

# Design for Street Safety

Building smart streets can stop unsafe behavior and reduce crashes.



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# Redesigning Streets

## Work with your Government

### 1. Figure Out the Problem

Before you talk to anyone about the problem, be sure that you understand it. Answer these questions.

- Are users following the rules? Why not?
- What is dangerous? (High speeds? Poor visibility? Erratic or illegal user behavior? All of the above?)
- Do all street users have a safe opportunity to use the road? Are users with limited mobility able to use the road safely?
- How many people are using the road? How many people are using it in unsafe ways?

See the *Knowing Your Streets* Guide for ways to get this information.

### 2. Find the Right People

In Portland, the Portland Bureau of Transportation (PBOT) is in charge of most roads (see the *Build Support* guide for phone numbers). The Oregon Department of Transportation (ODOT) controls freeways and highway interchanges. Contacting the public works department is also a good starting point.

### 3. Start Talking

Call the appropriate person or send an email. Include your name and phone number, a clear statement of the problem, and a solution, if you have any infrastructure suggestions. Describe the problem. Focus on solving the problem rather than getting a specific solution built; since roads are highly regulated, not all solutions are allowed on every road. Be sure to mention that you are concerned about the safety of all road users, and mention a couple of solutions if you have any in mind.

Changing the design of a street is permanent and effective. To get these changes you have to work with the agency in charge.

### 4. Work with Them

Be patient, polite, and persistent. Agencies like PBOT are in charge of lots of roads often with very little funding or support. If your request has been studied before and they cannot build it, they should tell you why. If your suggestion hasn't been studied before, the agency will have a staff member investigate. They will address three basic questions:

- Is it a problem? This will involve observation, traffic counts, and speed measurements of the cars.
- Does the agency have a solution? Would the solution cause a bigger problem?
- Is there money available to make the changes?

Answers to these questions can take 10-12 weeks. If the solution cannot be built, don't be discouraged - infrastructure is not the only way to improve street safety. Look at the *DIY Streets* guide for community and individual actions that you can work on without funds from the city.

The following designs may need to be combined to improve safety – it all depends on the local situation and the agency in charge.

## Marked Crossings

### What?

- In Oregon, all intersections are crosswalks unless there are signs that say otherwise. Marked crossings are crosswalks that are painted or signed.
- Short vertical stripes called “Continental Striping” are easy for cars to see at a distance, which is helpful when crossing away from an intersection.
- Traditional horizontal bars are used at stop signs and traffic lights, where drivers stop for cross-traffic anyway.
- Crossings can also be highlighted with different colored pavement or unique bricks.
- Pedestrian crossing signs can help warn drivers of the marked crossing.

### Why?

- Marked crosswalks remind drivers to stop for pedestrians.
- People feel safer at marked crosswalks than at unmarked crosswalks.

### Where?

- Roads with high pedestrian traffic.
- Roads with high traffic with few gaps in traffic for pedestrians to cross.
- Roads with few legal, unmarked crossings.



### What else?

- One of the lowest-cost traffic calming solutions.
- Since many drivers do not stop at crosswalks, the City of Portland is hesitant to use markings that can give people a false sense of security while crossing roads.
- While marked crossings can be an important part of traffic calming, there is no evidence that they improve pedestrian safety on their own. On larger roads, crosswalks might even be a liability.

### Does it work?

- Marked crosswalks with no other safety improvements have been controversial in the US since a 1972 study in San Diego found that auto/pedestrian crashes were higher in marked crossings than at intersections with no marked crossings. One explanation for this is that marked crosswalks attract the most vulnerable of users, who are more likely to be in a crash.
- In a 2001 study, pedestrian crash rates were not significantly different between marked and unmarked crossings on roads with two lanes of traffic. On larger roads however, marked crossings were linked with higher crash rates.



## Speed Humps

### What?

- Speed humps are raised sections in the roadway several feet wide and a few inches high (also called speed tables or speed bumps).
- Speed humps are effective, inexpensive, and easy to maintain.

### Why?

- People driving cars slow down to avoid uncomfortable jostling from the speed humps.
- Can discourage drivers from using neighborhood streets as cut-throughs to avoid congestion on other roads.

### Where?

- Streets with traffic traveling faster than the speed limits.
- Neighborhood Greenways or Bike Boulevards.
- Speed humps are considered “traffic slowing devices” and may be prohibited on emergency response routes.

