » Collectors
  - » Local
  - » Where rail is present
  - » Over natural barriers
- 
- » Urban roadways
  - » Rural roadways

### DEMONSTRATED SAFETY EFFECTIVENESS

- » Proven (FHWA)
- » Promising
- » Not Available

### COLLISION TYPE ADDRESSED

#### PEDESTRIAN

- » Through vehicle
- » Through vehicle at signal
- » Right-turning vehicle
- » Right-turning vehicle at signal
- » Left-turning vehicle
- » Left-turning vehicle at signal
- » Other

#### BICYCLIST

- » Right-turning/merging vehicle
- » Left-turning/merging vehicle
- » Motorist drove out
- » Cyclist rode out
- » Motorist failed to yield
- » Cyclist failed to yield

### DESIGN GUIDANCE RESOURCES

- » California Manual on Uniform Traffic Control Devices (2014, Chapter 3B.10 3B.18, 3I.06)
- » City of Santa Ana Standards (Plan 1101, 1125B, 1504A/B)



# RECTANGULAR RAPID FLASHING BEACONS \\ CROSSING ENHANCEMENTS

The Rectangular Rapid Flashing Beacon (RRFB) is a device using LED flashing beacons in combination with pedestrian and bicycle warning signs, to provide a high-visibility strobe-like warning to drivers when pedestrians and bicyclists use a crosswalk.



## ADDITIONAL CONSIDERATIONS

Potential operational impacts include:

- » Vehicle delay due to yielding after the pedestrian has finished the crossing

## RELATIVE COST

**\$14,000 EACH**

## TYPICAL APPLICATION

- » Corridor
  - » **Intersection**
  - » Midblock
- 
- » All streets
  - » Arterials
  - » Collectors
  - » **Local**
  - » Where rail is present
  - » Over natural barriers

- » Urban roadways
- » Rural roadways

## DEMONSTRATED SAFETY EFFECTIVENESS

- » Proven (FHWA)
- » **Promising**
- » Not Available

## COLLISION TYPE ADDRESSED

### PEDESTRIAN

- » **Through vehicle**
- » Through vehicle at signal
- » Right-turning vehicle
- » Right-turning vehicle at signal
- » Left-turning vehicle
- » Left-turning vehicle at signal
- » Other

### BICYCLIST

- » Right-turning/merging vehicle
- » Left-turning/merging vehicle
- » Motorist drove out
- » Cyclist rode out
- » **Motorist failed to yield**
- » **Cyclist failed to yield**

## DESIGN GUIDANCE RESOURCES

- » City of Santa Ana Standards
- » California Manual on Uniform Traffic Control Devices (2014, Chapter 4F, 4L.101, 4L.02, 4L.03)

# ROADWAY LIGHTING AT CROSSINGS \\

## CROSSING ENHANCEMENTS

Safety lighting focuses on periodic roadway and marked crosswalk illumination for motorists. It provides little benefit at the roadway edge where pedestrians are walking or initiating their crossings. Fifty-nine percent of fatal pedestrian collisions occur at night on unlighted roads. Additional roadway lighting enhances safety of all roadway users, while pedestrian-scale lighting improves nighttime security and visibility.



### ADDITIONAL CONSIDERATIONS

No potential operational impacts.

### RELATIVE COST

**\$11,000 TO \$42,000 PER CROSSWALK LIGHTING**  
**\$3,600 PER STREETLIGHT**

### TYPICAL APPLICATION

- » Corridor
- » Intersection
- » Midblock

- » All streets
- » Arterials
- » Collectors
- » Local
- » Where rail is present
- » Over natural barriers

- » Urban roadways
- » Rural roadways

### DEMONSTRATED SAFETY EFFECTIVENESS

- » Proven (FHWA)
- » Promising
- » Not Available

### COLLISION TYPE ADDRESSED

#### PEDESTRIAN

- » Through vehicle
- » Through vehicle at signal
- » Right-turning vehicle
- » Right-turning vehicle at signal
- » Left-turning vehicle
- » Left-turning vehicle at signal
- » Other

#### BICYCLIST

- » Right-turning/merging vehicle
- » Left-turning/merging vehicle
- » Motorist drove out
- » Cyclist rode out
- » Motorist failed to yield
- » Cyclist failed to yield

### DESIGN GUIDANCE RESOURCES

- » Caltrans Standards (Plans ES)
- » City of Santa Ana Standards (Plan 1125B)

# SIGNAL MODIFICATIONS \\ SIGNALS AND SIGNS

Even where traffic signals are present, pedestrian collisions occur, both during conflicting phases and concurrent ones. Signal improvements should be considered to increase compliance and reduce conflicts. Compliance can be achieved by reducing cycle lengths, timing the green band to slower speeds, and using speed based actuation. Conflicting movements can be reduced by introducing exclusive left- and right-turn phases separate from the pedestrian phase or leading bicycle and pedestrian intervals. Finally, sometimes pedestrians start their crossings too late or take too long to finish.

Leading pedestrian intervals (which give pedestrians a few second head start to claim the right-of-way ahead of turning traffic), slower walking speeds, and longer all red can be considered for these situations. These modifications can optimize delay for all users, encourage users to wait for the appropriate phase, and eliminate bicycle and pedestrian conflicts with motor vehicles. Including pedestrian recall (walk signal occurs every cycle without requiring pedestrian to push a button) at high demand locations where the green phase will be unaffected by the call to the controller, may reduce the number of people who cross without the benefit of the “WALK” signal.



