City of Revere

TRAFFIC CALMING POLICY

OBJECTIVE

The City of Revere is committed to providing safe and slow streets for all its road users, including bicyclists, motorists, pedestrians, and people with disabilities. Traffic Calming is a key tool the city is using to achieve this goal.

Traffic Calming measures are defined as the combination of measures that reduce the negative effects of motor vehicle use, alter driver behavior, and improve conditions for non-motorized street users. Traffic calming consists of physical design and other measures put in place on existing roads to reduce vehicle speeds and improve safety for pedestrians and cyclists.

Traffic Calming Measures provide many benefits that include

- Reducing vehicle speeds and increased driver attentiveness
- Reducing dangerous driving behaviors, reducing the frequency and severity of collisions
- Improving safety for pedestrians, people with disabilities, bicyclist, strollers and users of public transit
- Reducing the need for police enforcement
- Enhancing the street environment
- Preserving neighborhood character and livability
- Increasing access for all modes of transportation
- Reducing cut-through motor vehicle traffic

TRAFFIC CALMING STANDARDS

The Federal Highway Administration and the Institute of Traffic Engineers categorize Traffic Calming Measures into four categories:

1. Horizontal deflection
2. Vertical deflection
3. Road Diets; and
4. Route restrictions.

Traffic Calming Measures the City of Revere will consider and include in regular routine roadway work and approved constituent petitions include:

City of Revere

Horizontal Deflection
A horizontal deflection hinders the ability of a motorist to drive in a straight path by creating a horizontal shift in the roadway. This shift reduces the ability of a motorist to maintain speed while comfortably navigating the measure. Solutions include:

- Lateral shift
- Realigned Intersection
- Chicane (a curb bump-out creating an artificial curve)
- Roundabout
- Mini-Roundabout (a small diameter circular island placed in an intersection)

Vertical Deflection
A vertical deflection creates a change in the height of the roadway that typically forces a motorist to slow down to maintain an acceptable level of comfort. Solutions include:

- Speed Hump
- Speed Cushion
- Speed Table
- Raised Crosswalk
- Raised Intersection

Street Width Reduction
A street width reduction narrows the width of a vehicle travel lane or roadway, so a motorist likely needs to slow the vehicle to maintain an acceptable level of comfort and safety. The measure can also reduce the distance required for pedestrian crossings, reducing exposure to vehicular conflicts. Solutions include:

- Choker
- Corner Extension/Bulb-Out
- Median Island
- Road Diet

Route Restriction
A routing restriction prevents particular vehicle movements at an intersection and is intended to eliminate some portions of cut-through traffic. Solutions include:

- Diagonal Diverter
- Closure
- Median Barrier/Forced Turn Island

Greater detail and applicability of these traffic calming measures are explained in Appendix A, Traffic Calming Design Standards

City of Revere

PETITION PROCESS

Revere community input is a vital component in assisting the city in reaching its goal of creating slower and safer streets for neighborhoods.

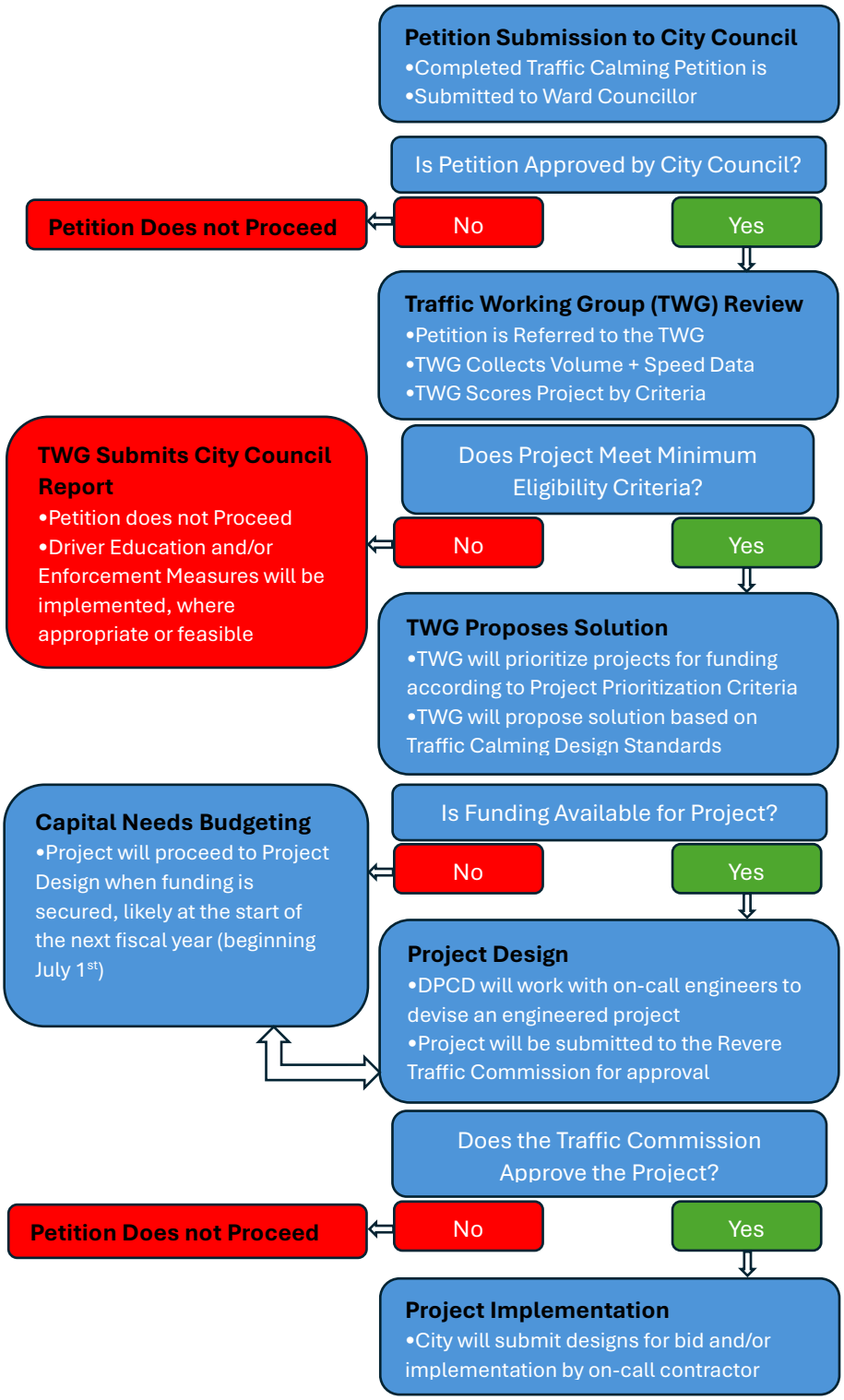
To start the process, Revere residents, business and property owners are encouraged to submit a traffic calming petition to their Ward Councilor. The submitted petition will start the process for evaluating and prioritizing constituent's request. Traffic calming measures will be considered for Revere-owned or maintained roads. Roadways under the jurisdiction of Massachusetts Department of Transportation or Department of Conservation and Recreation will not be considered.

