SWOV Fact sheet

Measures for speed management

Summary
Measures for speed management are essential for limiting the negative effects of driving too fast and at inappropriate speeds. To begin with, safe and credible speed limits must be determined. Dynamic speed limits that take into account the actual current circumstances, such as weather conditions and traffic situation, can be useful here. In addition, it is important that road users always know the local speed limit. Increasingly, this can be achieved by in-vehicle information. Where necessary, local infrastructural measures such as speed humps must be used to enforce a safe speed. These infrastructural measures require a logical location and good implementation. This approach will put a stop to most unintentional speeding offences. Strict police control remains essential for the group of motorists that deliberately drive too fast. Public information campaigns and education should accompany all these measures and, in a more general sense, inform road users about the importance of speed management. In the somewhat more distant future, a large effect is expected of Intelligent Speed Assistance (ISA).

Background
Driving speed is an important road safety factor. There is a strong relation between on the one hand speed and crash rate and injury severity on the other (see SWOV fact sheet *The relation between speed and crashes*). Furthermore, driving speed also influences accessibility, the environment, and quality of life (OECD/ECMT, 2006). Thus, speed control is important for a variety of reasons, and we shall continuously need to find a good balance between not always harmonious interests. This fact sheet discusses the general concept of speed management of motorized vehicles, with the emphasis on road safety. Specific groups, such as motorcycles, delivery vans, coaches, lorries, or cars with trailers, will not be discussed. The following instruments for speed management and the relations between them will be discussed in this fact sheet:
- (Safe and credible) speed limits;
- Good information about the local speed limit;
- Infrastructural measures;
- Police surveillance and enforcement;
- Education and information;
- Intelligent Speed Assistance (ISA).

How do we determine the correct speed limit?
Speed limits are the foundation of all speed policy. They are meant to inform road users about the speed that is safe and possible on a certain road. It has been calculated that if all motorists were to keep to the speed limit, there would be a 25 to 30% decrease in the number of injuries (Oei, 2001).

The current limits
Speed limits were first introduced in the Netherlands in 1957. From then on there was an urban speed limit of 50 km/h. Not until more than 15 years later, in 1974, speed limits were also set for roads outside urban areas: 100 km/h on motorways and 80 km/h on rural roads.

The Dutch general speed limits are legally laid down in the Road Traffic Act. These limits are:
- 120 km/h on motorways;
- 100 km/h on trunk roads;
- 80 km/h on other rural roads; and
- 50 km/h on urban roads.

According to the Ministry of Transport's Administrative Provisions Decree, specific exceptions are possible. Possible exceptions are, for example, 30 or 70 km/h on urban roads, 60 km/h on rural roads, and 100 or 80 km/h on motorways. The road authority then determines which limit applies where. The Administrative Provisions Decree further states that "the speed limits should be appropriate to the

local road conditions. This means that, where necessary, the road environment is adapted in such a way that the intended speed is indicated by the nature and design of the road concerned and its surroundings".

Towards safe and credible speed limits
Speed limits should primarily indicate a safe speed. The safe speed depends on the function of the road and thus on the traffic composition. If motorized traffic mixes with pedestrians, cyclists, and moped riders, the speed limit must be low. In principle, the same applies for roads with a relatively large volume of heavy vehicles. The possibility or impossibility of certain conflicts, for instance lateral or frontal conflicts, also is an indicator of safe speed. *Table 1* shows the safe speeds for a number of road types and potential conflicts. They are defined in Advancing Sustainable Safety (Wegman & Aarts, 2006) based on knowledge of the vulnerability of the human body (biomechanical tolerance) and on the Swedish Vision Zero approach.

	Safe speed
Roads with possible conflicts between cars and unprotected road users	30 km/h
Intersections with possible lateral conflicts between cars	50 km/h
Roads with possible frontal conflicts between cars	70 km/h
Roads on which frontal and flank conflicts with other road users are impossible	$\geq$ 100 km/h

Table 1. *Safe speeds for a number of road types and their potential conflicts.*

Not only must the speed limit be safe, it must also be credible. This means that the speed limit meets the expectations evoked by the road image which is defined by the road's features and its surroundings (Van Schagen et al., 2004). Research has shown that it is possible to identify specific characteristics of road and environment that influence credibility, and that drivers are more inclined to keep to credible limits rather than to incredible limits (see SWOV fact sheet *Towards credible speed limits*). If a speed limit does not match the road image, either the limit or the design should be changed. This principle is not new, but in practice there is still a lot of room for improvement. Especially at transitions there is still a lot to be gained. According to the principle of credibility, a change in the limit should always be accompanied by a change in road image. Presently, SWOV, together with some provinces and a consultancy company, is developing an instrument to assist road authorities in determining whether speed is a problem on a specific road, and if so, in which way they can realize a safe and credible limit (see Aarts & Van Nes, 2007 for the first phase)

Dynamic speed limits
At this moment in time, the majority of speed limits in the Netherlands are static. They do not allow for actual current circumstances, and it is these that largely determine a safe speed. Dynamic speed limits do allow for real-time circumstances such as the weather and the traffic situation. That is why dynamic limits will usually be more credible than static limits.

