

**Summary:**

# **Measures for Pedestrians and Public Transport in City Intersections**

## **International experiences and evaluation studies**

**Evaluation studies and experiences concerning nine pedestrian measures, seven public transport measures and shared space are summarized. All the pedestrian measures eliminate the negative effect of pedestrian crossings on safety, while also improving time mobility and subjective safety for pedestrians. All public transport measures seem to improve mobility, but the documentation is insufficient and more studies should be made.**

### **Report series about environmentally friendly urban transport**

This report is the third report in a series of reports on how intersections in urban areas should be designed to ensure good conditions for cycling, walking and buses. The first report was a literature study of how other countries recommend intersections to be designed to ensure good conditions for the three groups of road users. The second report was a supplemental review of experiences and evaluations of the six most relevant measures for bicycles.

This third report includes a supplementary review of the effects and experiences with measures for pedestrians and bus traffic. The focus is road design and markings. The review focuses on the total effects on objective safety, subjective safety, mobility, accessibility, violations, behaviour and attitudes for pedestrians and the effect on mobility for bus traffic.

### **Pedestrian measures with positive effect**

Nine pedestrian measures and shared space are reviewed. The measures are listed in table i, which also summarizes the results of the literature review and recommendations for future use. The measures are divided into five groups.

Group 1 includes pedestrian crossings without other measures. The measure improves mobility and subjective safety, but has a negative effect on safety. The measure should still be used, but only in combination with other measures. In addition, existing pedestrian crossings should be inspected.

The measures in the group 2-4 are complementary measures that aim to eliminate the negative effect of pedestrian crossings on safety and improve the positive effect on mobility and subjective safety. As summarized in table i this objective is fulfilled to a greater or lesser degree by all of the supplementary measures.

Common to these measures is that they make the crossing more visible, improve sight and reduce speed level. This improves objective and subjective safety and mobility. Thus, pedestrian attitudes are usually also positive. The positive effect may be greater or smaller among the various measures and be more or less well

documented. At the same time little is known about the effect on the volume of pedestrian traffic.

Table i. Likely effect of pedestrian measures as well as current and recommended future use in Norway. + indicates positive effect. - indicates negative effect.

Group of measures	Number of studies	Total effect	Current and recommended future use in Norway			
1 Pedestrian crossing	25	+ / -	Used in very large scale Should still be used, but combined with other measures Existing pedestrian crossings should be inspected and incorrect crossings should be upgrade or removed			
			Traffic island	14	+	Used in large scale Should still be used and its use should be intensified
2 Raised crosswalks	11	+	Used in large scale Should still be used and its use should be intensified			
			Curb extensions	15	+	Used in unknown scale Should still be used, but the measures should be evaluated
3 High-visibility markings	9	+	Used to a limited extent The measure should be tested and evaluated			
			Pavement legends	11	+	Used to a limited extent The measure should be tested and evaluated
			Diagonal crossing	12	+	Not used The measure should be tested and evaluated
4 Pork chop island	5	(+)	Used at separate right turn traffic lanes Existing island should be inspected			
			Reduced curb radii	4	(+)	Are used but maybe not as a pedestrian measure Should be tested and evaluated as a pedestrian measure
5 Shared space	10	(+)	Used to a limited extent The measure should be tested and evaluated			

TØI report 1108/2010

The largest and best-documented effect is found for the measures in group 2, raised crosswalk, traffic island and curb expansion, especially the first two measures. The measures should still be used and their use should be intensified.

Group 3 includes alternative marking, pavement legends and diagonal crossings. The effect of these measures is less well documented. The effect is likely also smaller than group 2, as the measures are less radical. There should be pilots and evaluation of these measures in Norwegian intersections in urban areas.

Group 4 includes the two physical measures, pork chop island and reduced curb radii. No empirical studies are found for these measures. The assessment is therefore based only on assessment from expert and recommendations in manuals. Studies of existing solutions, pilot project and evaluation should be made. In addition existing pork chop island should be inspected because studies show that they often have an inappropriate design.

Shared space is also assessed to have a positive effect as a result of lower speed and greater attention. This measure is particularly important to demonstrate and evaluate in Norway. Firstly, there is a lot of focus on the measures. Secondly, the evaluations are based on weak studies and the effect is probably overestimated. Thirdly, it may be questioned if the measure will operate well in Norway.