If a submitted petition is approved by the City Council the petition, then begins the review process:

1. Petition will be referred to the Traffic Working Group, which consists of representatives from the Mayor's Office, Planning and Community Development, Revere Fire Department, Revere Police Department, Public Works Department, and the Parking Department.
2. Members of the Traffic Working Group will score the project on the minimum eligibility criteria, which includes speed and traffic volume data. If such data is not available, it will be collected by the Revere Police Department.
3. If the petition does not meet the Minimum Eligibility Criteria, the TWG will consider Driver Education and/or Enforcement Measures (further outlined below), but not further action will be taken, and a report will be submitted to the City Council to that effect.
4. If the petition meets Minimum Eligibility Criteria, the TWG will prioritize the project based on the Priority Project Criteria, and propose a solution based on the ITE Traffic Calming Toolkit.
5. If funding is available for the project, TWG will work with the City's on-call engineering firms, or in-house, to develop design drawings
6. If funding is not available for the project, the project will proceed to project design when the funding is secured, likely in the following fiscal year.
7. Once the project design is developed, it will be submitted to the Revere Traffic Commission for approval
8. If the Traffic Commission does not approve the project, the petition does not proceed
9. If the Traffic Commission approves the project, the City will implement the project. It will be performed through one of the City's on-call contracts or (if necessary) will go out to bid.

City of Revere

PETITION PROCESS FLOW CHART



City of Revere

PROJECT PRIORITIZATION

Provided the petition is approved by the City Council, the Traffic Working Group will use scoring rubric to validate applicant requests for traffic calming interventions, identify the appropriate intervention for the roadway and prioritize the intervention within the City's Street and Sidewalk Construction Schedule.

Minimum Eligibility Criteria	Project Must Meet All Five Criteria to Proceed	
	Criteria	Criteria Met?
Prevailing Speeds	85th percentile speed exceeds 25 mph	Yes? __ No? __
Street Widths	Paved width of street does not exceed 40 feet	Yes? __ No? __
Minimum Traffic Volume	Average Daily Traffic of at least 800 vehicles per day	Yes? __ No? __
Public Support	At least 10 households support petition	Yes? __ No? __
Engineering Solution Available	Is there an ITE-recommended solution to this problem?	Yes? __ No? __

Project Prioritization Criteria	Helps to Prioritize Projects Among Available Funding	
	Criteria	Criteria Met?
Excess Speeding	85th percentile speed exceeds 30 mph	Yes? __ No? __
Adjacent Land Use	Street serves or is adjacent to a school, public space, senior center, affordable housing or building of worship.	Yes? __ No? __
Upcoming Street Work	Street is adjacent to or on an upcoming street reconstruction project	Yes? __ No? __
Equal Distribution	Neighborhood has not had a similar Traffic Calming solution implemented in the last year	Yes? __ No? __

In instances where the Minimum Criteria threshold is not met for a given project area, DPCD and the TWG will review the applicability of driver education and/or enforcement alternatives such as:

Neighborhood traffic education	Neighborhood signs
Crosswalk improvements (including RRFBs)	Restricted movement signs
Neighborhood pledge program	Targeted police enforcement
Speed display unit (radar feedback signs)	Other regulatory or warning signs

City of Revere

TRAFFIC CALMING PETITION

In order for the City of Revere Traffic Working Group and the Traffic Commission to consider your Traffic Calming Request please fill out this form completely. The form must be submitted to your Ward Councilor with 10 or more signatures from other residents on your street. Only one signature is permitted per household.

1. Name _____ Date_____

Address: _____

Phone: _____ Email: _____

Best way to be reached during the day is: phone / email (circle one)

2. Please list the street(s)/ location that concerns you most:_____

_____

_____

_____

_____

3. What time of day do the concerns you have seem most noticeable?

_____

_____

_____

_____

_____

4. Please check each item that applies to the street(s) listed above:

___ Speeding ___Difficult to cross street ___Lack of courtesy to cyclists

___ Cars parked too close to corner ___Difficult to bike

___ Drivers not yielding to pedestrians

Other (please describe): _____

_____

_____

_____

_____

City of Revere

NEIGHBORHOOD SUPPORT PETITION

Name	Address	Email	Phone #

City of Revere

Appendix A:

Traffic Calming Design Standards

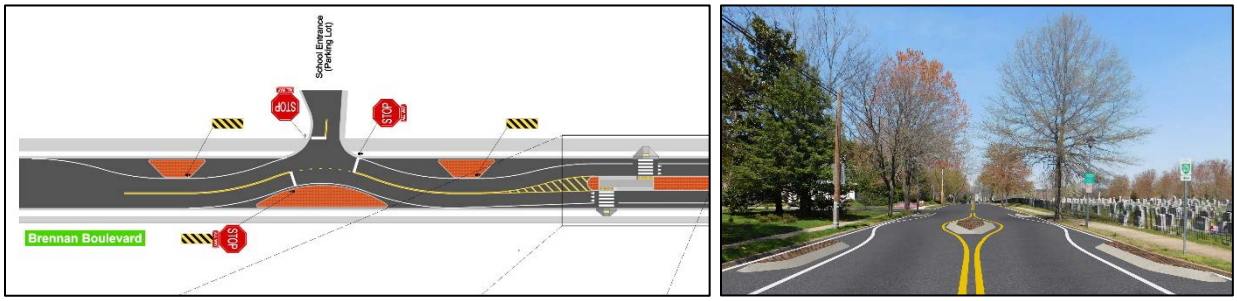
Chicane

Description:

- A series of alternating curves or lane shifts that force a motorist to steer back and forth instead of traveling a straight path
- Also called deviations, serpentines, reversing curves, or twists

Applications:

- Appropriate for mid-block locations but can be an entire block if it is relatively short
- Most effective with equivalent low volumes on both approaches
- Appropriate speed limit is typically 35 mph or less
- Typically, a series of at least three landscaped curb extensions
- Can use alternating on-street parking from one side of a street to the other
- Applicable on one-lane one-way and two-lane two-way roadways
- Can be used with either open or closed (i.e. curb and gutter) cross-section
- Can be used with or without a bicycle facility



(Source: Delaware Department of Transportation)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:

- Chicanes may still permit speeding by drivers cutting straight paths across the center line
- Minimize relocation of drainage features
- May force bicyclists to share travel lanes with motor vehicles
- Maintain sufficient width for ease of emergency vehicles and truck throughput

Potential Impacts:

- No effect on access, although heavy trucks may experience challenges when negotiating
- Limited data available on impacts to speed and crash risk
- Street sweeping may need to be done manually
- Minimal anticipated volume diversion from street
- May require removal of some on-street parking
- Provides opportunity for landscaping
- Unlikely to require utility relocation
- Not a preferred crosswalk location
- Bus passengers may experience discomfort due to quick successive lateral movements

Emergency Response Issues:

