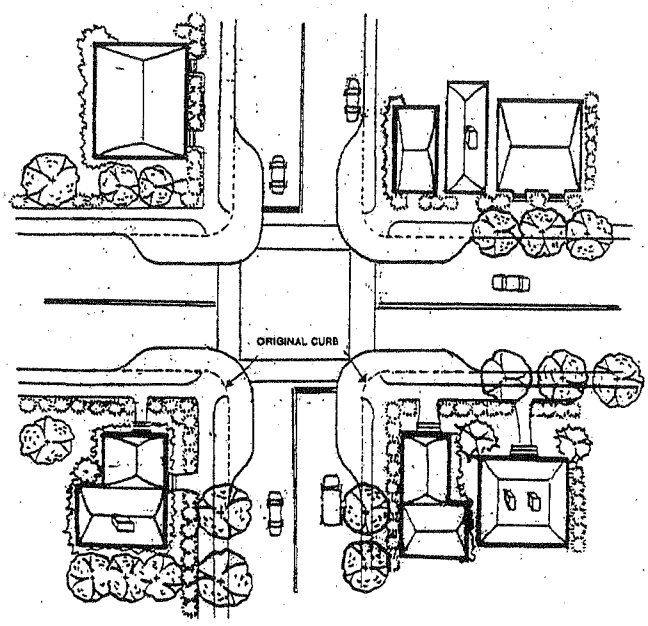
CURB EXTENSIONS / BULB-OUTS

Description:
Curb extensions, sometimes referred to as bulb-outs, are areas of expanded curbing.

Appropriate Locations:
- Appropriate for all street classifications: local roads, collectors, and arterials.
  - Many jurisdictions extend the curb only 6 feet from the existing curb, which protects parked vehicles, improves pedestrian visibility, and minimizes crossing distance, but does not typically affect the speed of motorists. For extensions that do not result in narrowing of the travel lanes, usage on streets of up to 15,000 ADT with posted speeds up to 40 mph is appropriate.
- Works well in downtown areas.
- Primarily used at intersections.
- Can be used at mid-block locations with significant pedestrian activity, school children, or senior citizens. Mid-block curb extensions may also be used to address speeding on streets where speed humps are not permitted.



N.T.S.

Typical Uses:
- Reduce the crossing distance for pedestrians.
- Improve the line-of-sight for pedestrians.
- Make pedestrians more visible to oncoming traffic.
- Slow traffic by funneling it through a narrower street opening.
- Slow vehicles making a right turn by reducing the curb radius.

Speed/Volume Reductions:
- Most curb extensions result in speed reductions of 1-2 mph.
- Potential to reduce speeds by up to 5 mph when significantly narrowing the travel lanes. For example, some jurisdictions use extensions to briefly narrow two travel lanes to a total width of 18 feet. (This width is not recommended for arterials or high-volume collectors.)

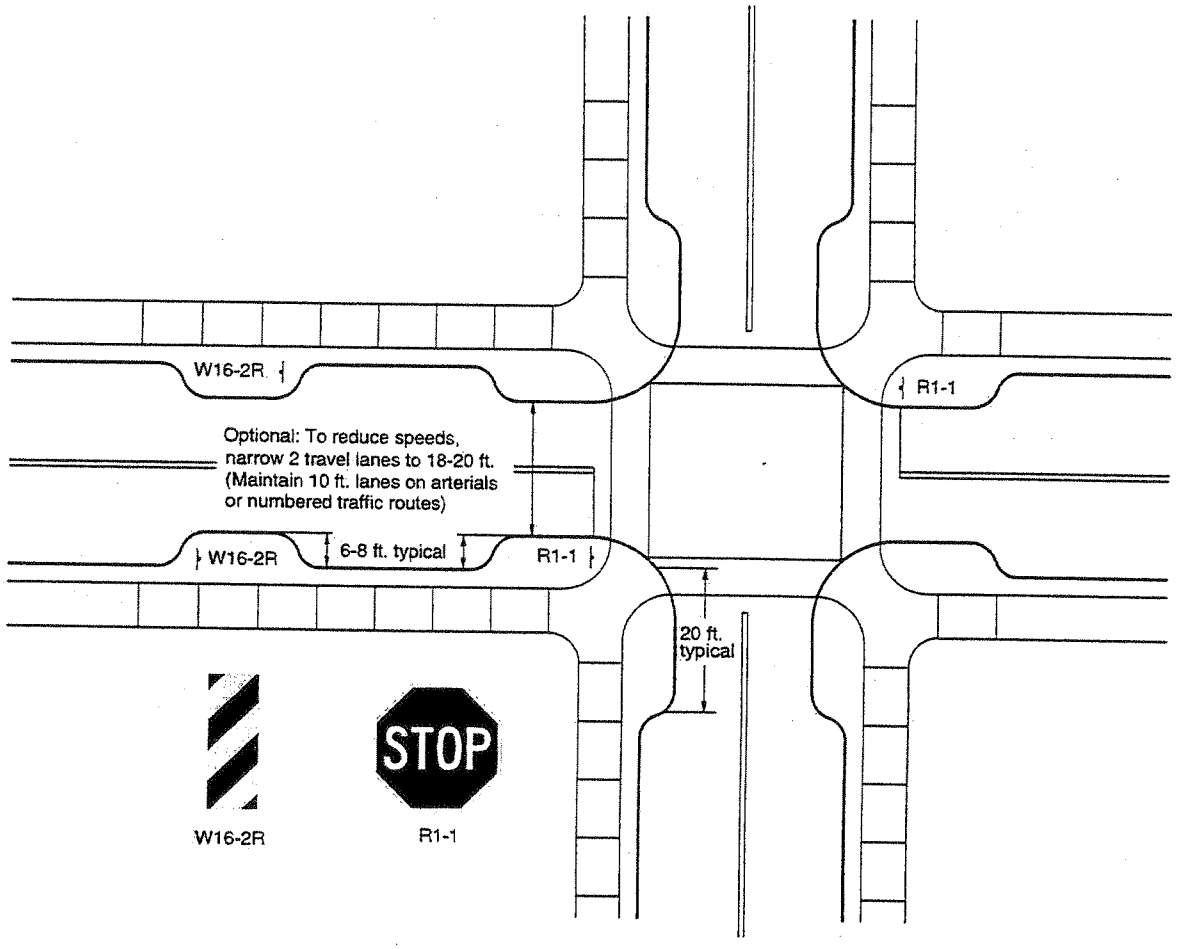
Approximate Cost:
- Each pair may cost $7,000 to $10,000. Mid-block measures may cost less ($4,000) if they are smaller.

