

## Shoulders on rural access roads

### Summary

In a sustainably safe traffic system, uniformity of traffic facilities is a point of special interest. Uniformity ensures recognizability and predictability of (critical) traffic situations. The uniformity of rural access roads can be increased by applying shoulders on both sides of the road; this creates a narrow single lane for motorised vehicles in the middle of the carriageway: a driving lane. Shoulders are marked with broken lines. The shoulders on either side of the driving lane can be used by cyclists if they are sufficiently wide. Studies indicate that this type of marking slightly increases road safety.

### Background and contents

When redesigning rural roads according to the Sustainable Safety guidelines, 80 km/h roads with a minor traffic function in rural residential areas are converted into rural access roads. This road category is intended for use by all transport modes and has a speed limit of 60 km/h.

In a sustainably safe traffic system, uniformity of traffic facilities is a point of special interest. Uniformity is a way of ensuring recognizability and predictability of (critical) traffic situations (see also the SWOV Fact sheet [Recognizable road design](#)). The uniformity of rural access roads can be increased by applying shoulders; this leaves a driving lane for motorized vehicles in the middle of the carriageway (see *Figure 1*). The present Fact sheet will discuss the requirements for the different types of rural access road and the effects on traffic behaviour and road safety.

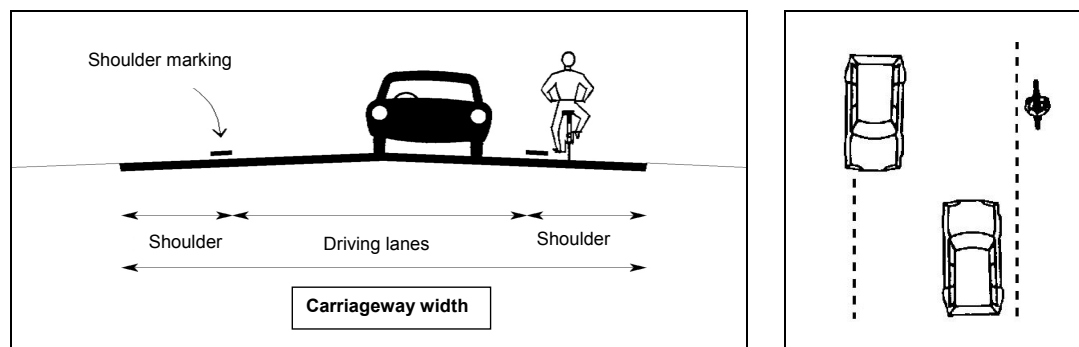


Figure 1. *Driving lanes with shoulders; cross section (left) and view from above (right).*

### How many casualties on 60 km/h access roads?

Table 1 shows that in 1998 there were 11 registered fatalities on Dutch 60 km/h rural access roads. In 2009 there were 82 fatalities; an increase by a factor of 7. This amounts to an increase from about 1% of all registered road deaths in the Netherlands in the late 1990s to about 12% one decade later. This increase seems to be almost entirely due to the increase in 60 km/h roads. In 1998, there was an estimated 2,100 km of 60 km/h access roads; in 2008 this was approximately 35,400 km (Weijermars & Van Schagen, 2009), an increase by a factor of 16. This means that the casualty density, here the number of road fatalities per 1,000 kilometres road length, went down by 62% from 5.2 in 1998 to 2.0 in 2008. Too little reliable data is available about the traffic volumes on these roads to allow any statements about the crash rate.

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Intersection	3	1	2	4	5	9	11	9	15	17	17	11
Road section	8	9	21	20	23	27	31	45	46	52	51	71
Total	11 (1%)	10 (1%)	23 (2%)	24 (2%)	28 (3%)	36 (4%)	42 (5%)	54 (7%)	61 (8%)	69 (10%)	68 (10%)	82 (12%)

Table 1. Registered numbers of fatalities on 60 km/h roads in the period 1998-2009 in the Netherlands, and the percentage of the total number of fatalities on all roads. Source: Dutch Ministry of Transport- BRON.

### What are the guidelines for access roads with shoulders?

According to the Dutch guidelines, the rural access roads can be subdivided into roads of type I (carriageway width of 4.50-6.20 m) and type II (carriageway width of 2.50-4.50 m) (Table 2). From the Sustainable Safety point of view, the 60 km/h speed limit on rural access roads is in fact too high for the mixing of different transport modes. For safe mixing the maximum speed should not be higher than 30 km/h. To make the situation as safe as possible, applying a single driving lane for car traffic in both directions in the middle of the carriageway on type I access roads is recommended (CROW, 2002; see also Figure 1). Such a visual narrowing is intended to make motor vehicles drive slower and more in the middle of the carriageway. The driving lane is marked by broken lines. The spaces between the driving lane and the edge of the carriageway on either side are called shoulders. Shoulders provide more room to correct steering errors, thus reducing the risk of going off the road. We expect that this will reduce the damage to road shoulders, which, in its turn, can substantially lower the maintenance costs. The width of the shoulder and the type of edge marking determine the name that is used for the shoulder (CROW, 2004, 2006):

- Diverging lane, intended for motorized vehicles when overtaking or when passing oncoming traffic (marked with broken line in a ratio of 1 m line – 3 m open, width of 0.25-0.40 m);
- Auxiliary lane, intended for use by bicycles (marked with broken line in a ratio of 1 m line – 1 m open, width of 1.25-1.50 m);
- Bicycle lane (marked with broken line in a ratio of 1 m line – 1 m open, width of 1.50-2.00 m and red in colour).