## ADDITIONAL CONSIDERATIONS

Potential operational impacts include:

- » Increased cycle length increases overall delay
- » Operational impact depends on traffic demand

## RELATIVE COST

**\$200 EACH**

### TYPICAL APPLICATION

- » Corridor
  - » Intersection
  - » Midblock
- 
- » All streets
  - » Arterials
  - » Collectors
  - » Local
  - » Where rail is present
  - » Over natural barriers

- » Urban roadways
- » Rural roadways

### DEMONSTRATED SAFETY EFFECTIVENESS

- » Proven (FHWA)
- » Promising
- » Not Available

### COLLISION TYPE ADDRESSED

#### PEDESTRIAN

- » Through vehicle
- » Through vehicle at signal
- » Right-turning vehicle
- » Right-turning vehicle at signal
- » Left-turning vehicle
- » Left-turning vehicle at signal
- » Other

#### BICYCLIST

- » Right-turning/merging vehicle
- » Left-turning/merging vehicle
- » Motorist drove out
- » Cyclist rode out
- » Motorist failed to yield
- » Cyclist failed to yield

### DESIGN GUIDANCE RESOURCES

- » City of Santa Ana Traffic Impact Guidelines
- » City Traffic Engineer
- » California Manual on Uniform Traffic Control Devices (2014, Chapter 4A-4K)



# SPEED FEEDBACK SIGNS \\ SIGNALS AND SIGNS

Speed feedback signs display passing vehicle speeds to motorists. They can be installed on a temporary or permanent basis, providing feedback on motorist speed related to the speed limit.



## ADDITIONAL CONSIDERATIONS

No potential operational impacts.

## RELATIVE COST

**\$2,500 TO \$4,000 EACH**

## TYPICAL APPLICATION

- » **Corridor**
  - » **Intersection**
  - » **Midblock**
- 
- » **All streets**
  - » **Arterials**
  - » **Collectors**
  - » **Local**
  - » **Where rail is present**
  - » **Over natural barriers**
- 
- » **Urban roadways**
  - » **Rural roadways**

## DEMONSTRATED SAFETY EFFECTIVENESS

- » **Proven (FHWA)**
- » **Promising**
- » **Not Available**

## COLLISION TYPE ADDRESSED

### PEDESTRIAN

- » **Through vehicle**
- » **Through vehicle at signal**
- » **Right-turning vehicle**
- » **Right-turning vehicle at signal**
- » **Left-turning vehicle**
- » **Left-turning vehicle at signal**
- » **Other**

### BICYCLIST

- » **Right-turning/merging vehicle**
- » **Left-turning/merging vehicle**
- » **Motorist drove out**
- » **Cyclist rode out**
- » **Motorist failed to yield**
- » **Cyclist failed to yield**

## DESIGN GUIDANCE RESOURCES

- » California Manual on Uniform Traffic Control Devices (2014, Chapter 2B.13)
- » City of Santa Ana Standards (Plan 1504A/B)



# GATEWAY SIGNS \\ SIGNALS AND SIGNS

Gateways can create an expectation for motorists to drive more slowly and watch for pedestrians when entering a commercial, business, or residential district from a higher speed roadway. They also create a unique sense of place for an area.



## ADDITIONAL CONSIDERATIONS

No potential operational impacts.

## RELATIVE COST

**\$500 TO \$5,000 EACH**

## TYPICAL APPLICATION

- » Corridor
- » Intersection
- » Midblock
- » All streets
- » Arterials
- » Collectors
- » Local
- » Where rail is present
- » Over natural barriers
- » Urban roadways
- » Rural roadways

## DEMONSTRATED SAFETY EFFECTIVENESS

- » Proven (FHWA)
- » Promising
- » Not Available

## COLLISION TYPE ADDRESSED

### PEDESTRIAN

- » Through vehicle
- » Through vehicle at signal
- » Right-turning vehicle
- » Right-turning vehicle at signal
- » Left-turning vehicle
- » Left-turning vehicle at signal
- » Other

### BICYCLIST

- » Right-turning/merging vehicle
- » Left-turning/merging vehicle
- » Motorist drove out
- » Cyclist rode out
- » Motorist failed to yield
- » Cyclist failed to yield

## DESIGN GUIDANCE RESOURCES

- » Not available

# REGULATORY AND WARNING SIGNS

## SIGNALS AND SIGNS

Signs provide warning and regulatory reminders and information to all road users. NO TURN ON RED signs can increase safety and decrease collision with right-turning vehicles; BIKES MAY USE FULL LANE signs can make motorists more aware of bicyclists legal right to share the lane; and wayfinding signs direct bicyclists to the best routes connecting destinations. Regulatory YIELD TO PEDESTRIANS can inform drivers of their responsibility to yield at marked crossings.



### ADDITIONAL CONSIDERATIONS

No potential operational impacts.

**RELATIVE COST**  
**\$500 EACH**

### TYPICAL APPLICATION

- » Corridor
  - » Intersection
  - » Midblock
- 
- » All streets
  - » Arterials
  - » Collectors
  - » Local
  - » Where rail is present
  - » Over natural barriers
- 
- » Urban roadways
  - » Rural roadways

### DEMONSTRATED SAFETY EFFECTIVENESS

- » Proven (FHWA)
- » Promising
- » Not Available

### COLLISION TYPE ADDRESSED

#### PEDESTRIAN

- » Through vehicle
- » Through vehicle at signal
- » Right-turning vehicle
- » Right-turning vehicle at signal
- » Left-turning vehicle
- » Left-turning vehicle at signal
- » Other

#### BICYCLIST

- » Right-turning/merging vehicle
- » Left-turning/merging vehicle
- » Motorist drove out
- » Cyclist rode out
- » Motorist failed to yield
- » Cyclist failed to yield

### DESIGN GUIDANCE RESOURCES

- » California Manual on Uniform Traffic Control Devices (2014, Chapter 2B)
- » City of Santa Ana Standards (Plan 1504A/B)