Signing and Markings:
- Signing or pavement markings may be needed, especially when installed at a mid-block location.

Other Considerations:

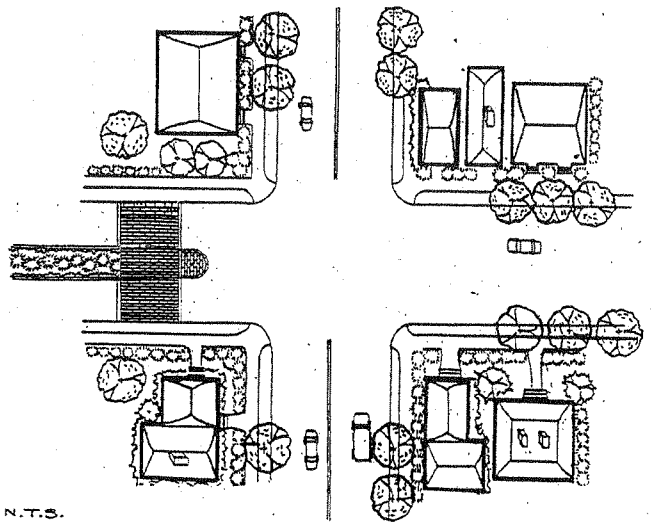
- Impact on roadway drainage must be addressed. Drainage may be provided by devices such as catch basins, concrete channels, valley gutters, inlets, and trench drains. Ponding on the sidewalk may also occur if the measure is not properly designed.
- Vertical curb is recommended, but mountable curb can be used if necessary to accommodate turning trucks and buses.
- Mid-block curb extensions should be combined with crosswalks whenever possible.
- Provisions should be made for snow and ice removal.

Advantages:	**Disadvantages:**
❑ Improve pedestrian safety. ❑ May reduce travel speed. ❑ May slow right-turning vehicles. ❑ Prevent illegal parking close to intersections. ❑ Facilitate pedestrian access directly to transit vehicles without entering street. ❑ Can improve neighborhood appearance with landscaping and/or textured treatments.	❑ Can result in loss of one on-street parking space on each side of the road, though at intersections this is unlikely given statutory prohibitions of parking close to intersections. ❑ May prevent right turns at intersection when another vehicle is stopped at the stop line. ❑ May make it difficult to accommodate full bicycle lanes.



GATEWAYS

Description:
Gateways are special entrance treatments that provide identity to a neighborhood by using a combination of physical and textural changes.



Appropriate Locations:
- Local roads only.
- Entrance to a residential community.

Speed/Volume Reductions:
- May reduce entry speed, depending on the inclusion of other measures such as bulb-outs and planted median islands.

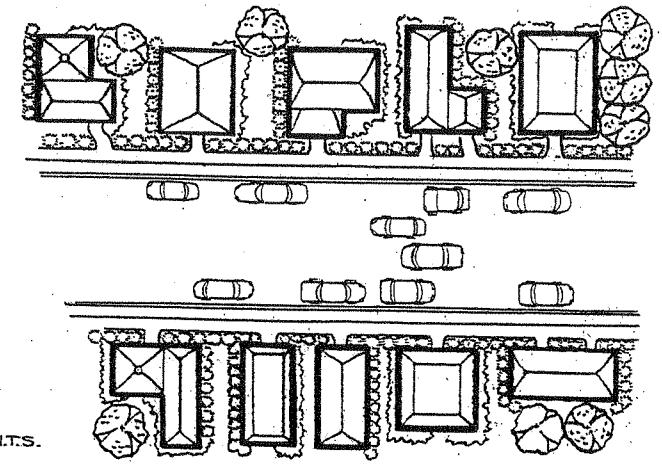
Approximate Cost:
- Cost varies widely ($5,000 to $20,000) depending on the design and extent of physical elements used.

