

**Summary:**

## **Speed reducing measures at pedestrian crosswalks – examples and experiences**

*There is often a need to reduce car speeds on stretches of road used by pedestrians. Recent years have seen the development of a number of different speed calming measures for use on roads with pedestrian crossings. These measures generally improve pedestrian mobility to the detriment of car driver mobility. However, each particular measure also has its own advantages and disadvantages, depending on factors such as traffic volume, road type and road layout. Choosing the most optimal measure therefore requires knowledge about these factors. This report gives an overview of 9 relevant measures used and evaluated in USA, Canada, Norway, Germany, Switzerland, Austria and Great Britain.*

Examples of speed reducing measures for pedestrian crosswalks have been collected in this report from other countries than Norway. Pedestrian crosswalks in Norway are marked with Zebra stripes and pedestrians have the right of way. The main focus is on measures that can be used on roads with a speed limit of 50 or 60 km/h. In Norway, speed reducing measures are recommended when the 85<sup>th</sup> percentile speed (V85) is above 45 km/h on roads with a 50 km/h speed limit. On roads with a 60 km/h speed limit pedestrian crosswalks should not be installed unless V85 is below 45 km/h. Recommended measures are raised crosswalks, medians, lane narrowings and speed cushions. Otherwise, the crosswalk may be removed or replaced by either a grade separated crossing or a pedestrian crossing where pedestrians do not have the right of way. Other speed reducing measures, such as road humps, reduced number of lanes, kerb extensions, signing and road markings are recommended only on roads with a speed limit lower than 50 km/h.

Most measures described in this report are road measures which aim at deterring from driving fast. Lower speed will in most cases make it easier and safer for pedestrians to cross a crosswalk, but increase travel times for drivers. In an overall assessment of crosswalk one may therefore aim at achieving the best possible effects for pedestrians while at the same time minimizing disadvantages for motorized traffic. Consequently, achieving lowest possible speed should not always be the main aim for all crosswalks. This depends amongst other things on volumes of motorized traffic, pedestrian volumes. Making crosswalks more visible, improving sight conditions and shortening the crossing distance can make crosswalks safer and easier to cross for pedestrians as well.

*Sidewalk extensions* are a frequently used measure at crosswalks. Extending the sidewalk usually results in somewhat narrower driving lanes, which may force drivers to slow down. Moreover, sight conditions improve for pedestrians, pedestrians become more visible to drivers and the crossing distance is shortened. Sidewalk extensions are often equipped with low poles or pillars which prevent cars using the extension as parking space. In Norway sidewalk extensions are recommended only on roads with a speed limit below 50 km/h. In German speaking countries they are used on roads with a 50 km/h speed limit as well as on roads with lower speed limits.

*Chicanes* reduce driving speed, depending on lane width, deflection and curve radius and sight conditions at crosswalks may be improved. Chicanes do usually not result in increased conflicts between driving directions or inconveniences to car drivers, emergency vehicles or cyclists. Some adverse effects may occur when drivers try to drive as straight (and fast) as possible through the chicane.

*Medians with pedestrian refuges* may reduce speed when lanes are narrowed or built around the median as a chicane. Pedestrian refuges are quite often designed so as to minimize disadvantages for motorized traffic and cannot be regarded as speed reducing measures. However, safety and mobility for pedestrians may be improved even if speed is not reduced. The crossing distance is reduced, pedestrians have to observe traffic from one direction only, and they may become more visible in the refuge. A pedestrian refuge may be designed with a “Z” pattern, so that the pedestrian has to turn towards approaching traffic while crossing the refuge. Medians may involve some disadvantages for cyclists when the lane is narrowed and cars and cyclists have to use the same part of the road. Pedestrian refuges were found to reduce pedestrian accidents. The effect is however not statistically significant.

In a before-and-after study in Austria pedestrian refuges and raised crosswalks were those measures that had the greatest impact on the proportion of drivers looking for and yielding for pedestrians (Stefan et al., 2007). Other measures investigated in this study were signing, road markings and flashing beacons.

The design of sidewalk extensions, lane narrowings and chicanes may vary from comprehensive, space consuming and expensive measures to simple and cheap measures. Some of the examples presented in this report indicate that more comprehensive measures which appear as natural elements of the road environment may achieve larger effects and fewer disadvantages than simpler measures. Simpler measures may be perceived as unnecessary nuisances and some drivers may even react aggressively. However, a general negative relationship between costs and effectiveness cannot be concluded.

Vertical design elements may be used in order to increase the visual impression of measures, e.g. posts and poles, flowerpots or trees. Such elements may reduce sight and may be crashed into. Lower and more yielding elements, such as bushes are therefore often used as supplemental design elements.

*Speed cushions* may be used on roads with a speed limit of 50 or 60 km/h. Road humps are only recommended on roads with a lower speed limit. Speed cushions are installed in the middle of driving lanes. Cars are forced to drive over the cushion with the wheels on at least one side of the car, while heavy vehicles

usually may drive with all wheels beside the cushions. Cyclists may cycle beside the cushions as well. Speed cushions may be installed either before and after a crosswalk, or the crosswalk may cross over the speed cushions. Speed cushions are, by themselves, only speed reducing devices, i.e. they do not improve crossing conditions for pedestrians otherwise.

*Rumble strips* or *cobblestones* may be used as speed reducing measures. Some examples were found where cobble stones are used for pedestrian crossings that are not marked as crosswalks. The rumble effect of cobblestones may be speed reducing and the crossing may become more visible for drivers. The noise may be annoying, especially in residential areas. No examples were found where rumble strips are used at marked crosswalks.

*Reduced speed limits* and *police enforcement* are possible measures at crosswalks that do not involve any road design or construction measures. Only one example was found where the speed limit is reduced during times with high pedestrian volumes. Drivers reduced speed during these times. A permanent reduction of the speed limit usually only leads to small changes in driving speed. According to Norwegian recommendations frequent changes of the speed limit should be avoided. No examples were found of speed enforcement at crosswalks. Even if reduced speed limits and speed enforcement may reduce speed, it is most likely that speed will not be reduced to far below the speed limit. It is unlikely that these measures alone would increase drivers attention at crosswalks. One study was found of police enforcement with a focus on yielding for pedestrians. No effect of police enforcement was found in this study.

*Increasing the number of crosswalks* in an area may reduce driving speeds. There is however no empirical evidence.

A number of other measures aim at reducing speed or at improving yielding behaviour at crosswalks, but which were not found to reduce speed in empirical studies. These are for the most part road signs and road markings. Road signs have usually no long-term effect and the use of alternative signs may lead to confusion. Advance stop lines were not found to have any effect on speed or driver yielding. Pedestrian activated measures have often more long-lasting effects than permanent signs or markings. Drivers experience that measures are active only when there actually are pedestrian crossings and such measures are therefore more trustworthy. Such measures do not reduce speed when there are no pedestrians crossing. Possible pedestrian activated measures are flashing beacons (not used in Norway), or flashing lights which are installed in the asphalt.