- Appropriate along primary emergency vehicle routes

Typical Cost (2017 dollars):

- Reported costs range between $8,000 and $25,000

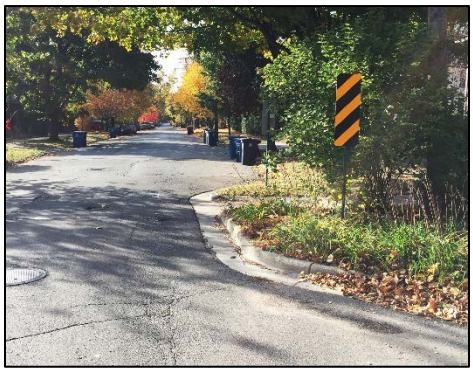
Choker

Description:

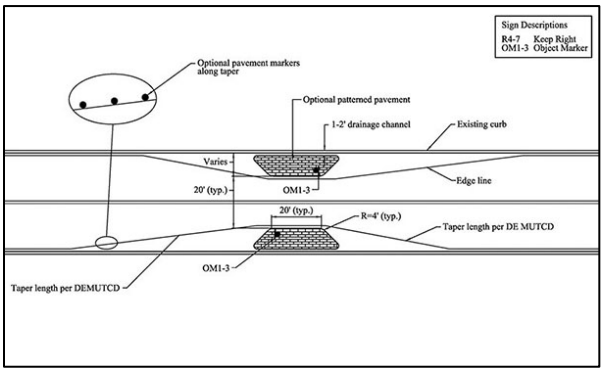
- Curb extension is a lateral horizontal extension of the sidewalk into the street, resulting in a narrower roadway section
- If located at an intersection, it is called a corner extension or a bulb-out
- If located midblock, it is referred to as a choker
- Narrowing of a roadway through the use of curb extensions or roadside islands

Applications:

- Can be created by a pair of curb extensions, often landscaped
- Encourages lower travel speeds by reducing motorist margin of error
- One-lane choker forces two-way traffic to take turns going through the pinch point
- If the pinch point is angled relative to the roadway, it is called an angled choker
- Can be located at any spacing desired
- May be suitable for a mid-block crosswalk
- Appropriate for arterials, collectors, or local streets



(Source: City of An Arbor, Michigan)



(Source: Delaware DOT)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:

- Only applicable for mid-block locations
- Can be used on a one-lane one-way and two-lane two-way street
- Most easily installed on a closed-section road (i.e. curb and gutter)
- Applicable with or without dedicated bicycle facilities
- Applicable on streets with, and can protect, on-street parking
- Appropriate for any speed limit
- Appropriate along bus routes
- Typical width of 6 to 8 feet; offset from through traffic by approximately 1.5 feet
- Locations near streetlights are preferable
- Length of choker island should be at least 20 feet

Potential Impacts:

- Encourages lower speeds by funneling it through the pinch point
- Can result in shorter pedestrian crossing distances if a mid-block crossing is provided
- May force bicyclists and motor vehicles to share the travel lane
- May require some parking removal
- May require relocation of drainage features and utilities

Emergency Response Issues:

- Retains sufficient width for ease of use for emergency vehicles

Typical Cost (2017 dollars):

- Between $1,500 and $20,000, depending on length and width of barriers

Closure

Description:

- **Half closures** are barriers that block travel in one direction (creates a one-way street) for a short distance on otherwise two-way streets; sometimes called partial closures or one-way closures
- **Full-street closures** are barriers placed across a street to completely close the street to through-traffic, usually leaving open space for pedestrians and bicyclists; they are sometimes called cul-de-sacs, dead-ends, or mini-parks

Applications:

- Appropriate for local streets (half and full), at intersection (half and full), or mid-block (full closure only)
- Typically applied only after other measures have failed or are deemed inappropriate or ineffective
- Typically found on closed-section roadways (i.e. curb and gutter)
- Can be applied with and without dedicated bicycle facilities and on roads with on-street parking
- Often used in sets to make travel through neighborhoods more circuitous
- Not appropriate along bus transit routes
- Can be used to assist crime prevention

(Source: James R. Barrera, Horrocks, New Mexico)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:

- Potential legal concerns
- Can be placed at intersections or mid-block locations
- Barriers may consist of landscaped islands, walls, gates, side-by-side bollards, or other obstructions that result in openings smaller than the width of a typical passenger car
- Appropriate signing needed at entrances to full-closure street blocks
- May require modifications to maintain surface drainage capacity
- Should consider traffic diversion patterns and associated impacts
- Possible to make diverters passable for pedestrians and bicyclists

Potential Impacts:

- Concerns regarding street network connectivity and capacity
- May result in traffic diverting to other local streets (should be used in groups/clusters)
- No significant impact on vehicle speeds beyond the closed block
- Can improve pedestrian crossing safety

Emergency Response Issues:

- Full or half closures can increase response times and should not be used on roads/streets that provide access to hospitals or emergency medical services; half closures allow for a higher degree of emergency vehicle access than full closures
- Both closure types can be designed to allow emergency vehicle access with removable, or breakaway delineators or bollards, gates, mountable curbs, etc.

Typical Cost (2017 dollars):

- **Full Closure** - <$10,000 for simple closures, to $100,000 for complex closures with drainage mods.
- **Half Closure** - $3,000 for simple closure, to $40,000 for complex closures with drainage mods.

Corner Extension/Bulb-Out

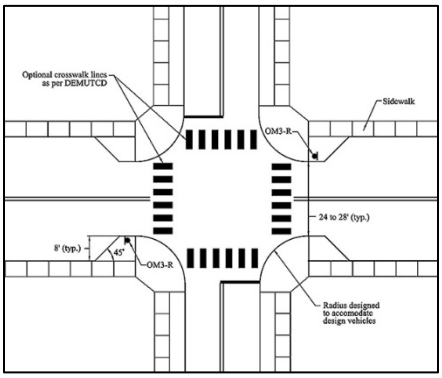
Description:

- Horizontal extension of the sidewalk into the street, resulting in a narrower roadway section
- If located at a mid-block location, it is typically called a choker

Applications:

- When combined with on-street parking, a corner extension can create protected parking bays
- Effective method for narrowing pedestrian crossing distances and increase pedestrian visibility
- Appropriate for arterials, collectors, or local streets
- Can be used on one-way and two-way streets
- Installed only on closed-section roads (i.e. curb and gutter)
- Appropriate for any speed, provided an adequate shy distance is provided between the extension and the travel lane
- Adequate turning radii must be provided to use on bus routes

(Source: James Barrera, Horrocks, New Mexico)



(Source: Delaware DOT)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:

- Effects on vehicle speeds are limited due to lack of deflection
- Must check drainage due to possible gutter realignment
- Major utility relocation may be required, especially drainage inlets
- Typical width between 6 and 8 feet
- Typical offset from travel lane at least 1.5 feet
- Should not extend into bicycle lanes

Potential Impacts:

- Effects on vehicle speeds are limited due to lack of deflection
- Can achieve greater speed reduction if combined with vertical deflection
- Smaller curb radii can slow turning vehicles
- Shorter pedestrian crossing distances can improve pedestrian safety
- More pedestrian waiting areas may become available
- May require some parking removal adjacent to intersections

Emergency Response Issues:

- Retains sufficient width for ease of emergency-vehicle access
- Shortened curb radii may require large turning vehicles to cross centerlines

Typical Cost (2017 dollars):

- Cost between $1,500 and $20,000, depending on length and width of barriers

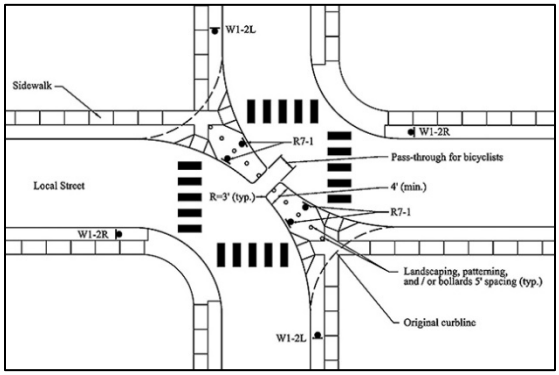
Diagonal Diverter

Description:

- Barriers placed diagonally across four-legged intersections, blocking through movements
- Sometimes called full diverters or diagonal road closures

Applications:

- Typically applied only after other measures are deemed ineffective or inappropriate
- Provisions are available to make diverters passable for pedestrians and bicyclists
- Often used in sets to make travel through neighborhoods more circuitous



(Source: Delaware Department of Transportation)

(Source: PennDOT Local Technical Assistance Program)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:

- Possible legal issues associated with closing public streets (e.g., business and/or emergency access)
- Can only be placed at intersections
- Can be used on both one-way and two-way streets
- Typically found on closed-section roads (i.e. curb and gutter)
- Typical maximum appropriate speed limit is 25 mph
- Maintain drainage as necessary to mitigate potential flooding
- Corner radii should be designed to allow full-lane width for passing motor vehicle traffic
- SU-30 default design vehicle
- Appropriate signing and pavement markings needed on approaches
- Openings for pedestrians and bicyclists should allow movement between all intersection legs
- Barriers may consist of landscaped islands, walls, gates, side-by-side bollards, or any other obstruction that leave an opening smaller than the width of a typical passenger car

Potential Impacts:

- Concern regarding impacts to emergency response, street network connectivity, and capacity
- Should consider traffic diversion patterns and associated impacts
- No significant impacts on vehicle speeds beyond the approach to the diverter
- Not appropriate for bus transit routes
- Improved pedestrian and bicycle safety

Emergency Response Issues:

- Should not be used on roads that provide access to hospitals or primary emergency services
- Restricts emergency vehicle access through intersections
- Can be designed to allow emergency vehicle access with removable, or breakaway delineators or bollards, gates, mountable curbs, etc.

Typical Cost (2017 dollars):

- Typical cost of $6,000 for diverter with limited drainage modifications

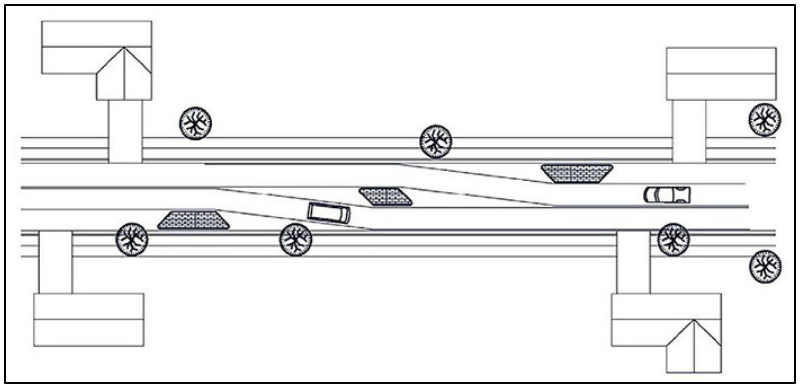
Lateral Shift

Description:

- Realignment of an otherwise straight street that causes travel lanes to shift in at least one direction
- A chicane is a variation of a lateral shift that shifts alignments more than once

Applications:

- Appropriate for local, collector, or arterial roadways
- Appropriate for one-lane one-way and two-lane two-way streets
- Appropriate on roads with or without dedicated bicycle facilities
- Maximum appropriate speed limit is typically 35 mph
- Appropriate along bus transit routes



(Source: Delaware Department of Transportation)

(Source: Google Street View)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:

- Typically separates opposing traffic through the shift with the aid of a raised median
- Applicable only to mid-block locations
- Can be installed on either open- or closed-section (i.e. curb and gutter) roads
- Location near streetlights preferred
- May require drainage feature relocation
- Should not require utility relocation

Potential Impacts:

- Without islands, motorists could cross the centerline to drive the straightest path possible
- No impact on access
- May require removal of some on-street parking
- Limited data available on impacts on speed, volume diversions, and crash risk
- Provides opportunities for landscaping
- Can provide locations for pedestrian crosswalks

Emergency Response Issues:

- Appropriate along primary emergency vehicle routes or on streets with access to hospitals/emergency medical services, provided vehicles can straddle the street centerline

Typical Cost (2017 dollars):

- Reported costs range between $8,000 and $25,000

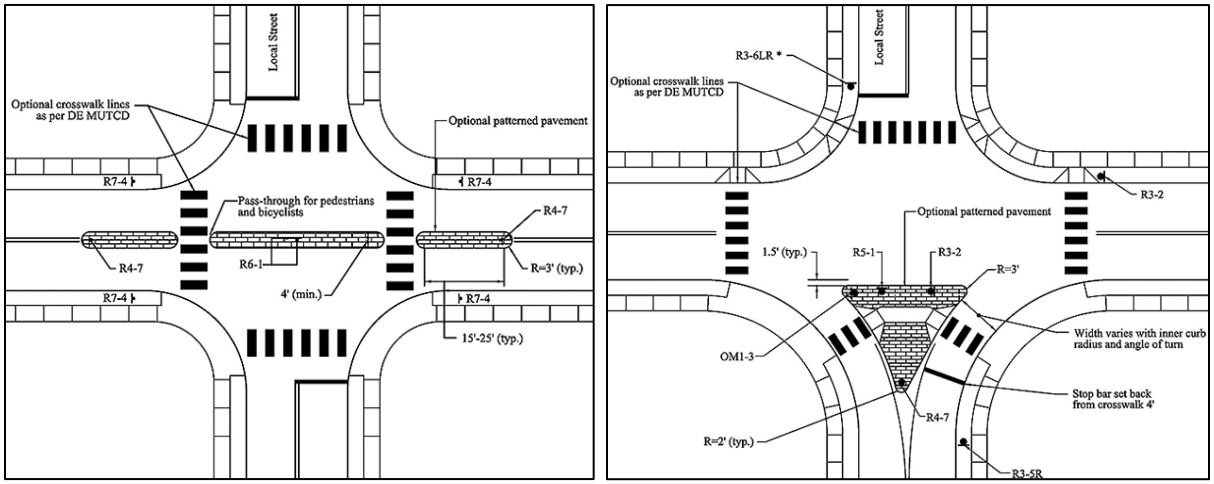
Median Barrier/Forced Turn Island

Description:

- Raised islands along the centerline of a street and continuing through an intersection that block the left-turn movement from all intersection approaches and the through movement from the cross street; also called median diverter, intersection barrier, intersection diverter, and island diverter
- Raised island that forces a right turn is called a forced turn island

Applications:

- For use on arterial or collector roadways to restrict access to minor roads or local streets and/or to narrow lane widths
- Typically applied only after other measures have failed or been deemed inappropriate/ineffective
- Barriers are made passable for pedestrians and bicyclists
- Often used in sets to make travel to/through neighborhoods more circuitous



(Source: Delaware Department of Transportation)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:

- Potential legal issues associated with blocking a public street (e.g., business/emergency access)
- Placed on major roads on approaches to and across intersections with minor roads
- Should extend beyond the intersection to discourage improper/illegal turn movements
- Barriers may consist of landscaped islands, mountable features, walls, gates, side-by-side bollards, or any other obstruction that leave an opening smaller than the width of a passenger car

Potential Impacts:

- May divert traffic volumes to other parallel and/or crossing streets
- May require removal or shortening of on-street parking zones on approaches/departures
- May impact access to properties adjacent to intersection
- No significant impacts on vehicle speeds beyond the approaches to intersection

Emergency Response Issues:

- Restricts emergency vehicle access using minor street
- Can be designed to allow emergency vehicle access

Typical Cost (2017 dollars):

- Cost between $1,500 and $20,000, depending on length and width of barriers

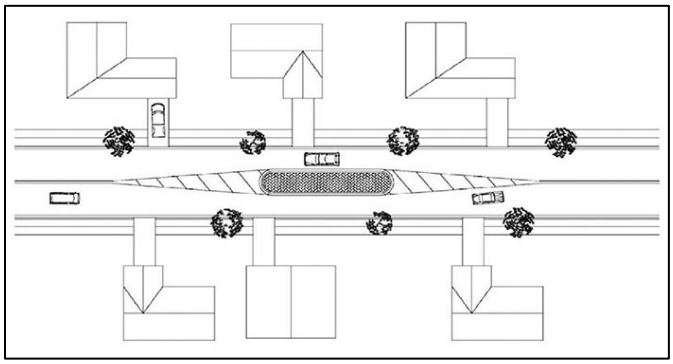
Median Island

Description:

- Raised island located along the street centerline that narrows the travel lanes at that location
- Also called median diverter, intersection barrier, intersection diverter, and island diverter

Applications:

- For use on arterial, collector, or local roads
- Can often double as a pedestrian/bicycle refuge islands if a cut in the island is provided along a marked crosswalk, bike facility, or shared-use trail crossing
- If placed through an intersection, considered a median barrier



(Source: Delaware Department of Transportation)

(Source: James Barrera, Horrocks, New Mexico)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:

- Potential legal issues associated with blocking a public street (e.g., business or emergency access)
- Barriers may consist of landscaped islands, mountable facilities, walls, gates, side-by-side bollards, or any other obstruction that leave an opening smaller than the width of a passenger car
- Can be placed mid-block or on the approach to an intersection
- Typically installed on a closed-section roadway (i.e. curb and gutter)
- Can be applied on roads with or without sidewalks and/or dedicated bicycle facilities
- Maximum appropriate speed limits vary by locale
- Typically not appropriate near sites that attract large combination trucks

Potential Impacts:

- May impact access to properties adjacent to islands
- No significant impact on vehicle speeds beyond the island
- Little impact on traffic volume diversion
- Safety can be improved without substantially increasing delay
- Shortens pedestrian crossing distances
- Bicyclists may have to share vehicular travel lanes near the island
- May require removal of some on-street parking
- May require relocation of drainage features and utilities

Emergency Response Issues:

- Appropriate along primary emergency vehicle roads or street that provides access to hospitals/emergency medical services

Typical Cost (2017 dollars):

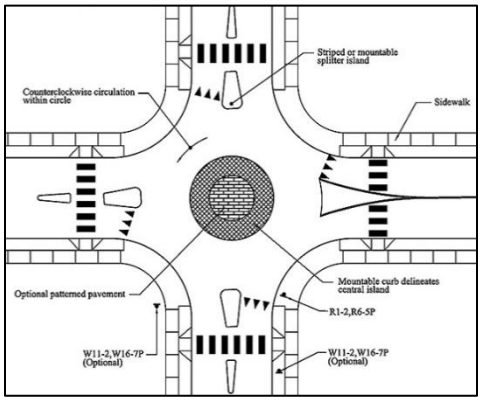
- Cost between $1,500 and $10,000, depending on length and width of island

Traffic Calming Fact Sheets
March 2019 Update

Mini Roundabout

Description:
- Raised islands, placed in unsignalized intersections, around which traffic circulates
- Motorists yield to motorists already in the intersection
- Require drivers to slow to a speed that allows them to comfortably maneuver around them
- Center island of mini roundabout is fully traversable, splitter islands may be fully traversable

Applications:
- Intersections of local and/or collector streets
- One lane each direction entering intersection
- Not typically used at intersections with high volume of large trucks or buses turning left
- Appropriate for low-speed settings



(Source: Delaware DOT)


(Source: Gary Schatz)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation:
- See NCHRP Report 672 for design details
- Typically circular in shape, but may be an oval shape
- Controlled by YIELD signs on all approaches with pedestrian crosswalks, if included, one car-length upstream of YIELD bar
- Preferable for roadway to have urban cross section (i.e., curb and gutter)
- Can be applied to road with on-street parking
- Can be applied to roads both with and without a bicycle facility. Bicycle facilities, if provided, must be separated from the circulatory roadway with physical barriers; cyclists using the circulatory roadway must merge with vehicles. Bicycle facilities are prohibited in the circulatory roadway to prevent right-hook crashes.
- Key design features are the fastest paths and path alignment.

