Institute of Transport Economics
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Summary:

Road safety in Norwegian urban areas

Accident analysis and assessment of countermeasures

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Based on the "vision zero" of preventing road accidents leading to death or permanent injury, an analysis of severe road accidents in urban areas (speed limit 50 km/h or less) showed that the main challenge is pedestrian and bicycle accidents. More than two-thirds of fatalities in urban areas are pedestrians or bicyclists. About one-half of pedestrian fatalities occur at marked pedestrian crossings. A review of both conventional and some innovative countermeasures showed that a considerable reduction of "vision zero" accidents can be achieved by more extensive use of conventional measures like speed management, enhanced visibility and improved design of crossing facilities for vulnerable road users. Additional safety improvement may be obtained by some new countermeasures that have been tested in other countries, or that exist only as ideas. Some of these measures should be assessed for potential implementation in Norway.

The essence of "vision zero" for road safety is that road traffic shall not result in accidents leading to death or permanent injury to road users. It is therefore an important goal for road authorities to find countermeasures against such "vision zero" accidents. This report focuses on "vision zero" accidents occurring in urban streets.

Vulnerable road users are involved in two-thirds of fatal accidents

As a background for assessing possible countermeasures, accident analysis reports from fatal accidents during the years 2005-2009 were reviewed. The reports had been prepared by the accident investigation teams (UAG – "UlykkesAnalyseGruppe") of the Norwegian Public Roads Administration, which perform in-depth analyses of all fatal road accidents in Norway. In addition, the national register of police-reported personal injury accidents for the years 1999-2008 was used for additional analyses. The review of UAG reports showed that about 15 % of all fatalities occur in urban areas with speed limit 50 km/h or lower. When looking at accidents leading to death or severe injury, we find that 24 % occur in those areas. The different proportions of fatalities vs. severe injuries in urban areas reflect a lower average crash severity in urban as compared to rural areas, which is most likely explainable by lower speeds in urban areas.

The "vision zero" accidents in urban areas mainly involve pedestrians and bicyclists. These two road user groups make up more than two-thirds of urban road fatalities and about half of fatalities and severe injuries combined.

A few accident types stand out. The most frequent accident type involves pedestrians being hit by a motorized vehicle while crossing the street. Most of these accidents occur in marked pedestrian crossings, but also a large number occur outside marked crossings. Most bicycle accidents also involve bicyclists crossing a street. A rather frequent accident type involves a bicyclist riding straight on in an intersection and being hit by a heavy vehicle coming in the same direction and turning right at the intersection.

Even though deviations from road design guidelines were identified only in a minority of the accidents (14 out of 161 fatal accidents), there are several additional accidents where various aspects of the road or the road environment may have contributed to the occurrence or severity of the accident, and where consequently there may be room for improvement. The most frequent road design feature that may have contributed to an accident is reduced visibility distance. Therefore, an important challenge is to develop and apply guidelines in a way that contributes to avoid visibility problems related to vegetation, poles, or signs, alone or in combination with street alignment.

There seems to be a lack of a coordinated approach to designing a safe urban traffic environment. Examples of suboptimal solutions are bus stops without safe nearby crossing facilities, or unregulated pedestrian crossings in traffic environments that are demanding for drivers' attention, e.g. too close to a roundabout.

Some of the "zero vision" accidents happen outside public roads, e.g, at parking areas, shopping centres, camping sites, courtyards, etc. Since public road design guidelines cannot be applied to private areas even though they are open to the public, it is a particular challenge to prevent accidents in such areas. An important question is to what extent authorities can require owners to design such facilities in accordance with certain basic road safety criteria.

Based on the accident analyses the most important challenge in urban areas seems to be the development of effective countermeasures against serious conflicts between motorized vehicles and vulnerable road users.

Conventional measures could be used more extensively

The review of countermeasures against pedestrian and bicyclist accidents suggests that the number of accidents can be substantially reduced by more extensive use of countermeasures that are already included in current design guidelines. Speed-reducing measures at pedestrian crossings is one example. Most pedestrian accidents at marked crossings occur in streets with 50 km/h speed limit. It is likely that the "vision zero" recommended speed limit of 30 km/h in areas with mixed traffic, combined with physical speed-reducing measures, would be a very efficient countermeasure.

Several more or less promising novel countermeasures

In addition to the measures already included in road design guidelines (Handbook 017 of the Norwegian Public Roads Administration) there are some countermeasures that have been tried in other countries and should be considered further regarding possible safety effects.

- Alternative colours and patterns of marked pedestrian crossings for increased conspicuity
- Painted text on pavement at crossings
- Diagonal marked crossings in signalized intersections with "all-green" pedestrian signal phase
- Moving vehicle stop line farther from marked crossings at intersections
- Longitudinal zigzag markings before marked pedestrian crossings to increase driver attention
- "Ergonomic" pedestrian crossings
- Positioning of bike lane for traffic ahead between motor traffic right-turn and straight-on lanes
- Coloured or patterned marking of bike lanes through intersections
- Speed-reducing measures for bicycles in intersections and on pavements
- Bicycle express roads
- Widened bike lane marking line
- Painted bike symbol in lanes with mixed traffic
- Protected bike lanes and bike paths

For some of these measures the safety gain is likely to be marginal. The paucity of really efficient alternative countermeasures can be explained by the fact that the most efficient measures are the conventional ones that are already more or less used up, and are included in the guidelines. Therefore, as mentioned above, more use of conventional countermeasures is probably more efficient that introducing new measures. On the other hand, it is important to investigate further the potential of the most promising alternative measures.

For some measures it is suggested to carry out more extensive assessments, possible including literature surveys and other compilation of international experiences, expert judgments, accident investigations, road user behaviour observations, etc.

Suggested measures for further exploration

Among the countermeasures that are judged to have documented or probable positive effect on safety, the following ones are suggested to be investigated further, and possibly tested in practice.

- Alternative colours or patterns on pedestrian or bicycle areas
- Painted text at crossings
- Diagonal marked crossings
- Stop line moved back from crossing
- Longitudinal zigzag markings
- Pedestrian-activated signs and signals
- "Shared space"

In addition, there are some ideas for new countermeasures that would be interesting to assess further. It should be taken into consideration that some of the ideas cannot be implemented without changing current regulations for road design, signing or markings. Examples of countermeasure ideas that are recommended for further investigation include:

- "Three-dimensional" marking (perceptual illusion) of crossing areas or other symbols/lines
- "Ergonomic" pedestrian crossings
- Increased illumination at pedestrian crossings
- Widened bike lane marking lines
- Protecting bike lanes by plastic poles
- Guardrails on bicycle paths
- Painted bicycle symbols in mixed-traffic lanes
- Electronic warning (to motorists) of approaching bicycles, or bicycles in blind zones

The uniquely Norwegian regulation permitting bicycling on pedestrian pavements should be thoroughly assessed, in order to estimate its total effect on serious accidents. Apparently, it reduces some types of accidents but increases other types.

Conclusion

The main conclusion is that the biggest challenge regarding "vision zero" accidents in urban areas is to prevent pedestrian and bicyclist accidents. It appears that more extensive use of traditional countermeasures, such as speed management and visibility improvements at pedestrian crossing facilities can contribute to a substantial reduction of pedestrian accidents. To prevent bicycle accidents it is important to design crossing facilities in order to maximize bicyclist conspicuity to other road users, and to force bicyclists to reduce their speed at crossings.

In addition to the solutions that are already described in Norwegian guidelines, there are some new countermeasures that look promising. It is suggested that some of them should be considered further for possible trial or implementation.