



Best practice bicycle safety – improvement fact sheet

# Junctions and crossings

## Overview

When assessing road infrastructure safety, special attention is given to junctions and crossings, as those are the **most common spots** where **conflicts between different (and same) modes of transport** occur. Not only that **most of the conflicts occur on junctions**, but also the ones that are known to occur have **more severe consequences** compared to conflicts occurring on straight sections of the road.

Cycling accidents predominantly occur at junctions between cycling facilities and facilities for other – mostly motorised – road users. The following principles can help ensuring the safety and comfort of cyclists at junctions:

- » Good **visibility and physical proximity** (or adequate distance, >5 m) between the road and parallel cycling facility, at least for the last 20 metres before the junction
- » **Straight trajectories** should be ensured for cyclists to avoid ambiguities on their further route choice and/or changes of direction
- » **Right-of-way regulations** should be self-evident for all users
- » **Directional arrows** (road markings) increase clarity of dedicated use and trajectories
- » Conflict areas should be **colour-coded** (including those with pedestrians)

Studies show that, even when motorised vehicles are expected to yield the **right of way to cyclists**, drivers may **fail to respect it**. Various reasons can cause such behaviour, such as drivers not being aware of the presence of a cyclist due to **limited vision** or **lack of attention** [1]. Crossings can be divided into minor and major crossings, with minor crossings involving the intersection of two residential or local streets with low motor vehicle volumes and speeds. Major crossings are those locations where a bicycle boulevard crosses a major street with right-of-way priority [2].

## Curb radius reduction

There are numerous countermeasures which can be applied to junctions and crossings in order to increase safety levels for cyclists [3]. One of the proposed improvement measures is the **reduction of the curb radius**. The curb radius has a significant **influence on the motorised vehicle speed**, as larger radii allow for greater turning speeds, while smaller radii force turning vehicles to negotiate the turn at lower speeds, **increasing** the drivers' **probability to spot the cyclist**. When reducing the curb radius, it is important to consider the needs of turning vehicles.

## Intersection pavement markings

**Intersection pavement markings**, another junction improvement measure, also help in reducing cyclist injuries by providing better visibility and guidance for cyclists approaching junctions. Pavement markings per se, include a range of improvements such as **painted bike lanes**, **dashed lines** or even **bike boxes** (also known as advanced stop bars). For bike boxes at signalised intersections for example, several studies [e.g., 4,5] indicate a reduction in the number of conflicts between bicyclists and motorised vehicles after their installation.

## Sight distance improvement

Depending on the junction condition, one of the simpler (or more complex) improvements is the **sight distance improvement**. In order to increase the cycling safety level, an adequate sight distance should be provided. In some cases, this could be **trimming of vegetation** or **increasing the height of traffic signs** while, on the other hand, it also could be a more substantial intervention, such as the **relocation of parking spaces** near the crossing or the provision of a **curb extension**. A simple

alternative to a curb extension could be the **vertical delineator installation** [3]. To improve the visibility and detectability of cyclists, a similar rule can be applied as for the design of the infrastructure for motorised vehicles which is that the **angle** at which the cycling infrastructure and motorised vehicles infrastructure meet each other should be designed as close to 90° as possible.

## Traffic lights

In particular at unsignalised junctions with a high amount of motor traffic and bicyclists at different traffic streams, the installation of **traffic lights** can additionally improve cyclist safety: By **separating cross traffic streams** by time intervals, the likelihood of crossing collisions is reduced [6]. However, traffic-light intersections are always a second-best solution for cyclists in terms of safety and a **cycle-friendly design** (see measures below) is needed to improve safety, speed and comfort [7].

## Advanced stop lines (bike boxes)

At **traffic light-controlled junctions**, stop lines for cyclists should be placed 3-5 metres in front of the stop lines for motor vehicle traffic. Thereby it can be ensured that cyclists have had the chance to position themselves in front of motorists and be **visible** for them when the traffic light turns green. This can be crucial in avoiding blind-spot collisions with (right-turning) heavy goods vehicles (HGVs).

## Protected intersections








Protected intersections aim to **improve the safety situation** at intersections for vulnerable road users (VRUs) by means of **physical separation between transport modes**, providing **clear guidance**, **adequate visibility**

as well as **encouraging predictable user behaviour** [10]. Protected intersections come as a seamless continuance to protected cycle lanes and offer protection on those parts of the network where vulnerable road users are more exposed.



Unlike at conventional intersections, cyclists at protected intersections are not forced to merge into mixed traffic, instead they are given a dedicated path through the intersection [2]. Some of the features a protected intersection can be equipped with are **painted cycle lanes, corner refuge island, curb extensions, and cycle friendly signal phasing** [1].

Features that can be added to a protected intersection include **painted cycle lanes, corner refuge island, curb extensions, cycle friendly signal phasing** and other features [8, 9]. In addition, there are corner islands, bike queue areas and waiting zones for turning cars. Protected intersections also provide more safety for pedestrians through shorter and safer crossings and pedestrian islands [9].