Other Considerations:
- Entrance treatments alone (landscaping, signing, pavement treatments) do not reduce speeds or total volumes, unless combined with other physical measures. They are, however, thought to increase driver awareness of the environment in which they are driving.
- A number of traffic calming measures such as bulb-outs at the intersection, textured pavement treatments, and median islands may be included in a gateway design. The exact configuration of a gateway will vary based on the location of the gateway, available funding, and any conflicts such as driveways.
- Landscaped median islands may be added at the intersection to slow turning movements and visually enhance the street.
- Provisions should be made for snow and ice removal.

Advantages:	**Disadvantages:**
❑ Help identify neighborhood. ❑ Create added streetscape area for landscaping. ❑ Can discourage truck entry, depending on the extent of narrowing and inclusion of median islands at the intersection. ❑ Emphasize a change in environment from an arterial to a residential street.	❑ If textured pavements are used, some noise will result.

ON-STREET PARKING

Description:
Parking on one or both sides of the roadway which has the effect of reducing the roadway width. By law, on-street parking is permitted unless otherwise prohibited.


N.T.S.

Appropriate Locations:
- On-street parking may be appropriate for all classifications of streets.

Typical Uses:
- Reduce vehicle speeds by reducing the effective width of the roadway.

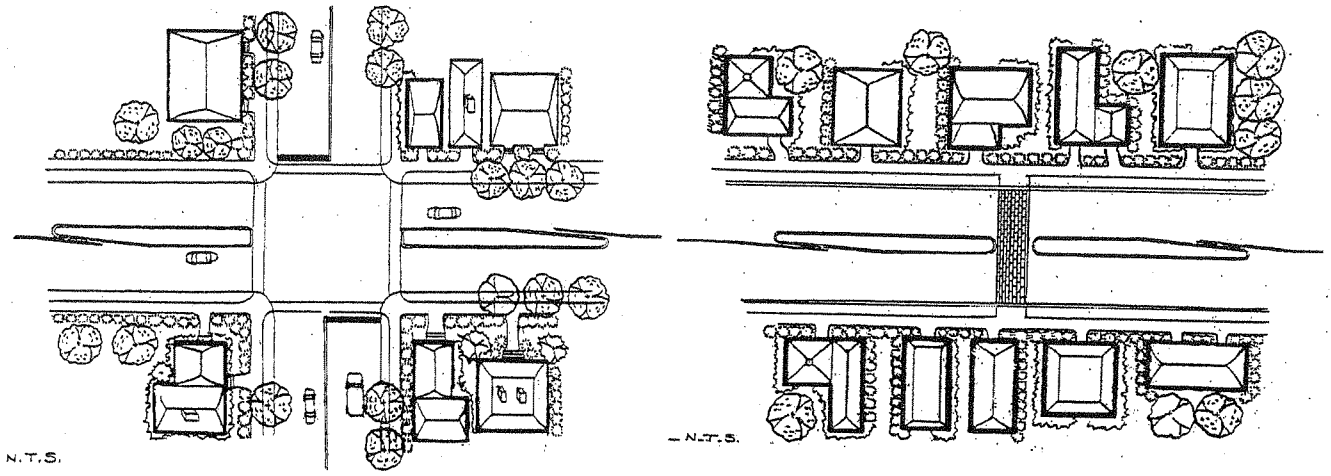
Speed/Volume Reductions:
- The most pronounced effect on speed occurs on narrow two-way streets with parking on both sides. If parking is sufficiently occupied, and street width is less than 30 feet, there is a "chicane" effect as vehicles may occasionally have to pull over to permit opposing vehicles to pass. Creating this chicane effect is appropriate only on local streets. Even for streets wider than 30 feet, on-street parking may serve to reduce speeds slightly by narrowing the effective roadway width.

Approximate Cost:
- If landscaped islands are created to protect parking, the cost can reach $5,000 or more per island.

Other Considerations:
- On-street parking can be protected by a landscaped island that projects out from the curb.
- Angle parking has the potential to cause more crashes than parallel parking, and is generally not recommended to achieve speed reduction.
- If half or more of the block face is not parked out, on-street parking is not likely to result in reduced travel speeds.

Advantages:	Disadvantages:
❑ May reduce travel speeds, depending on extent of use of on-street parking. ❑ Parked vehicles provide a buffer between traffic and pedestrians on sidewalks. This provides a comfort level for pedestrians that can be particularly important in downtown commercial areas.	❑ On-street parking can reduce the visibility of pedestrians and vehicles to each other. ❑ Increased risk of suddenly opened doors hitting cyclists where the adjacent travel lane is narrow.

RAISED MEDIAN ISLANDS / PEDESTRIAN REFUGES



Description:
Median islands are narrow islands between travel lanes that can be designed with breaks in landscaping and curbing for pedestrians.