Potential Impacts:
- Slight speed reduction
- Little diversion of traffic
- Bicycle and motorist will share lanes at intersections because of narrowed roadway
- Large vehicles/buses usually drive over the center island for left turns

Emergency Response:
- Emergency vehicles maneuver using the center island at slow speeds

Typical Cost
- Cost is similar to bulb-outs because pedestrian ramps and outside curb lines usually have to be relocated

On-Street Parking

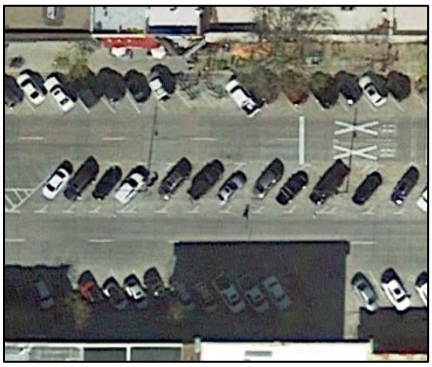
Description:

- Allocation of paved space to parking
- Narrows road travel lanes and increases side friction to traffic flow
- Can apply on one or both sides of roadway
- Can be either parallel or angled, but parallel is generally preferred for maximized speed reduction

Applications:

- High likelihood of acceptability for nearly all roadway functional classifications and street functions
- More appropriate in urban or suburban settings
- Can be combined with other traffic calming measures
- Can apply alternating sides of street for chicane effect
- Can combine with curb extensions for protected parking, including landscaping for beautification
- Can apply using time-of-day restrictions to maximize throughput during peak periods
- Can be used on one-way or two-way streets
- Preferable to have a closed-section road (i.e. curb and gutter)
- Appropriate along bus transit routes

(Source: PennDOT Local Technical Assistance Program)



(Source: Google Earth, Fort Collins, CO)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:

- Appropriate distance needed between travel lane and parking lane
- Impact is directly affected by demand; must have parked vehicles present to be effective
- If used for chicane effect, must verify parking demand to ensure that majority of spaces are occupied when effect is desired most during the day; can use parallel, angled, or combination
- Should not be considered near traffic circles nor roundabouts
- Should not be applied along median island curbs
- For lower-demand locations, can counteract negligible impact with curb extensions or other road-narrowing features

Potential Impacts:

- Can be blocked in by snow during plowing operations; required vehicle removal
- May limit road user visibility and sight distance at driveways/alleys/intersections
- Can put bicyclists at risk of colliding with car doors
- May be impacted if other traffic calming measures are considered or implemented
- Provides buffer between moving vehicles and pedestrian facilities

Emergency Response Issues:

- Preferred by emergency responders to most other traffic calming measures
- Requires consideration of design of parking lanes near hydrants and other emergency features

Typical Cost (2017 dollars):

- Approximately $6000 or less (factor of design specifics and length of application); can be much higher

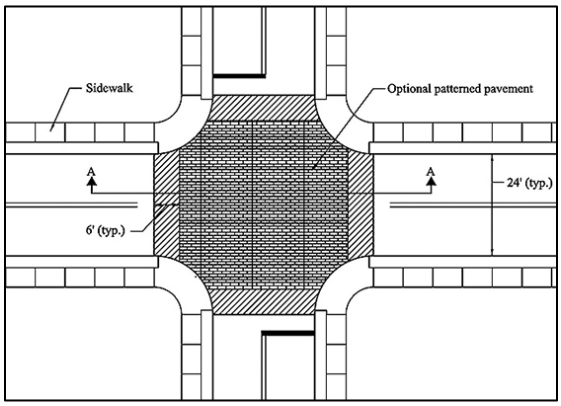
Raised Intersection

Description:

- Flat raised areas covering entire intersections, with ramps on all approaches and often with brick or other textured materials on the flat section and ramps
- Sometimes referred to as raised junctions, intersection humps, or plateaus

Applications:

- Intersections of collector, local, and residential streets
- Typically installed at signalized or all-way stop controlled intersections with high pedestrian crossing demand
- Works well with curb extensions and textured crosswalks
- Often part of an area-wide traffic calming scheme involving both intersecting streets in densely-developed urban areas



(Source: Delaware Department of Transportation)

(Source: Chuck Huffine, Phoenix AZ)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:

- Used at intersections with a maximum speed limit of 35 mph
- Typically rise to sidewalk level; appropriate if crosswalks exist on all four legs
- Appropriate if a dedicated bicycle facility passes through the intersection
- Detectable warnings and/or color contrasts must be incorporated to differentiate the roadway and the sidewalk
- May require bollards to define edge of roadway
- Storm drainage/underground utility modifications are likely necessary
- Minimum pavement slope of 1 percent to facilitate drainage

Potential Impacts:

- Reduction in through movement speeds likely at intersection
- Reduction in mid-block speeds typically less than 10 percent
- No impact on access
- Can make entire intersections more pedestrian-friendly
- No data available on volume diversion or safety impacts

Emergency Response Issues:

- Slows emergency vehicles
- Appropriate for primary emergency vehicle routes and streets with access to a hospital or emergency medical services

Typical Cost (2017 dollars):

- Costs range between $15,000 and $60,000

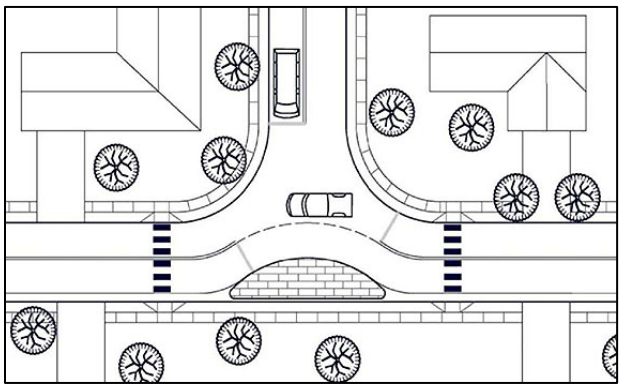
Realigned Intersection

Description:

- Reconfiguration of an intersection with perpendicular angles to have skewed approaches or travel paths through the intersection
- Also called modified intersection

Applications:

- Appropriate for collector or local streets
- Most applicable at T-intersections
- Can be used where on-street parking exists
- Applicable on one-way and two-way roadways
- Most commonly installed on closed-section roads (i.e. curb and gutter)
- Can be applied with and without a dedicated bicycle facility
- Can be applied with or without on-street parking



(Source: Delaware Department of Transportation)

(Source: Delaware DOT)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:

- Need to avoid relocating drainage features such as catch basins, concrete channels, valley gutters, inlets, and trench drains
- Bicyclists and motorists may have separate lanes or may share lanes at intersections
- Be cognizant of pedestrian crossing needs (e.g., ADA, wheelchair ramps at T-intersections)
- Default design vehicle SU-30
- Typical maximum speed limit of 25 mph
- May be appropriate for buses if adequate turning radii can be provided

Potential Impacts:

- Limited-to-no impact on access
- Minimal anticipated diversion of traffic
- Can result in speed reductions between 5 and 13 mph within intersection limits
- Provides opportunity for landscaping
- Can improve pedestrian safety
- Consider additional intersection lighting

Emergency Response Issues:

- Appropriate along an emergency vehicle route or on a street with access to hospital/emergency medical services
- Little impact on response time

Typical Cost (2017 dollars):

- Costs range between $15,000 and $60,000

Traffic Calming Fact Sheets
March 2019 Update

Roundabout

Description:
- Raised islands placed in unsignalized intersections around which traffic circulates
- Approaching motorists yield to motorists already in the intersection
- Requires drivers to slow to a speed that allows them to comfortably maneuver around them
- Different from traffic circles or mini-roundabouts; possible substitute for traffic signal control

Applications:
- Intersections of arterial and/or collector streets
- One or more entering lanes
- Can be used at intersections with high volumes of large trucks and buses, depending on design


(Source: Grant Kaye)


(Source: PennDOT Local Technical Assistance Program)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation:
- See NCHRP Report 672 for design details
- Design vehicle is determined specifically for each site ranging from emergency vehicles to over size/overweight vehicles
- Typically circular in shape but may be an oval shape
- Key physical elements are center islands, truck aprons, and splitter islands
- Controlled by YIELD signs on all approaches with pedestrian crosswalks, if included, one car-length upstream of YIELD bar
- Key design features include: fastest paths, swept paths, and path alignment
- Large vehicles circulating around the center island for all movements may traverse the apron
- Landscaping needs to be designed to allow adequate sight distance per NCHRP 672
- Preferable to have a closed-section road (i.e. curb and gutter)
- Bicycle facilities, if provided, must be separate from the circulatory roadway with physical barriers; cyclists using the circulatory roadway must merge with vehicles. Bicycle facilities are prohibited in the circulatory roadway to prevent right-hook crashes.