The Netherlands already has dynamic limits, albeit to a limited extent. For example, on motorways with matrix road signs the speed limit is adjusted to the circumstances, for instance when there are congestions or extremely large traffic volumes. They are also used at road works on motorways, often beside the ordinary static limits. Depending on the local conditions, the speed limit in this situation is either 70 or 90 km/h. One of the criteria used for setting the limit at 70 km/h is that road workers must be actually working at that time. In 2007, the Dutch Ministry of Transport started experiments with dynamic speed limits on some motorways to learn about the effects on safety, traffic flow and environment.

In a completely dynamic speed limit system the limit at that place and at that time will probably be indicated in the vehicle. However, before this is accomplished, not only do some necessary technical details have to be developed, but also some crucial questions need to be answered. One of the most important questions is which speed limit under which circumstances can guarantee an acceptable level of safety.

How does the driver know the speed limit?
As mentioned before, the road authority first has to determine which speed limit applies at a location. Then, of course, it is important that the road users always and at any time know the speed limit. Every

lack of clarity must be eliminated, but in practice this is not always the case. Information about the local limit is now often indicated by a road sign. However, general limits are not communicated by road signs; the road user is supposed to know them. In addition, it is possible to consistently use road markings as, for example, is pleaded for in 'Essential Recognizability Features' (see also SWOV fact sheet *Recognizable road design*). Increasingly in-vehicle information will be used, often linked to a navigation system.

What can we achieve with infrastructural measures?
Next, the road design and the infrastructure must support the speed limit. At places where a low speed is very important, e.g. in the vicinity of schools, pedestrian crossings and cyclist crossings, but also at intersections, physical speed limiters can be used. In this manner motorists will be forced to lower their speed.

30 and 60 km/h zones
According to the principles of Sustainable Safety, mixing motorized traffic with non-motorized traffic is only permitted on sections of access roads and at intersections. This has resulted in a considerable increase in the number of urban 30 km/h zones and the introduction of rural 60 km/h zones. Evaluation studies have shown that these measures have resulted in a reduction of the number of injury crashes of 22 and 25% respectively in these zones. (Vis & Kaal, 1993; Beenker et al., 2004). To achieve these effects it is important that the road design supports the 30 and 60 km/h speed limits. In general, lowering a limit without supplementary measures leads to only a limited reduction in driving speeds.

Intersections and road sections
Raised junctions and especially also roundabouts are constructed to achieve a reduction in speed. Where urban intersections have been replaced by roundabouts, the number of crashes with fatalities and severe injuries has been reduced by about 73% (Dijkstra, 2005), whereas the general reduction in severe crashes during the same period was only approximately 10%. Fortuijn (2005) also reports large effects of roundabouts on urban roads.

To an increasing extent, raised junctions as speed reducing measure are being used in rural areas and not just in 60 km/h zones. A before-and-after study in the province of Zuid-Holland has measured the effect of plateaus on 80 km/h roads (Fortuijn et al., 2005). The study showed that at raised junctions with traffic lights, the number of casualty crashes declined with 40-50%. Raised priority junctions also showed a decrease in the number of casualty crashes. However, as yet, the number of intersections studied is too small to make definite statements. Speed humps are also used to physically reduce speed at intersections, especially in urban areas. In general, the speed humps are located just before the crossing area.

Besides speed humps, axis offsets and road narrowing are also used to limit speed, especially on urban access roads. For all physical speed reducing measures, it is important that the location is logical and that the geometric design is consistent with the purpose. For guidelines see, for example, CROW, 2004.

Urban borders and other 'transitions'
The motorist often insufficiently adapts his/her speed, especially in the transition from a high speed limit to a lower speed limit. One of the reasons lies in the fact that after driving at a high speed for a long time, he, at a given moment, underestimates the speed and does not adjust it sufficiently. This phenomenon occurs, for example, when going over to a lower order road with a lower speed limit after having driven on a motorway for a long time (see also the fact sheet *Speed choice: the influence of human, vehicle, and road*).

The transition between a rural and an urban area presents a specific problem especially on main roads that pass through villages. It also applies here that one has often been driving at a higher speed for some time. What is more, the required reduction in speed that usually accompanies an urban-rural transition is often insufficiently 'visible' or 'noticeable' to the motorist. Specific measures to mark this transition clearly, supplemented with physical and visual speed limiters, like for instance a gate construction, and preferably supplemented with urban measures, can result in substantial safety improvements (see CROW, 1999).