### **Other good pedestrian measures**

Each pedestrian measure is described and may be used as an independent measure. However, a combination of several measures is likely to provide the best overall effect and may help to make it even more attractive to be a pedestrian.

In addition to the measures reviewed, measures primarily used for pedestrian crossings on sections might also be used in intersections. These are measures such as zigzag markings and advanced stop lines.

There also exist some innovative and creative markings measures, such as three-dimensional markings and ergonomic, advertising and art pedestrian crossings, which are not included in this review. These measures may have a positive effect, since they make the crossing more visible and probably reduce the speed level. However, they may also have a negative safety effect, as they provide unnecessary deceleration, distraction and confusion about traffic regulations. It is therefore uncertain whether such measures should be used. If used, they should be used with great caution, their use being carefully monitored and evaluated.

In addition to markings and physical measures, many other even more innovative measures exist, such as ITS and signal technical measures, signs, road light and audio measures. Several of these measures will help improve conditions for pedestrians. It is recommended to make a review of these measures to provide an overview of the measures and assess their effect.

### **Construction and maintenance of pedestrian measures**

Inspection of the existing pedestrian crossings in for example Oslo shows that many pedestrian crossings have flaws in design, marking and maintenance. It appears that the road authorities do not have enough resources to operate the existing pedestrian crossings. Many of the studies reviewed point out that continual maintenance is very important in order to achieve and maintain a positive effect.

The supplementary pedestrian measures will increase costs for both construction and maintenance. This may be a problem when currently there are not enough resources for the operation of pedestrian crossings. More resources for construction and maintenance is needed to get a positive effect.

### **Few studies about public transport measures**

It is difficult to find studies that document the effect on mobility or other parameters of public transport measures in intersections. The reason is that most studies evaluate the effect for the total section and not the isolated effect for the intersection. Additionally, the studies primarily evaluate the effect of total packages of measures and not only markings and physical measures.

The main focus for intersections seems to be ITS measures. Physical measures are rarely used as an independent measure. Generally it is recommended to combine markings and physical measures with ITS measures such as traffic lights and traffic management systems.

### **Public transport measures likely with positive effect**

Seven bus measures and shared space as a bus measure are reviewed. The measures are listed in table ii, which also summarizes the results of the literature review and recommendations regarding future use in Norway.

For most of the measures no or very few studies or project descriptions have been found. Most studies and descriptions have been found for bus lanes, but they focus mostly on the effect on the section and not in the intersection. Six studies and descriptions have been found for bus transport through roundabouts.

In spite of the fact that few studies have evaluated the effect of the measures, the main impression is that the measures have a positive effect on mobility in terms of reduced travel time. This is based on the fact that the measures are recommended in several handbooks and reports and because the measures seem to have a positive effect for the whole length of the road section.

Table ii. Likely effect of public transport measures as well as current and recommended future use. + indicates positive effect. - indicates negative effect.

Measure	Number of projects	Effect, mobility	Current and recommended future use in Norway
Bus lane	10	+	Used to some extent Should still be used and its use should be intensified Should be evaluated and the effect quantified
Bus lane through roundabout	6	+	Not used The measure should be tested and evaluated
Stops in intersection	3	(+)	Used in unknown scale The use should be quantified Should be evaluated and the effect quantified
Parallel bus lane outside intersections	2	(+)	Not used The measure should be tested and evaluated
Short bus lane in intersection	0	(+)	Not used The measure should be tested and evaluated
Lane for left turn in right road side	0	(+)	Not used The measure should be tested and evaluated
Lock acting measures	0	(+)	Used to a limited extent Should still be used and its use should be intensified Should be evaluated and the effect quantified
Shared space	2	+ / -	Used to a limited extent The measure should be tested and evaluated

TØI report 1108/2010

The overall recommendation regarding the use in Norway is that the measures should be tested and evaluated in Norwegian intersections in urban areas. This should be done partly to document that they have a good effect on mobility, partly to evaluate if the measures have some unintended side effects, and partly to quantify the size of the various effects.

As the extent of use of the various measures is more or less unknown, it is also recommended to clarify the use. This can be done by questionnaires to road authorities and bus companies in, for example, the largest Norwegian cities.

### Effect for other road users

In this review, the focus is what effect the measures have for pedestrians and bus traffic. Several of these measures reduce mobility for private cars. However, reduced mobility can also be seen as a measure to promote more environmentally friendly urban transport. Measures that result in poorer conditions for private cars are therefore no disadvantage when the objective is to promote environmentally friendly urban transport.