Potential Impacts:
- Limited impact on access, except for access points immediately adjacent to intersection
- Limited impact on roadways with on-street parking
- May draw additional traffic but with reduced delays and queues

Emergency Response:
- Appropriate for emergency vehicle routes or streets that provide access to hospitals
- Emergency vehicles may traverse the apron

Typical Cost
- Cost varies widely by site, but is usually comparable to a traffic signal

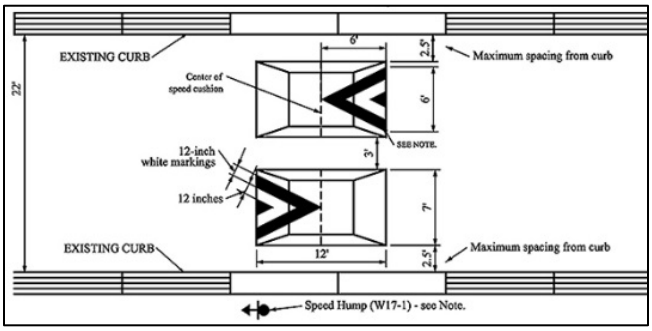
Traffic Calming Fact Sheets
May 2018 Update

Speed Cushion

Description:
- Two or more raised areas placed laterally across a roadway with gaps between raised areas
- Height and length similar to a speed hump; spacing of gaps allow emergency vehicles to pass through at higher speeds
- Often placed in a series (typically spaced 260 to 500 feet apart)
- Sometimes called speed lump, speed slot, and speed pillow

Applications:
- Appropriate on local and collector streets
- Appropriate at mid-block locations only
- Not appropriate on grades greater than 8 percent

(Source: James Barrera, Horrocks, New Mexico)



(Source: Delaware Department of Transportation)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:
- Two or more cushions at each location
- Typically 12 to 14 feet in length and 7 feet in width
- Cushion heights range between 3 and 4 inches, with trend toward 3 - 3 ½ inches maximum
- Speed cushion shapes include parabolic, circular, and sinusoidal
- Material can be asphalt or rubber
- Often have associated signing (advance-warning sign before first cushion at each cushion)
- Typically have pavement markings (zigzag, shark's tooth, chevron, zebra)
- Some have speed advisories

Potential Impacts:
- Limited-to-no impact on non-emergency access
- Speeds determined by height and spacing; speed reductions between cushions have been observed averaging 20 and 25 percent
- Speeds typically increase by 0.5 mph midway between cushions for each 100 feet of separation
- Studies indicate that average traffic volumes have reduced by 20 percent depending on alternative routes available
- Average collision rates have been reduced by 13 percent on treated streets

Emergency Response Issues:
- Speed cushions have minimal impact on emergency response times, with less than a 1 second delay experienced by most emergency vehicles

Typical Cost (2017 dollars):
- Cost ranges between $3,000 and $4,000 for a set of rubber cushions

Traffic Calming Fact Sheets
May 2018 Update

Speed Hump

Description:
- Rounded (vertically along travel path) raised areas of pavement typically 12 to 14 feet in length
- Often placed in a series (typically spaced 260 to 500 feet apart)
- Sometimes called road humps or undulations

Applications:
- Appropriate for residential local streets and residential/neighborhood collectors
- Not typically used on major roads, bus routes, or primary emergency response routes
- Not appropriate for roads with 85th-percentile speeds of 45 mph or more
- Appropriate for mid-block placement, not at intersections
- Not recommended on grades greater than 8 percent
- Work well in combination with curb extensions
- Can be used on a one-lane one-way or two-lane two-way street

(Source: City of Boulder, Colorado)

(Source: PennDOT Local Technical Assistance Program)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:
- ITE recommended practice - "Guidelines for the Design and Application of Speed Humps"
- Typically 12 to 14 feet in length; other lengths (10, 22, and 30 feet) reported in practice in U.S.
- Speed hump shapes include parabolic, circular, and sinusoidal
- Typically spaced no more than 500 feet apart to achieve an 85th percentile speed between 25 and 35 mph
- Hump heights range between 3 and 4 inches, with trend toward 3 - 3 ½ inches maximum
- Often have associated signing (advance warning sign before first hump in series at each hump)
- Typically have pavement markings (zigzag, shark's tooth, chevron, zebra)
- Taper edge near curb to allow gap for drainage
- Some have speed advisories
- Need to design for drainage, without encouraging means for motorists to go around a hump

Potential Impacts:
- No impact on non-emergency access
- Average speeds between humps reduced between 20 and 25 percent
- Speeds typically increase approximately 0.5 to 1 mph midway between humps for each 100 feet Beyond the 200-foot approach and exit of consecutive humps
- Traffic volumes diversion estimated around 20 percent; average crash rates reduced by 13 percent

Emergency Response Issues:
- Impacts to ease of emergency-vehicle throughput
- Approximate delay between 3 and 5 seconds per hump for fire trucks and up to 10 seconds for ambulances with patients

Typical Cost (2017 dollars):
- Cost ranges between $2,000 and $4,000

Speed Table/Raised Crosswalks

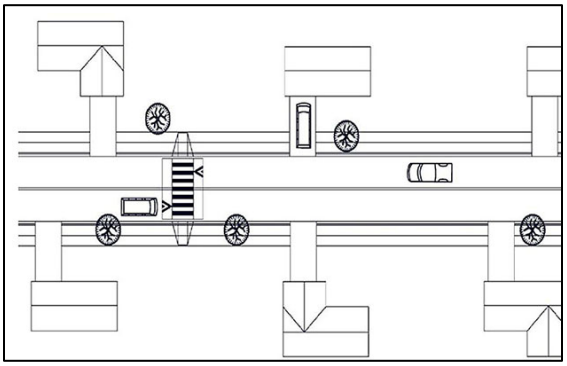
Description:

- Long, raised speed humps with a flat section in the middle and ramps on the ends; sometimes constructed with brick or other textured materials on the flat section
- If placed at a pedestrian crossing, it is referred to as a raised crosswalk
- If placed only in one direction on a road, it is called an offset speed table