Appropriate Locations:
- Median islands may be appropriate for all classifications of streets: local, collector, and arterial.
- They may be used on high-volume roadways and roadways posted up to 40 mph, if they do not significantly narrow the travel lane.
- Either at mid-block locations or intersections.

Typical Uses:
- Reduce the crossing distance for pedestrians by allowing them to cross half the street at a time.
- Prevent passing movements.

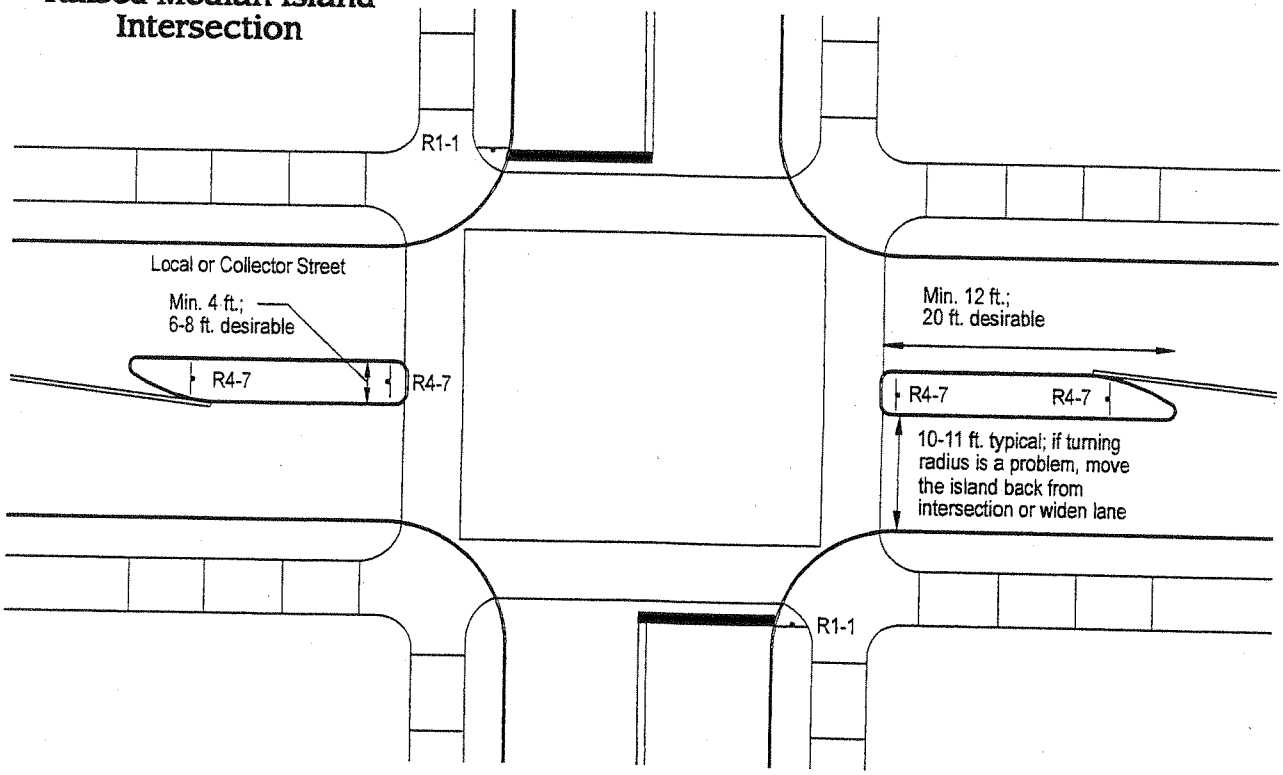
Speed/Volume Reductions:
- Vehicle speeds may decrease, particularly if the median islands result in roadway narrowing.
- Reductions in speed may range from 1 to 5 mph, with reductions of 2 to 3 mph most prevalent.

Approximate Cost:
- Approximate cost is $5,000 to $15,000 per island, depending on size, curbing, and landscape features.

Other Considerations:
- The maximum length of median islands will be affected by driveway and intersection locations.
- Median islands should be 6 to 8 feet wide to comfortably accommodate pedestrians.
- Islands should be at least 12 feet, and preferably 20 feet, in length.
- Provisions should be made for snow and ice removal.

Advantages:	Disadvantages:
❑ Separate opposing vehicle travel lanes and prevent passing movements. ❑ Can be designed with breaks for pedestrian refuges and may reduce vehicle-pedestrian conflicts. ❑ Allow pedestrians to cross half of the street at a time. ❑ May visually enhance the street, if landscaped. ❑ Vehicle speeds may decrease. ❑ Can be used on curves to prevent vehicles from swinging wide at excessive speeds.	❑ May require removal of on-street parking to create room for median. ❑ May restrict access to driveways from one direction.