Characteristic*	Rural access road type I	Rural access road type II
Speed limit	60 km/h	60 km/h
Number of lanes	One	One
Carriageway width	4.50 – 6.20 m	<4.50 m
Width of driving lane	3.00 – 4.50 m	Same as carriageway width
Marking	Broken edge marking (10*-15** cm wide) 1 m line – 3 m open (diverging lane) 1 m line – 1 m open (auxiliary lane) 1 m line – 1 m open + red pavement (bicycle lane)	No marking
Width of shoulder	0.25 – 0.40 m (diverging lane) 1.25* – 1.50** m (auxiliary lane) 1,50 – 2,00 m (bicycle lane)	n.a.

Table 4. Dutch Guidelines for rural access roads. CROW, 2002; 2004 (\*);2006 (\*\*).

In the Dutch *Design manual for bicycle traffic* (CROW, 2006), the width of the auxiliary lane intended for bicycles has been reduced to 1.5 m and markings must have a line width of 15 cm; previously these measures were 1.25 m and 10cm (CROW, 2004). The auxiliary lane for bicycles has no legal status as a traffic facility; therefore motor vehicles may use it, stop on it, and park on it. The auxiliary lane for bicycles was sometimes given extra emphasis by giving it a red colour. However, in the *Design manual for bicycle traffic* this red colour is strictly reserved for the bicycle lane. Bicycle lanes are further distinguished from non-compulsory bicycle lanes by a bicycle symbol on the road surface approximately every 500 metres and after every intersection. Bicycle lanes do have the legal status of a bicycle facility. Motor vehicles and mopeds are permitted to use the bicycle lane, but they are not

allowed to use it for halting or parking on or next to it. The *Design manual for bicycle traffic* advises against positioning parking spaces next to the bicycle lane.

Separate bicycle and moped tracks do not contribute to the recognizability of the access road which has mixing of all transport modes as one of its important Sustainable Safety features. Only if the daily traffic volume exceeds 2,000 to 3,000 motor vehicles per day, does CROW (2006) recommend a separate bicycle track. When redesigning the current situation (with a smaller traffic volume), the bicycle and moped lanes can be converted into non-compulsory bicycle lanes, with mopeds on the carriageway.

According to the recommendations in the *Road design manual (CROW, 2002)*, access roads of type II are too narrow (< 4.5 m) for a marked driving lane and therefore have no edge markings. A broken edge marking can be applied here (in the ratio of 3-1; 3 metres line, 1 metre open) in dangerous bends or when vehicles often go off the road.

On both types of access road, a centre line marking may only be applied in exceptional cases: only in a bend for safety reasons and only on short stretches.

### **What proportion of the access roads have been fitted with shoulders?**

To improve its insight in the layout of roads in the Netherlands, SWOV in early 2009 held a survey among the Dutch road authorities (Weijermars & Van Schagen, 2009). This showed that in 2008, 35,400 km (63%) of the approximately 56,000 km of non-urban roads categorized as access roads indeed had a 60 km/h speed limit. The speed limit on the remaining roads generally (still) was 80 km/h. According to the road authorities approximately three-quarters of the access roads with a 60 km/h limit had markings according to the Dutch Essential Recognizability Characteristics (CROW, 2004), which means that roads wider than 4.5 m had broken edge markings.

### **How do shoulders affect the number of road casualties?**

To assess the 60 km/h projects a crash study (with before-and-after data plus reference areas) was performed in twenty zones with an 850 km total road length (Beenker, 2004). At road sections, the number of crashes with casualties (fatalities, serious road injuries and slightly injured) appears to be almost one-fifth lower. The carriageway width of the roads included in this study varied between 3 and 5 m. Only those roads with a surface width of between 4.5 and 5 m were likely to have been fitted with shoulders. Therefore it is not absolutely certain for which share of the casualty reduction these roads with shoulders are responsible. It should be noted that the number of casualties at intersections even decreased by almost 50%, probably as a result of the construction of raised intersections at hazardous locations. Although this evaluation study indicates that changing an 80 km/h road into an access road has a positive effect on the number of road casualties, it is not possible to make any statement about the specific contribution of shoulder and driving lane.