### Does it work?

- In *Traffic Calming: State of the Practice*, 12’ long speed tables were found to reduce speed by 22% on average (184 speed humps were studied).
- Results from another study of 143 showed that 12’ long speed tables reduced volume (the number of cars on a road) by 18%.
- 14’ long speed humps reduced speed by 23% and reduced volume by 22%.
- 22’ speed tables had more modest results, with an average 20% reduction in speed and 12% reduction in volume.

### What else?

- Cost: \$2,500 – \$6,000 per bump.
- Installation Time: 1 day to 1 week depending on location, drainage needs, and traffic disruptions during construction.
- Speed humps extending to the curb can disrupt bicyclists.
- Speed humps are not generally used on major streets.
- Often used in a series to calm an entire section of a road; single speed humps are not used in Portland.





## Traffic Circles

### What?

- Traffic circles are round islands in the middle of an intersection; motor vehicles drive around the traffic circles to pass the intersection or turn left.
- Traffic circles typically have concrete curbs with plants inside, though they can be entirely concrete or even contain artwork.
- Traffic circles can be designed to allow large trucks to pass. A low, flattened curb allows trucks to drive over them. Mini-traffic circles can allow trucks to turn left in front of the circle (these smaller circles can be four feet wide).

### Why?

- Slows cars by making drivers turn carefully and by creating visual barriers on the street, which makes the street seem slower to people driving.
- Reduces crashes at intersections by reducing the number of potential conflicts - drivers turn around the circle, rather than directly crossing paths.
- Planters and bioswales in traffic circles can make the street look nice and improve stormwater management.

### Where

- Intersections with one lane of traffic in each direction.
- Intersections with frequent crashes.
- Traffic circles can slow drivers, so they cannot be used on Emergency Routes.

### Does it work?

- In a review of 17 traffic circles, there was a 29% reduction in crashes after installation.
- Seattle has a very successful mini-traffic circle program - there was a 73% reduction in crashes with a sample size of 130 traffic circles.
- In a different study, mini-traffic circles reduced traffic volume by 5% on average.

### What else?

- Cost: \$5,000 – \$100,000 per location.
- City or neighbors must maintain plants in intersections.
- Slows traffic but does not reduce the number of cars.
- Can be confusing to drivers.
- Can be uncomfortable for bicyclists.
- May impede trucks and other large vehicles

## Neighborhood Street Lighting

### What?

- Pedestrian scale lighting is any kind of light that is less than 2 stories tall and works well for pedestrians and bicyclists.
- Many streetlights are designed for the needs of car drivers, and are too high to provide light for pedestrians.

### Why?

- Streetlights that are lower to the ground provide light for pedestrians and bicyclists to see and be seen.
- Streetlights can make a neighborhood feel safer and more welcoming.

- Decorative street lamps can help to add character to a neighborhood.

### Where?

- Streets with heavy walking and bicycling traffic.
- Streets that feel dangerous in the dark.
- Streets without adequate lighting for people using the road.

### What else?

- Cost: \$1,000 - \$2,500 (in an area with development).
- In addition to the cost of the streetlight, maintenance and electricity costs can be high.



## Crossing Island

### What?

- Crossing islands are pedestrian or bike refuges in the middle of the road, to provide a place to wait while crossing multiple lanes of traffic.
- They typically are raised or surrounded by a curb to prevent cars from driving on them.
- They can also be used as barriers to cars, preventing left turns.
- Crossing islands can be used to make car lanes seem smaller to drivers, which slows down cars.

### Why?

- Crossing busy, multi-lane roads can be hard for pedestrians, since there might not be gaps in the traffic, and it can be difficult for the pedestrian to get the attention of drivers in the far lanes of traffic.

- Crossing islands allow pedestrians to cross in two phases, make it easier to get drivers attention, and let the pedestrian cross when there is a gap in only one direction of traffic.

### Where?

- Appropriate for high-volume, multilane roads.
- Intersections without traffic lights.

### What else?

- Cost: \$5,000 - \$10,000.
- If the island is used to narrow traffic lanes, it can impede emergency vehicles and squeeze bicyclists.

## Raised Crossing

### What?

- Raised crossings combine crosswalks and speed humps.
- The crosswalk can be raised as high as curb level.
- An entire intersection can be raised, making it clear that the space is shared with everyone using the road.

### Why?

- Raised crossings slow traffic in the same way that speed humps do.
- When the crossing is at curb level, pedestrians with wheeled vehicles are able to cross without using ramps.