### Characteristics

Measure	Costs	Treatment life	Effectiveness
Curb radius reduction	€€€	⌚⌚⌚	
Intersection pavement markings	€€€	⌚⌚⌚	
Sight distance improvements	€€€	⌚⌚⌚	
Protected intersections	€€€	⌚⌚⌚	
Traffic lights	€€€	⌚⌚⌚	
Advanced stop lines	€€€	⌚⌚⌚	
Protected intersections	€€€	⌚⌚⌚	






### Implementation benefits

	Improved <b>visibility</b> of cyclists
	<b>Increased cyclist and pedestrian safety</b> at crossings and junctions

## SOLUTIONS

	Specific implementation measures are quite <b>inexpensive</b>
	<b>Decrease</b> in vehicle – bicycle <b>conflict points</b>
	Increase in VRU <b>crossing safety</b>
	Improved <b>visibility</b> of all road users

### Implementation issues

	Specific improvement measures are quite <b>expensive</b>
	Some improvement measures require <b>additional space</b>
	Poorly planned measures can <b>deteriorate safety levels</b> for all involved road users
	Intersection <b>capacity implications</b> of added bicycle signal phases
	<b>Truck turning requirements</b> for freight movement
	<b>Interaction</b> between bicyclists and pedestrians

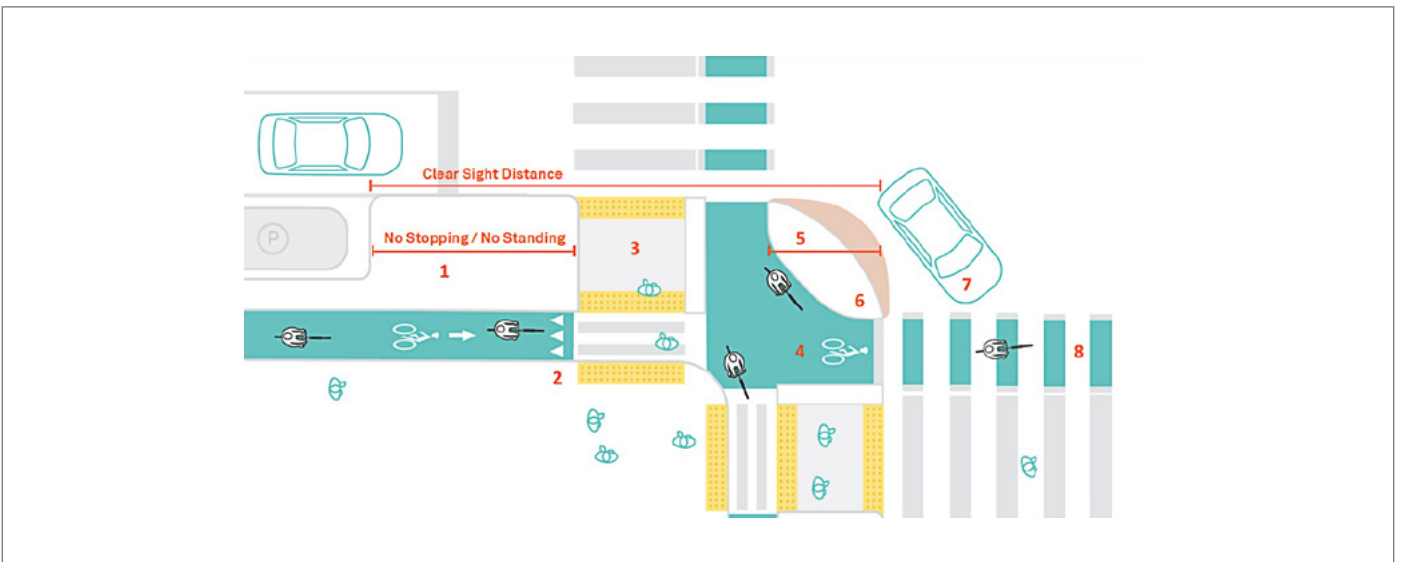
Examples



The figure shows an aerial view of a protected intersection on Zagreb Avenue in Zagreb. The infrastructure provides clear guidance for cyclists by means of a painted red cycle path around the intersection as well as guidance across the intersection. Given that cyclists and pedestrians have to cross multiple lanes, refuge islands are provided in between lanes of opposing directions of travel. The whole intersection is regulated by traffic lights [11].



Advanced stop line (bike box) for cyclists in Vienna [12]



Example of a protected intersections design [9]

## Related fact sheets

### RISKS

- » Narrow infrastructure
- » Junctions and crossings: blind spot
- » Junctions and crossings: left turn issues

## References and links

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12. *Picture repository of KFV (Austrian Road Safety Board)*

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