### **How do shoulders influence driving behaviour?**

SWOV performed two observation studies at road sections with and without shoulders, so that a little is known about the effects on the behaviour of both drivers and cyclists. It should be noted that in both studies the investigated shoulders were intended for use by cyclists – and were therefore wider than a diverging lane – but that they were too narrow for a non-compulsory lane according to the present definition in the guidelines.

The first study (Van der Kooi & Heidstra, 1999) compared roads with and roads without shoulders. On average, cars on roads with shoulders appeared to drive somewhat slower than cars on roads without shoulders. At the same time, however, it was shown that the space between cyclists and passing cars was slightly smaller on roads with shoulders, than on those without.

The second study (Van der Kooi & Dijkstra, 2003) was a before-and-after study. The driving speed and the lateral position of cars were observed before and after shoulders were applied. The findings broadly matched those in the previous study. A carriageway with shoulders has been found to have a channelling effect which both drivers and cyclists seem to accept. These are positive effects. Cyclists use 'their own' strip and usually keep somewhat more distance from the road edge than they did before a shoulder had been applied. Drivers also keep slightly more distance from the road edge when shoulders are present. When passing a cyclist they often choose not to cross the shoulder on the other side of the road. At the same time, this means that when drivers overtake a cyclist on a non-compulsory bicycle lane they are often closer to the cyclist. To what extent the distance being a few centimetres narrower is dangerous is hard to say. In most cases, the average driving speed goes down by a few km/h due to the edge lanes. This is a positive development that, however limited it may

be, has a positive effect on nearly all crash types (see also SWOV Fact sheet [The relation between speed and crashes](#)).

As was mentioned earlier, the shoulders that were investigated were narrower than is now the advice for non-compulsory lanes. A slightly wider strip may perhaps have a somewhat more positive effect on driving speed and distance between car and cyclist, but this would require further investigation.

Furthermore, Aarts & Davidse (2007) found that red shoulders – in their study without the bicycle marking – increase the distinction of access roads as opposed to other road categories and raise the correct expectations about the possible presence of cyclists.

Other than the studies into shoulders on 60 km/h roads, there has been much international research into the effects of line markings on driving behaviour. A meta-analysis of these types of studies (Davidse et al., 2004) shows that edge markings have a positive effect on the lateral position of cars on the road, and limit the risk of going off the road and damaging the road shoulder. An unwanted effect is that the good visual guidance of line markings encourages drivers to use a higher speed. Broken lines offer (somewhat) less visual guidance than solid lines and also give a clearer impression of the driven speed. If, like on access roads, the purpose is speed reduction, broken lines are preferred.

### **Conclusion**

The uniformity and recognizability of rural access roads is increased by shoulders at both sides of the road, thus creating a single driving lane for motorized vehicles in the middle of the carriageway. The marking of the shoulders consists of broken lines. The two shoulders can be used by bicycles if they are sufficiently wide. Such strips are called auxiliary lanes intended for bicycles. If the surface is marked with a bicycle symbol it is called a bicycle lane. Bicycle lanes have a legal status and are preferably carried out in red asphalt. Research findings indicate a slight road safety improvement as a result of edge markings.

### **Publications and sources**

#### **(SWOV reports in Dutch have an English summary)**

Aarts L.T & Davidse, R.J. (2007). [Herkenbare vormgeving van wegen; Eindrapport van de herkenbaarheidsprojecten in het SWOV-programma 2003-2006](#). R-2006-18. SWOV, Leidschendam. [in Dutch]

Beenker, N.J. (2004). [Evaluatie 60 km/uur projecten; Eindrapport](#). In opdracht van de Unie van Waterschappen. VIA Advies in verkeer & informatica, Vught.

CROW (2002). [Handboek wegontwerp wegen buiten de bebouwde kom: erftoegangswegen](#). Publicatie 164d. CROW, Ede.

CROW (2004). [Richtlijn essentiële herkenbaarheidkenmerken van weginfrastructuur: wegwijzer voor implementatie](#). Publicatie 203. CROW, Ede.

CROW (2006). [Ontwerpwijzer fietsverkeer](#). Publicatie 230. CROW, Ede.

Davidse, R.J., Driel, C.J.G van & Goldenbeld, Ch. (2004). [The effect of altered road markings on speed and lateral position: a meta-analysis](#). R-2003-31. SWOV, Leidschendam. [In English]

Kooi, R.M. van der & Dijkstra A. (2003). [Enkele gedragseffecten van suggestiestroken op smalle rurale wegen](#). R-2003-17. SWOV, Leidschendam. [in Dutch]

Kooi, R.M. van der & Heidstra, J. (1999). [Effect van kantstroken op verkeersgedrag](#). R-99-25. SWOV, Leidschendam. [in Dutch]

Weijermars, W.A.M. & Schagen, I.N.L.G. van (2009). [Tien jaar Duurzaam Veilig; Verkeersveiligheidsbalans 1998-2007](#). R-2009-14. SWOV. Leidschendam.