Raised Median Island Intersection

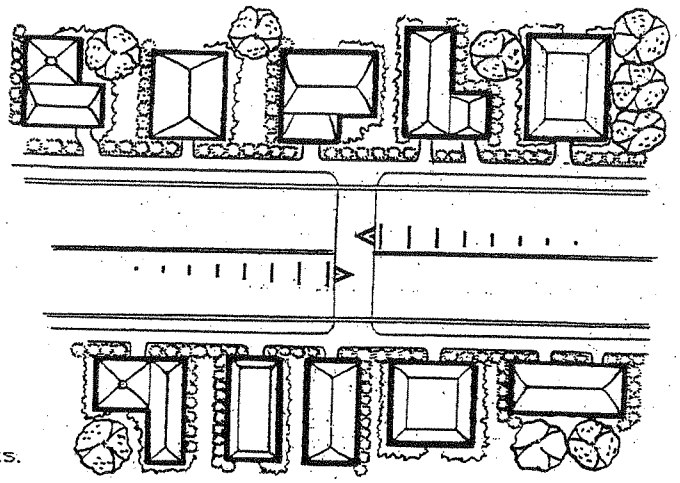


R1-1

R4-7

SPEED HUMPS

Description:
A speed hump is a raised surface on the roadway that is typically 3 to 4 inches in height, and 12 to 20 feet in length. Speed humps are by far the most popular traffic calming measure in the United States, likely because they are effective in reducing speeds at minimal cost.


N.T.S.

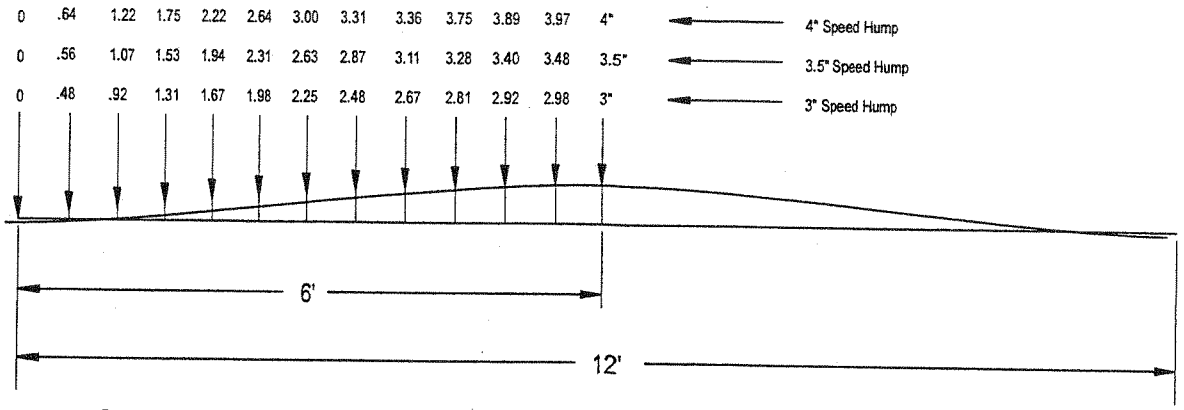
Common Designs:
- The Watts speed hump (designed by the Transport and Road Research Laboratory in Great Britain) is a parabolic hump 12 feet in length. This model was endorsed by ITE in *Guidelines for the Design and Application of Speed Humps*, June 1997.
- The Seminole County speed hump is the most popular alternative to the Watts hump. Designed by Seminole County, Florida, this hump is 22 feet in length with 6-foot ramps on either end of a 10-foot flat top. This type of speed hump design is also referred to as a "speed table".

Appropriate Locations:
- Both humps are appropriate for use on Pennsylvania roads. However, due to their different profiles, they are effectively employed in different settings.
- The Watts hump is recommended only for local streets with volumes less than 3,500 ADT and posted speeds of 30 mph or less. In addition, it is not recommended for major emergency service routes.
- The Seminole County hump can be used in a greater variety of situations. This type of hump can be used on collector roads as well as local roads. It is appropriate for streets with volumes up to 6,500 ADT. Many jurisdictions also permit the use of Seminole speed humps on emergency response routes.
- Primarily used at mid-block locations.
- Similar designs can be used as raised pedestrian crosswalks.

Typical Uses:
- Within typical residential travel speeds, humps create a gentle rocking motion encouraging motorists to slow to a safe speed at or below the speed limit.

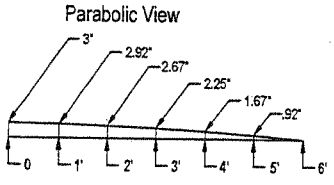
Speed/Volume Reductions:
- The design speed is determined by the dimensions of the speed hump.
- The Watts hump is designed to slow vehicles to 15 to 20 mph at each hump and 25 to 30 mph in between properly spaced humps (see "Other Considerations"). Numerous studies have demonstrated that Watts humps can reduce speeds by about 8 mph in the vicinity of humps. Volumes are reduced, on the average, by about 18 percent.
- Because of its gentler profile, the Seminole County hump has a design speed of 25 to 30 mph at the hump, and approximately 35 mph in between humps. It has been shown to reduce speeds by about 6.5 mph, and volumes by 12 percent. Some jurisdictions have found that speed of motorists at the hump and in-between the humps are not significantly different.