Applications:

- Appropriate for local and collector streets; mid-block or at intersections, with/without crosswalks
- Can be used on a one-lane one-way or two-lane two-way street
- Not appropriate for roads with 85th percentile speeds of 45 mph or more
- Typically long enough for the entire wheelbase of a passenger car to rest on top or within limits of ramps
- Work well in combination with textured crosswalks, curb extensions, and curb radius reductions
- Can be applied both with and without sidewalks or dedicated bicycle facilities
- Typically installed along closed-section roads (i.e. curb and gutter) but feasible on open section

(Source: Google Maps, Boulder, Colorado)



(Source: Delaware Department of Transportation)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:

- ITE recommended practice – "Guidelines for the Design and Application of Speed Humps"
- Most common height is between 3 and 4 inches (reported as high as 6 inches)
- Ramps are typically 6 feet long (reported up to 10 feet long) and are either parabolic or linear
- Careful design is needed for drainage
- Posted speed typically 30 mph or less

Potential Impacts:

- No impact on non-emergency access
- Speeds reductions typically less than for speed humps (typical traversing speeds between 25 and 27 miles per hour)
- Speeds typically decline approximately 0.5 to 1 mph midway between tables for each 100 feet beyond the 200-foot approach and exit points of consecutive speed tables
- Average traffic volumes diversions of 20 percent when a series of speed tables are implemented
- Average crash rate reduction of 45 percent on treated streets
- Increase pedestrian visibility and likelihood of driver yield compliance
- Generally not appropriate for BRT bus routes

Emergency Response Issues:

- Typically preferred by fire departments over speed humps, but not appropriate for primary emergency vehicle routes; typically less than 3 seconds of delay per table for fire trucks

Typical Cost (2017 dollars):

- Cost ranges between $2,500 and $8,000 for asphalt tables; higher for brickwork, stamped asphalt, concrete ramps, and other enhancements sometimes used at pedestrian crossings

Traffic Circle

Description:

- Raised islands placed in unsignalized intersections around which traffic circulates
- Approaching motorists yield to motorists already in the intersection
- Require drivers to slow to a speed that allows them to comfortably maneuver around them
- Approaches not designed to modern roundabout principals - no deflection

Applications:

- Appropriate at intersections of local streets
- One lane each direction entering intersection
- Not typically used at intersections with high volumes of large trucks or buses turning left
- appropriate for both one-way and two-way streets in urban and suburban settings

(Source: Scott Batson)

(Source: Scott Batson)

ITE/FHWA Traffic Calming EPrimer: https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm

Design/Installation Issues:

- Typically circular in shape but may be an oval shape
- Usually have landscaped center islands
- Recommend YIELD signs on all approaches
- Preferable for roadways to be closed-section (i.e. curb and gutter)
- Can be applied to roads with on-street parking
- Can be applied to roads both with and without dedicated bicycle facilities; bike lanes not striped in circulatory roadway
- Key design features include: offset distance (distance between projection of street curb and center island), lane width of circulatory roadway, circle diameter, and height of mountable apron for large vehicles

Potential Impacts:

- Minimal anticipated traffic diversion
- Bicyclist and motorists will share lanes at intersections because of narrowed roadway
- Large vehicles/buses usually not able to circulate around center island for left turns
- Landscaping needs to be designed to allow adequate sight distance, per AASHTO
- Minimize routing of vehicles through unmarked crosswalks on side-streets
- May require additional street lighting

Emergency Response Issues:

- Emergency vehicles maneuver intersections at slow speeds
- Constrained turning radii typically necessitates a left turn in front of the circle for large vehicles

Typical Cost (2017 dollars):

- Typical cost is $15,000, with a range between $10,000 and $25,000

U.S. Department of Transportation
Federal Highway Administration

Rectangular Rapid Flashing Beacons (RRFB)

A marked crosswalk or pedestrian warning sign can improve safety for pedestrians crossing the road, but at times may not be sufficient for drivers to visibly locate crossing locations and yield to pedestrians. To enhance pedestrian conspicuity and increase driver awareness at uncontrolled, marked crosswalks, transportation agencies can install a pedestrian actuated Rectangular Rapid Flashing Beacon (RRFB) to accompany a pedestrian warning sign. RRFBs consist of two, rectangular- shaped yellow indications, each with a light-emitting diode (LED)-array-based light source.[1] RRFBs flash with an alternating high frequency when activated to enhance conspicuity of pedestrians at the crossing to drivers.

For more information on using RRFBs, see the Interim Approval in the *Manual on Uniform Traffic Control Devices (MUTCD)*.[1]

Safety Benefits:

RRFBs can reduce crashes up to:

47%

for pedestrian crashes.[4]

RRFBs can increase motorist yielding rates up to:

98%

(varies by speed limit, number of lanes, crossing distance, and time of day).[3]

RRFBs used at a trail crossing.
Source: LJB

Applications

The RRFB is applicable to many types of pedestrian crossings but is particularly effective at multilane crossings with speed limits less than 40 miles per hour.[2] Research suggests RRFBs can result in motorist yielding rates as high at 98 percent at marked crosswalks, but varies depending on the location, posted speed limit, pedestrian crossing distance, one- versus two-way road, and the number of travel lanes.[3] RRFBs can also accompany school or trail crossing warning signs.

RRFBs are placed on both sides of a crosswalk below the pedestrian crossing sign and above the diagonal downward arrow plaque pointing at the crossing.[1] The flashing pattern can be activated with pushbuttons or passive (e.g., video or infrared) pedestrian detection, and should be unlit when not activated.

Considerations

Agencies should:[2]

- Install RRFBs in the median rather than the far-side of the roadway if there is a pedestrian refuge or other type of median.
- Use solar-power panels to eliminate the need for a power source.
- Reserve the use of RRFBs for locations with significant pedestrian safety issues, as over-use of RRFB treatments may diminish their effectiveness.

Agencies shall not:[2]

- Use RRFBs without the presence of a pedestrian, school or trail crossing warning sign.
- Use RRFBs for crosswalks across approaches controlled by YIELD signs, STOP signs, traffic control signals, or pedestrian hybrid beacons, except for the approach or egress from a roundabout.

For more information on this and other FHWA Proven Safety Countermeasures, please visit https://highways.dot.gov/safety/proven-safety-countermeasures and https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/techSheet_RRFB_2018.pdf.

FHWA-SA-21-053

1 *MUTCD* Interim Approval 21 - RRFBs at Crosswalks.
2 "Rectangular Rapid Flash Beacon" in PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System. FHWA, (2013).
3 Fitzpatrick et al. "Will You Stop for Me? Roadway Design and Traffic Control Device Influences on Drivers Yielding to Pedestrians in a Crosswalk with a Rectangular Rapid-Flashing Beacon." Report No. TTI-CTS-0010. Texas A&M Transportation Institute, (2016).
4 (CMF ID: 9024) NCHRP Research Report 841 Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments, (2017).