Continued police surveillance on top of it all?
When all the above measures have been carried out adequately, we may assume that unintended offences against the speed limit will largely have disappeared. But for as long as motorists can ultimately determine their speed themselves, a group will always remain that regularly exceeds the limit deliberately. Police surveillance and control remains of the utmost importance to reach this group. As long as the previously mentioned measures have not been carried out sufficiently, more police surveillance based on general deterrence and prevention will be needed. The fact sheet *Police surveillance and driving speed* discusses the how and why of police surveillance and the various methods and their effects.

What is the role of education and information?
Education and information are a support and a prerequisite for each of the measures discussed above. Road users must understand that speeding is a serious problem; they must understand why measures are taken; they must understand how the speed limit system works. The possibilities for education and information having a direct influence on driving speed are limited.

Primary school and secondary school
Structural traffic education in Dutch schools is limited to primary schools. At the ages between 4 and 12 years old it is practically impossible to influence driving speed habits that will be displayed at a later age. However, it may be possible to introduce the subject of speed to the children with the idea that they will address their parents about it. For pupils of secondary schools, the moped training is a good moment for paying attention to the consequences of driving (too) fast.

Driver training
In the driver training the future drivers have to learn all about safe speeds. This includes the limits themselves, why speed limits are necessary, adjusting speeds to the circumstances, et cetera. They must also learn to anticipate and to adjust speed in time. The importance of learning to deal with speed from the very beginning is illustrated by the fact that novice motorists have a four times higher probability of being severely injured in a traffic crash than experienced motorists, and that driving too fast is an important factor here (see the SWOV fact sheet *Young novice drivers*).

After having obtained a driving licence
Finally, the possibilities for education after the driving test has been passed are limited. In line with the Dutch rehabilitation course for drink-driving offenders, the rehabilitation course for dangerous driving behaviour was introduced in October 2008. This course is intended for road users who deliberately engage in risky behaviour and as a result create danger for themselves and for others. This measure also considers serious speeding dangerous behaviour.

Public information
Public information is especially effective when combined with other measures. This is certainly also the case for police surveillance (Delhomme et al., 1999). Public information should be used to explain the purpose, necessity, and effect of speed measures such as, for example, police surveillance and speed humps. In addition, information helps to increase awareness of the problem of driving (too) fast. Information on its own is insufficient to change behaviour.

The discrepancy between individual advantages and social disadvantages is a problem in information about speed. The Dutch 'Ecodriving' campaign, tries to link the advantages at the social level to advantages at the individual level especially from an environmental point of view. 'Ecodriving' is a combined initiative of the Ministry of the Environment and the Ministry of Transport. It focuses on a calm, economical driving style for both private and professional drivers, with the emphasis on increased comfort and economy for the driver, and positive environmental and road safety effects at the social level (http://www.hetnieuwerijden.nl/).

What is the position of Intelligent Speed Assistance (ISA)?
Intelligent Speed Assistance (ISA) is a system that uses information exchange between surroundings and vehicle. The vehicle receives information from the surroundings about the desirable or mandatory speed limit and reacts to it. The term ISA is often immediately associated with a completely intervening system. However, ISA is a collective term for various systems:
– The open ISA warns the driver (visibly and/or audibly) that the speed limit is being exceeded. The driver himself decides whether or not to slow down.

– The half-open ISA exercises counter-pressure on the accelerator pedal when the speed limit is exceeded (the 'active accelerator'). Maintaining the same speed is still possible, but less comfortable because of the counter-pressure.
– The closed ISA limits the speed automatically if the speed limit is exceeded. In principle, the driver cannot influence this.

The ISA system can work with static speed limits, together with or without the location-dependent (advised) speed limits. It will also become increasingly possible to work with dynamic speed limits. Large safety benefits are expected from ISA, especially from the more intervening systems. The technical problems have almost been solved. Informing/warning systems, like SpeedAlert, are already available. At this moment, mainly legal and political considerations are delaying the application of more intervening systems.

For more information see the fact sheet *Intelligent Speed Assistance (ISA)*.

Conclusion
It is abundantly clear that there are many ways of limiting the road safety effects of speeding. However, an integrated, step by step approach is required. It all begins with determining a safe speed limit which matches a road's function and, often dependent on its function, the traffic composition. Furthermore, the road image must also support this limit, so that the road user finds it credible. Physical speed limiters will be necessary at locations where a low speed is crucial, for example in residential areas, near schools, at pedestrian crossings, and at intersections. It must also be ensured that the driver always knows the actual speed limit. These measures are expected to put a stop to most of the unintentional speeding offences. To reach the remaining group of deliberate speed offenders, police surveillance remains essential, at least for the time being. Education and public information are supportive for all this and must inform the road users, better than is now the case, about the dangers of driving (too) fast and the positive effects of the various measures.

There are various technical developments that can make speed management more effective and more credible within a reasonably short time. For example, there are already systems, usually linked to a navigation system, that show the local speed limit inside the vehicle. The possibilities of using dynamic speed limits that take the local weather and traffic conditions into account are increasing rapidly. Finally, much is expected of ISA, not only of systems that make speeding offences impossible, but also of systems that send a warning when the limit is being exceeded.

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