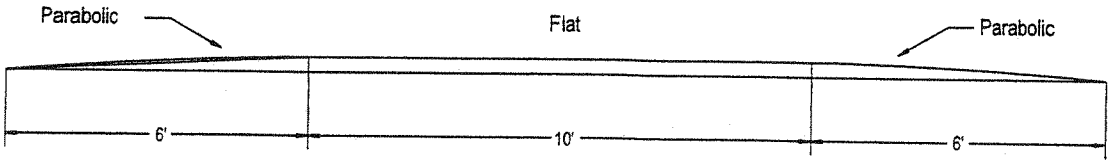
Watts (TRRL Profile) Speed Hump



Source: ITE, Guidelines for the Design and Application of Speed Humps

Seminole County Speed Hump/Table





Source: Seminole County, Florida

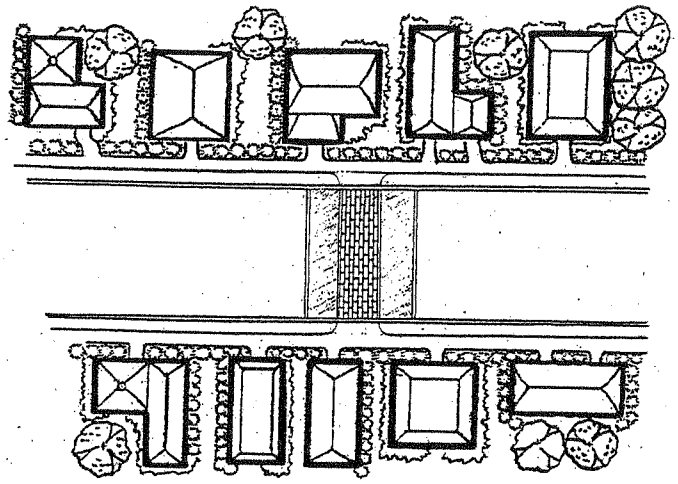
RAISED CROSSWALKS

Description:
Raised crosswalks are marked and elevated pedestrian areas that are an extension of the sidewalk at mid-block locations or intersections. Raised crosswalks are typically 3 to 6 inches above street level. In many jurisdictions, raised crosswalks are level with the curb, about 6 inches above the street. They often have the same profile as the Seminole County speed hump.

Appropriate Locations:
- They are appropriate on local streets and minor collectors, with volumes less than 10,000 vehicles per day.

Typical Uses:
- Reduce speeds and improve visibility of the pedestrians by defining crossings.

Speed/Volume Reductions:
- Raised crosswalks reduce speeds an average of 6 mph.
- Volumes are reduced an average of 12%.
- Due to their long flat tops and gently sloped ramps, raised crosswalks actually slow vehicles less than the Watts speed humps (12 feet in length; 3 inches in height) despite being as much as three inches higher.



NTS

Approximate Cost:
- Cost of a raised crosswalk is approximately $2,000 to $10,000 each. If drainage is an issue, costs could increase considerably.

Signing and Markings:
- It is recommended that the "Raised Pedestrian Crossing Warning Sign" (W11A-3) be used with each raised pedestrian crossing.