### Where?

- Corners or mid-block crossings.
- Raised crossings slow traffic and cannot be used on Emergency Routes.

### What else?

- Cost: \$2,000 – \$10,000.
- Can block water drainage if it extends into the gutter.
- Can be uncomfortable for bicyclists.



## Curb Extension

### What?

- Bulbouts extend beyond the rest of the sidewalk, into the road, to give pedestrians extra room to stand and be seen. They can be square or round, and some include plantings and bioswales. They usually replace a parking space.
- Neckdowns or chokers are expanded sidewalks to narrow the driving space (can be on one or both sides of the street). They can include extended sidewalks at crossings and bioswales.

### Why?

- Both types of curb extensions slow car traffic by making drivers turn carefully at corners.
- Makes pedestrian crossings safer by shortening the distance between curbs - people crossing the street are more visible and they are in traffic for less time.
- Improves visibility at corners by preventing cars from illegally parking at the corner and often replace the end parking spot.
- Planters and bioswales can make the street look nice and improve stormwater management.

### Where?

- Intersections with wide roads.
- Intersections with poor visibility and/or cars frequently parked up to the corner.
- Mid-block crossings with poor visibility.
- Bulbouts and neckdowns designed to slow roads can be used on local streets and neighborhood collectors; they are not allowed on Emergency Routes.

### Does it work?

- A review of “narrowings,” which include chokers and neckdowns, found that they reduced speed by an average of 4% and reduced car volumes by an average of 10%.
- A 2005 study showed that curb extensions encouraged cars to stop for pedestrians (from an average of 2.58 cars to 1.81 that passed the pedestrian before stopping).

### What else?

- Cost: \$5,000 – \$25,000 per location.
- Installation Time: 1 week to 1 month depending on location, drainage needs, and traffic disruptions
- Must consider freight traffic and their wide turning needs.
- Can squeeze bicycle riders into the car travel lane



## Partial and Full Closures



### What?

- Partial closures are curbs extensions or islands that stop cars from entering a street, while allowing local traffic to exit the street.
- Full closures divert traffic in both directions.
- Closures can allow for bicycle and pedestrian traffic to enter the streets.
- Closures can include plantings, which can make the area more enjoyable and improve stormwater management.

### Why?

- Closures keep out people driving through the neighborhood as a cut-through, making it safer and more pleasant for residents.
- Closures can keep cars on the arterials and collectors.
- Partial closures can shorten the crosswalk, making crossing safer and more comfortable for people on the street, while full closures give even more protection to pedestrians.

### Where?

- Partial closures can be used where traffic is spilling onto residential streets from nearby arterials.

- Partial and full closures can be used to discourage cars on Neighborhood Greenways or bike boulevards.
- Full closures can block emergency vehicles.

### Does it work?

- A review of 16 partial closures found that the average speed was 26.3 mph. On average the partial closures reduced speed by 19%. In a separate review of 53 partial closures, traffic volumes were reduced by an average of 42%.
- Partial closures reduced speeds on the affected streets by 4%, lowering the average speed to 27.9 mph. In a separate review of 27 full closures, 35% fewer cars used the roads.

### What else?

- Cost: \$15,000- \$100,000.
- Moves cars to other streets rather than calming traffic.
- Drivers may not comply with partial closures and enter the street going the wrong way.
- People driving cars in the neighborhood might have a longer, more indirect route.



## Center Diverter

### What?

- Center diverters are islands or curbs in the middle of the street to stop cars from making left turns. Medians can function as diverters.
- Can provide shelter to bicyclists and pedestrians trying to cross the street.
- Planters or bioswales in center diverters can make the street look nice and improve stormwater management.

### Why?

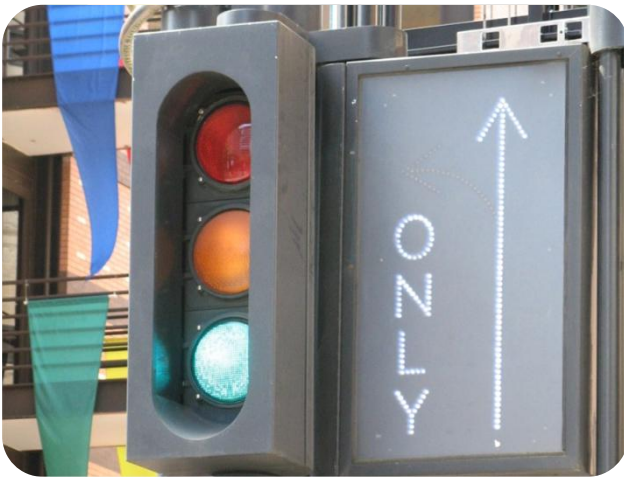
- Cars turning left can crash into people driving, biking, and walking in the opposite direction.
- Cars turning left can create traffic jams on busy roads.

