

Best practice bicycle safety – improvement fact sheet

Signs and markings

Overview

Signs communicate **critical information** with the potential to **improve road safety**. The purpose of cyclist-related signage is to provide them (and other road users) with adequate information, allowing them to **anticipate certain situations**, which can significantly enhance reaction times. There are multiple sign solutions which can improve cycling safety [5]:

» Rectangular Rapid Flashing Beacon (RRFB)

Used at pedestrian and bicycle crossings and activated by pushbuttons or automatic detection, the RRFB is a type of beacon that makes use of high-intensity light-emitting diodes (LEDs) that blink in a rapid and irregular pattern, similar to what is seen on many modern emergency vehicles.

» Supporting cyclist signs

This group includes all signs which are used to indicate that cyclists are present on the route: cyclists in mixed traffic signs, yield/stop for cyclists, or signs which are indicating the dangers for cyclists such as dooring.

» Pavement Markings

A range of pavement markings can be used at sections and intersections in order to indicate the presence of bicyclists and/or bike facilities and to provide information about upcoming manoeuvres which will need to be undertaken, as well as a guidance for bicyclists going through an intersection.

All signs should be periodically checked to make sure that they are in **good working condition**, free from graffiti, reflective at night, and continue to serve a purpose.

Rectangular Rapid Flashing Beacon (RRFB)

While the majority of studies that evaluate rectangular rapid flashing beacons (RRFBs) focus on their pedestrian safety benefits, the beacons' ability to **increase vehicle yielding** at midblock crossings **benefits bicyclists** crossing at RRFB locations as well. As stated within a 2009 report [1], when the flasher was activated, the vehicle yielding rate was **54%**. In the period before, **82%** of the trail users were able to cross all the way across the intersection, while 18% stopped in the middle. In the period after, **94%** of the trail users were able to cross the intersection completely, while **6%** stopped in the middle. The same report concluded that safety **at the intersection** was also **increased**, as a result of installing the RRFBs.

An FHA report [2] has concluded, that on average across all sites, **4%** of vehicles yielded pre-treatment, while at the two-year follow-up, an average of **84%** of vehicles yielded at all sites, demonstrating the measure's effectiveness.





Another research [3] suggested that RRFBs should be considered for facilities where posted speeds exceed 56 km/h (35 miles per hour) if pedestrians and bicyclists use the facilities.

The installation of RRFBs can reduce pedestrian crashes by **47%** [4]. While cyclists were not the main topic of the study, as mentioned before, it can be assumed that similar numbers can be deducted for this group as well.



Characteristics

Measure	Costs	Treatment life	Effectiveness
Rectangular Rapid Flashing Beacon	€ € €	⌚ ⌚ ⌚	🚲 🚲 🚲

Implementation benefits

	Yield rates to cyclists are high even after a couple of years
	Speeds are lowered on sections where RRFS is installed
	Increase in safety at the intersection
	Solar-power panels can be used to eliminate the need for a power source

Implementation issues

	<p>Should not be used in conjunction with YIELD, STOP, or traffic signals</p>
	<p>Should be reserved for locations with significant pedestrian & cycle safety issues, as over-use of RRFB treatments may diminish their effectiveness</p>

Examples



Rectangular rapid-flashing beacon installed on a pedestrian crossing, USA [6].

Related fact sheet

RISKS

- » Poor signing

References and links

1. Hunter, W. W., Srinivasan, R., Martell, C. A. (2009). *Evaluation of the Rectangular Rapid Flash Beacon at a Pinellas Trail Crossing in St. Petersburg, Florida*
2. Shurbutt, J., & Van Houten, R. (2010). *Effects of Yellow Rectangular Rapid-Flashing Beacons on Yielding at Multilane Uncontrolled Crosswalks. United States. Federal Highway Administration. Office of Safety Research and Development.*
3. Ross, J., Serpico, D., Lewis R. (2011). *Assessment of Driver Yielding Rates Pre- and Post-RRFB Installation. Bend, Oregon*
4. NCHRP (2014). *Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments*
5. <http://www.pedbikesafe.org/>
6. <https://www.youtube.com/watch?v=tT6E3scnXWA>

Supporting cyclist signs

Supporting cycling signs provide **alerting and guiding information** as well as helpful information aimed towards all road users with the purpose of assisting cyclists. Road sharing signs can cause vehicle drivers to be **more aware** of bicyclists on sections with inadequate cycling facilities, and wayfinding signs provide **directional information** about routes connecting destinations or circumventing barriers, while indicating to vehicle users that bicyclists may be present [2].

One research [1] showed that there was a significant increase in average bicyclist distance from the curb after installing “Bikes May Use Full Lane” supporting sign. Likewise, **motorist passing distance increased significantly**.

The researchers concluded that the “Bikes May Use Full Lane” sign can be an effective method of **improving bicyclist safety** and have recommended further research into the subject.

[2] mentioned that no **right-turn on red signal signs** can improve safety for bicyclists, but no specific reference to the research is given. However, it is elaborated that issues might often occur where right turns on red signal are allowed, especially if bicyclists are approaching the crossing from the right or are cycling the wrong way either in the street, sidewalk or a path, as vehicle users **tend to look to the left for a gap in traffic**.