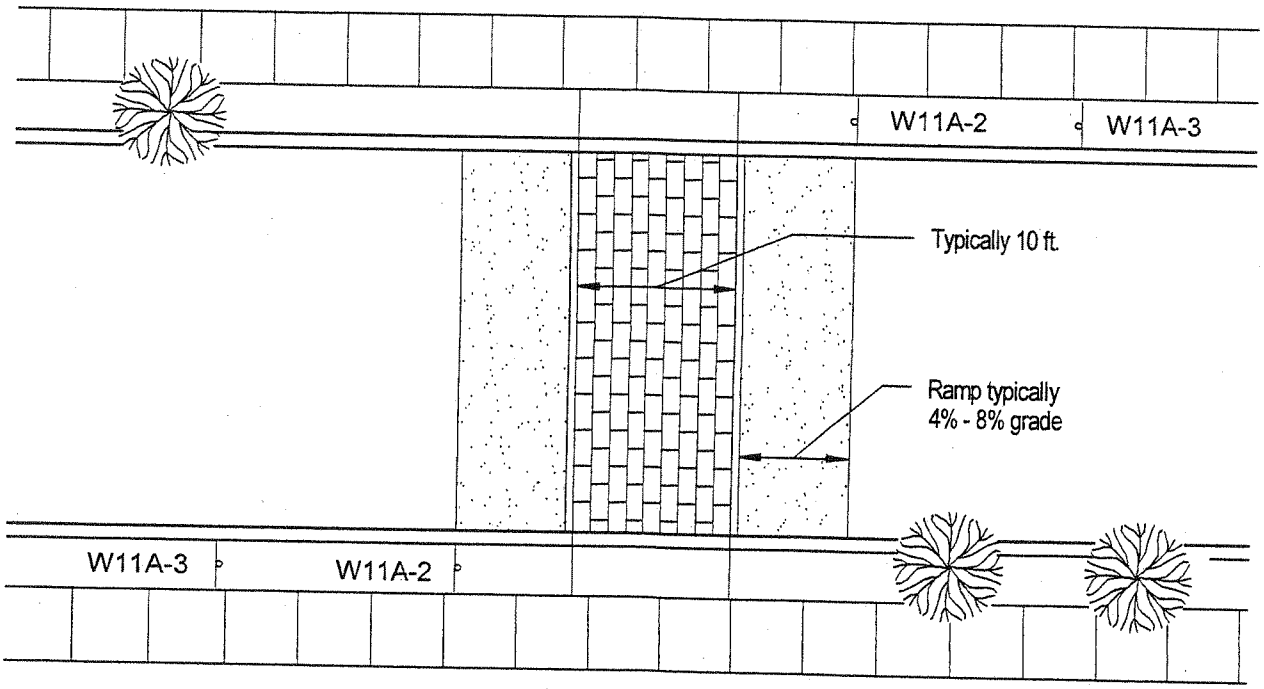
W11A-3

Other Considerations:
- If the raised pedestrian crossing is the same height as the curb, the edge of the raised crosswalk should be differentiated with a tactile measure to warn visually impaired people.
- Most appropriately used at areas with significant pedestrian crossing activity.
- Effectiveness of the measure is increased when used with textured crosswalks or curb extensions.
- Primary emergency access routes should be avoided, unless acceptable to emergency service providers.
- A catch basin should be installed for drainage on the uphill side of the raised crosswalk.
- All ADA requirements must be met.
- In areas with snow removal problems, a measure such as a flexible delineator post may be needed at each hump to alert snowplow operators to lift their blades.

Advantages:	Disadvantages:
❑ Reduce speeds. ❑ Improves visibility for pedestrians. ❑ Improves the visibility of pedestrians. ❑ May reduce volumes.	❑ Slows emergency vehicles by 4 to 6 seconds, on average. ❑ May generate noise and additional emissions from vehicle deceleration and acceleration. ❑ Require more maintenance than traditional crosswalks. ❑ Icing can be a problem If snow is not properly removed.

Raised Crosswalk

For typical profile, see drawings of Seminole County speed table or the Gwinnett County speed table in the "Speed Humps" section.