### Where?

- Can be used on major streets to stop traffic traveling on smaller streets.
- Not suitable for the intersections of two major streets.
- Can be used along Neighborhood Greenways (bike boulevards) to discourage cars driving on roads heavily used by bikes.

### What else?

- Cost: \$5,000 – \$10,000.
- Diverters can create longer trips for local traffic.



## Full Signal

### What?

- This is the common Red-Yellow-Green traffic light.
- Improved signal phasing, such as longer pedestrian crossings, or coordination between traffic lights to smooth traffic, can improve the safety of all users.

### Why?

- Traffic signals regulate large volumes of traffic efficiently and ensure that all users have an opportunity to cross the street.
- Traffic signals spaced every few blocks can ensure that cars travel at the speed limit.

### Where?

- Full signals are most appropriate for major intersections and along busy roads.

### What else?

- Cost: Approximately \$250,000, not including maintenance.
- Electricity costs to operate traffic lights can be high.
- Can encourage people in cars to use the signalized intersection more, since crossings will be reliable.

## Bicycle Lane

### What?

- Bicycle lanes are typically 5-6 feet wide and are located on the right side of the road, next to the car lanes.
- Buffered bike lanes create more separation between bikes and cars through elevation, extra space, or even parked cars.
- Sharrows are street paintings to show that bikes are sharing the car lane (also called bike boulevards or Neighborhood Greenways).

### Why?

- Buffered bike lanes help to protect bicyclists from higher-speed cars and increase the sense of safety.
- Separating bicycle and car traffic allows both modes to travel at a comfortable speed without conflict.

### Where?

- Bike lanes are used on many different kinds of roads, but usually connect major destinations.
- Bike lanes are best on streets with high bicycle/car traffic.
- Sharrow and bike boulevards are best on low traffic streets.



## Bicycle Boxes and Painted Bike Lanes

### What?

- Bicycle boxes are rectangles of green paint in the right-hand travel lane at traffic lights.
- Cars must stop behind the bicycle boxes and they can't turn right on red.
- Bicycle lanes can be painted to signal bicycle/car conflicts.

### Why?

- Bicycle boxes at intersections increase the visibility of cyclists and reduce the risk of "right-hook crashes."
- The boxes allow bicyclists to sort themselves out by speed, resulting in smoother traffic in the bicycle lane.
- When sections of bicycle lanes are painted, it increases the awareness of cars crossing through bike lanes.

### Where?

- Bicycle boxes are appropriate at intersections with signals and heavy bicycle traffic.
- Painted bike lanes are appropriate wherever there is a high chance of bicycle/car crashes.

### Does it work?

- A study in Portland found that bicycle/car conflicts were reduced from 29 to 20 while the number of cyclists increased by 32%.
- 42% of drivers and 77% of bicyclists felt that the intersection was safer with a bike box.
- Cyclists that got to the intersection on a red light were less likely to stop on the sidewalk after the bike box was installed, which left more room for pedestrians.

### What else?

- Cost: \$15,000.
- Preventing right turns on red may reduce the total number of cars that can pass through the intersection.
- Similar benefits may be seen with right turn on red restrictions.
- Bike boxes are considered experimental by the Federal Highway Administration (FHWA)

## Rapid Flash Beacon

### What?

- Pedestrian activated yellow lights, with signs to alert drivers that there are pedestrians wanting to cross the road.

### Why?

- The use of flashing lights makes pedestrians more visible to drivers, and cars are four times more likely to stop compared to a marked crosswalk.
- Since the light only flashes when pedestrians want to cross, it is a flexible system that does not interrupt traffic when there are no pedestrians.

### Where?

- Crossings where there is not enough car or pedestrian traffic to justify a conventional signal.
- Crossings where a conventional signal might attract more car traffic.
- Mid-block crossings where drivers are not accustomed to stopping for pedestrians, but there is a need for pedestrians to cross.



### Does it work?

- Motorists are not guaranteed to stop, as the Rapid Flash Beacon is not a red light.
- In a study of Rapid Flash Beacons in Florida, two beacon treatments increased the percentage of drivers stopping for pedestrians, from an average of 28% to 84%. After fourteen months, they found that a four-beacon treatment led drivers to yield an average of 97-100%. Immediately after installing the beacons, motorists yielded 93% of the time.