Characteristics

Measure	Costs	Treatment life	Effectiveness
Various signs (metal or electronic sign)	€ – € €	⌚ ⌚ ⌚	🚲 🚲 🚲

Implementation benefits

	Regulatory signs , such as STOP, YIELD, or turn restrictions require driver actions and are enforceable
	Prohibiting right turn on red (RTOR) is a simple, low-cost measure

Implementation issues

	Overuse often results in non-compliance and/or disrespect
	Part-time right turn on red prohibitions during peak hours may be sufficient to address the cycling safety problem, but the impact on traffic flow should be studied

Examples



Yield to crossing bikes from both directions. Different signs but the same meaning. Left Netherlands, right Australia [3]



Cycling crossing sign in Croatia [4]

Related fact sheet

RISKS

» Poor signing

References and links

1. Brady, J., J. Loskorn, A. Mills, J. Duthie, and R. Machemehl (2011). *Operational and Safety Implications of Three Experimental Bicycle Safety Devices in Austin, Texas*
2. www.pedbikesafe.org
3. <https://bicycledutch.wordpress.com/2012/06/04/road-signs-for-cycling-in-the-netherlands/>
4. <https://www.signal.hr/hr/proizvodi-usluge/turisticka-rjesenja-22/biciklisticke-oznake-46>

Pavement Markings

Some examples for pavement markings include **striping and painting symbols** associated with bike lanes, striping for paved shoulders, turning lanes at intersections, shared lane markings, railroad crossings, and drainage grates or other pavement hazards or irregularities [1].

The **overall principle** for optimising cycling safety is ensuring that all pavement markings are **durable, visible, and non-skid**. The amount of skid resistance varies with each product and material. If thermoplastic is used for bicycle markings, a thin, non-skid type is recommended. In some instances, glass beads, crushed glass, and aggregate can be included during marking installation in order to increase skid resistance [1].

A **bike box** is a pavement marking pattern which is intended to provide priority for bicyclists over vehicles at signalised intersections, while also serving as a measure to improve visibility between vehicles and bicyclists. This treatment is used at signalised intersections on roads with a marked bike lane and, according to [2], **reduces conflicts between bicyclists and turning motor vehicles** by making the cyclists easier to see. One research [3] found the use of the bike box to be promising and en-




courages more studies into its effectiveness. Following the installation of the bike boxes, bicyclist volumes at study intersections increased by **94%**, while the number of conflicts between bicyclists and vehicles **have been reduced by 9%**. Another study [4] also indicated a reduction in the number of conflicts after the installation of bike boxes. However, it should be taken into account that bike box markings are an effective measure only for cyclists arriving at the intersection at red light [5] (see also Fact Sheet Junctions and Crossings).

Shared lane markings, also known as **sharrows**, are bike-and-chevron pavement markings that provide information to bicyclists about the safe space to ride within the road and encourage them to use more of the travel lane to avoid unsafe spacing between bicycles and the side of the road. A number of studies validated that when utilising sharrows, a **significant shift in the percentage of bicyclists cycling on a road** instead on a sidewalk occurs [6, 7], and **the distance between bicyclists and parked cars is increased** [7]. Another study [8] found that the number of **near-doorings was decreased** after installing sharrow markings.



Characteristics

Measure	Costs	Treatment life	Effectiveness
Pavement marking	€€€	⌚⌚⌚	🚲🚲🚲

Implementation benefits

	Can be used at intersections to indicate the presence of bicyclists and bike facilities
	Increases cycling usage when compared with no facilities
	Reduces conflicts between vehicles and cyclists

Implementation issues

	<p>Long-term maintenance costs should be taken into consideration as durability and cost are generally inversely related.</p>
	<p>Local weather conditions and how pavement markings are applied will impact pavement marking durability</p>

Examples



Street with **sharrow** pavement marking, Croatia [10]



Bike Box in Croatia [11]

Related fact sheets

RISKS

- » Network Issues
- » Poor signing

References and links

1. www.pedbikesafe.org
2. Hunter, W. W., Stewart, J. R., Stutts, J. C., Huang, H. H., Pein, W. E. (1999). *A Comparative Analysis of Bicycle Lanes Versus Wide Curb Lanes*. Federal Highway Administration.
3. Hunter, W. W. (2000). *Evaluation of Innovative Bike-Box Application in Eugene, Oregon*. *Transportation Research Record*, 1705(1), pp. 99-106.
4. Dill, J., Monsere, C. M., McNeil, N. (2012). *Evaluation of bike boxes at signalized intersections*. *Accident Analysis and Prevention*, 44, pp. 126–134.
5. Horn, B., Menge, J., Spiegelberg, I. (2015). *Sicher geradeaus! Leitfaden zur Sicherung des Radverkehrs vor abbiegenden Kfz*. Berlin. In: <https://repository.difu.de/jspui/bitstream/difu/232443/1/DS1410.pdf>
6. Pein, W. E., Hunter, W. W., Stewart, J. R. (1999): *Evaluation of the Shared-Use Arrow*.
7. *Alta Planning + Design* (2004). *San Francisco's Shared Lane Pavement Markings: Improving Bicycle Safety*. In: <https://nacto.org/wp-content/uploads/2010/08/San-Franciscos-Shared-Lane-Pavement-Markings-Improving-Bicycle-Safety.pdf>
8. Hunter, W. W., Srinivasan, R., Martell, C. A. (2012). *Evaluation of Shared Lane Markings in Miami Beach, Florida*. In: https://rosap.nhtl.bts.gov/view/dot/24298/dot_24298_DS1.pdf
9. Weigand, L., McNeil, N., Dill, J. (2013). *Cost Analysis of Bicycle Facilities: Cases from cities in the Portland, OR region*. In: https://activelivingresearch.org/sites/activelivingresearch.org/files/Dill_Bicycle_Facility_Cost_June2013.pdf
10. <https://www.index.hr/vijesti/clanak/biciklisti-oprez-evo-kako-odsad-mozete-voziti-gajevom-ulicom/935503.aspx>
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about safety on
two wheels.**

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