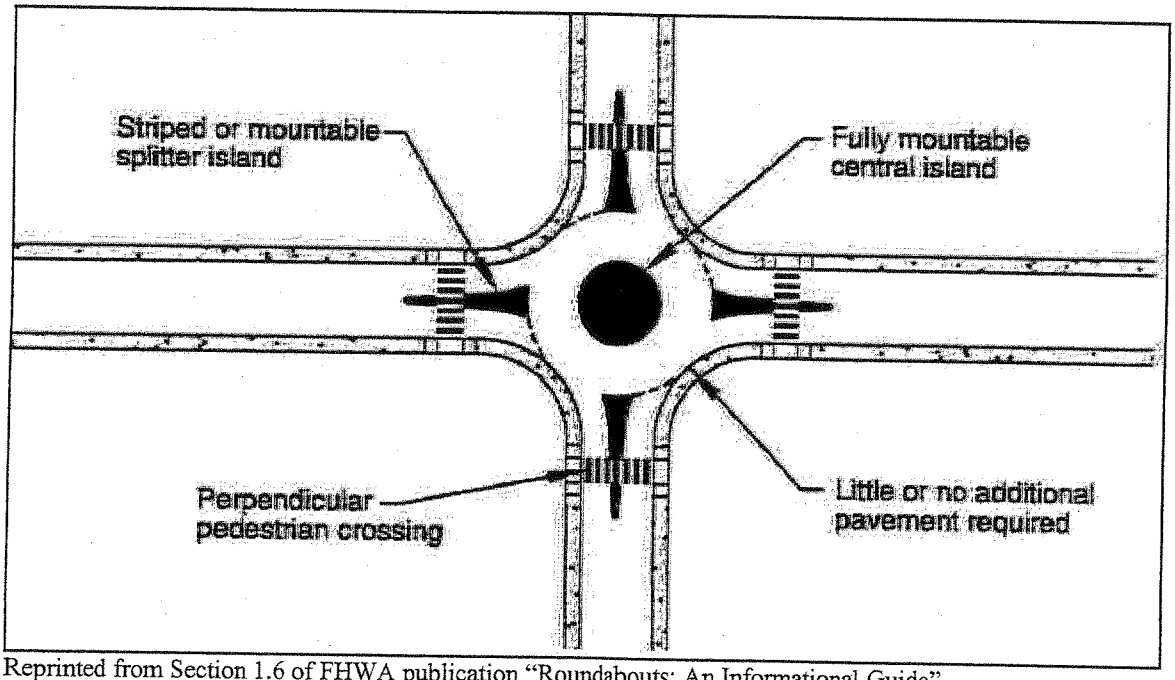


W11A-2

W11A-3

Mini-roundabouts

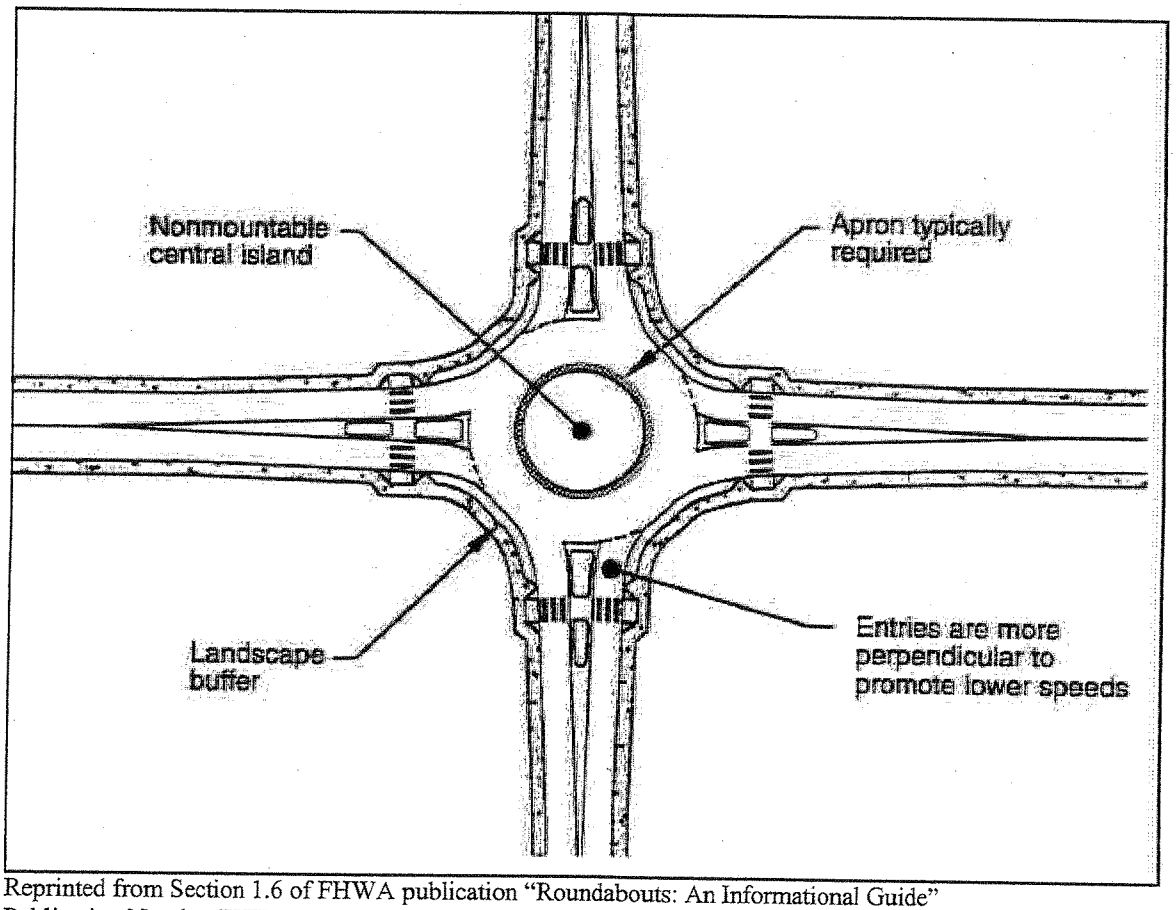
Mini-roundabouts are small roundabouts used in low-speed urban environments, with average operating speeds of 35 mph (60km/h) or less. The figure below provides an example of a typical mini-roundabout. They can be useful in low-speed urban environments in cases where conventional roundabout design is precluded by right-of-way constraints. In retrofit applications, mini-roundabouts are relatively inexpensive because they typically require minimal additional pavement at the intersection roads – for example, minor widening at the corner curbs. They are mostly recommended when there is insufficient right-of-way for an urban compact roundabout. Because they are small, mini-roundabouts are perceived as pedestrian-friendly with short crossing distances and very low vehicle speeds on approaches and exits. The mini-roundabout is designed to accommodate passenger cars without requiring them to drive over the central island. To maintain its perceived compactness and low speed characteristics, the yield lines are positioned just outside of the swept path of the largest expected vehicle. However, the central island is mountable, and larger vehicles may cross over the central island, but not to the left of it. Speed control around the mountable central island should be provided in the design by requiring horizontal deflection. Capacity for this type of roundabout is expected to be similar to that of the compact urban roundabout. The recommended design of these roundabouts is based on the German method, with some influence from the United Kingdom.



Reprinted from Section 1.6 of FHWA publication "Roundabouts: An Informational Guide"
Publication Number FHWA-RD-00-067

Urban compact roundabouts

Like mini-roundabouts, urban compact roundabouts are intended to be pedestrian and bicyclist friendly because their perpendicular approach legs require very low vehicle speeds to make a distinct right turn into and out of the circulatory roadway. All legs have single-lane entries. However, the urban compact treatment meets all the design requirements of effective roundabouts. The principal objective of this design is to enable pedestrians to have safe and effective use of the intersection. Capacity should not be a critical issue for this type of roundabout to be considered. The geometric design includes raised splitter islands that incorporate at-grade pedestrian storage areas, and a nonmountable central island. There is usually an apron surrounding the nonmountable part of the compact central island to accommodate large vehicles. The recommended design of these roundabouts is similar to those in Germany and other northern European countries. The figure below provides an example of a typical urban compact roundabout.



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