### What else?

- Cost: Approximately \$20,000 per location.
- Since flashing beacons are not often used, there is extra maintenance needed for the signs and paint to make sure that everything is clear to drivers and pedestrians.
- Can be confusing to drivers since the beacons are not frequently used.



## Pedestrian Crossing Signal

### What?

- Engineers refer to this type of signal as a Hybrid Signal or HAWK Signal.
- A Crossing Signal that serves pedestrians or bicyclists, with lights controlling only the busy street.
- When a bicycle or pedestrian wants to cross, they press a button, and the busy street receives a red light, allowing the bicyclists and pedestrians to cross.

### Why?

- Crossing Signals can be implemented when there is not enough traffic to justify a full signal, or where there is a chance that a full signal will attract more traffic to the intersections.
- More flexible than a full signal since pedestrians and bicyclists do not have to hit the button for the signal when there are few cars on the road, and they can cross safely.

### Where?

- Crossings where there is not enough car or pedestrian traffic to justify a conventional signal.
- Crossings where a conventional signal is not desired due to the potential of increased traffic.

### Does it work?

- In Tucson, Arizona, a Federal Highway Administration (FHWA) Study found that HAWK signals reduced pedestrian crashes by 65% and reduced all crashes by 27%.
- A 2006 report found that drivers stopped for pedestrians over 95% of the time.

### What else?

- Cost: Approximately \$45,000 per location.
- HAWK signals are subject to the same maintenance needs and requirements as standard traffic signals.
- Signing and striping need to be maintained to help users understand these traffic signals.

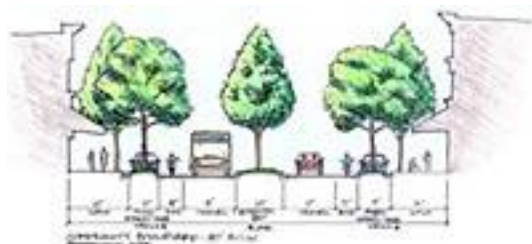
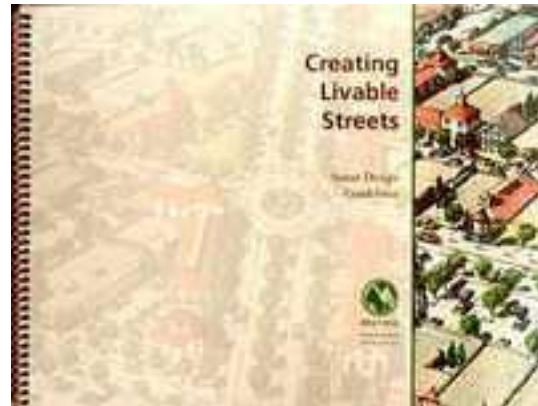


## Resources

**This brochure is only an introduction to innovative, safe street design.** There are dozens of resources to learn more about how to make streets safe and pleasant for all users:

### Portland and Oregon Specific:

- **Vision Zero Oregon:** Where to learn more about the project and find several more street safety guides [www.visionzerooregon.org](http://www.visionzerooregon.org).
- **Metro “Tools for Designing Streets”:** Metro (the planning organization for Portland) has created a series of easy-to-read, good-looking guides on getting the most out of your streets. This includes discussion of *Green Streets*, *Street Trees*, and *Streets for Livable Communities*. These books are available on their website at <http://www.oregonmetro.gov/>



Metro created guides, such as “Creating Livable Communities” describe current practice and standards for making good streets in the Portland region.

### National:

- **Streets Blog:** Focusing on better street design from around the world [www.streetsblog.org](http://www.streetsblog.org).
- **Streets Films:** Short videos explaining innovative infrastructure, and interviews with engineers, policy makers, and commuters; [www.streetsfilms.org](http://www.streetsfilms.org).
- **International Road Assessment Program:** This organization looks at improving road safety around the world: <http://toolkit.irap.org/>.
- **Bike Safe:** This collection of infrastructure case studies provides a good background and hard data on the potential improvements. [www.bicyclinginfo.org/bikesafe/case\\_studies.cfm](http://www.bicyclinginfo.org/bikesafe/case_studies.cfm).



Streetfilms.org features a series of films about safe, healthy livable streets, including one about Portland’s Neighborhood Greenway system, providing comfortable routes for people walking and biking.