SWOV Fact sheet

Zones 30: urban residential areas

Summary
Sustainable Safety uses a road categorization in which through traffic is concentrated on motorways and other main roads. In residential areas, which have a living, shopping, or work function, through traffic is discouraged by setting a speed limit of 30 km/h, and by speed reducing measures such as speed humps, road narrowing etc. When a 50 km/h residential area is redesigned into a 'Zone 30', the average decrease of the number of injuries is approximately 25%. The Zones 30 also have a positive effect on the quality of life: there is less noise, crossing the road is easier, and emissions are less. According to the Sustainable Safety requirements, residential areas should be as large as possible, but 2 km^2 is the largest feasible area. A road structure of the 'limited access' type is the most suitable for a 30 km/h area.

What are residential areas?
Residential areas are unbroken areas with a living, shopping, or work function. According to the Sustainable Safety principles, the only cars allowed are those with their origin or destination in that area. Through traffic should as much as possible make use of roads and streets that are meant for that purpose. According to the road categorization, these are distributor roads, urban and rural main roads with speed limits of 50 and 80 km/h respectively, and through roads, usually motorways and trunk roads with a speed limit of 100 or 120 km/h.
According to Sustainable Safety, residential areas have a speed limit of 30 km/h because collisions at speeds lower than 30 km/h rarely result in fatal crashes. Slow traffic (pedestrians, cyclists, and (light) moped riders) and motor vehicles can mix safely at this maximum speed. The quality of life also improves (noise level, ease of crossing the road, level of exhaust fumes).

Since 1983 it has been legally possible to create 30 km/h zones in the Netherlands. Originally, the demands for its design were published in the *Manual for 30 km/h measures* (Ministry of Transport, 1984). This design requires quite a few measures per kilometre road length. In 1998, about 15% of the total length of residential streets in the Netherlands had been converted into Zones 30. By early 2003, the Start-up Programme Sustainable Safety which was carried out in the period 1998-2002 had increased this to approximately 45% and to about 75% in 2008 (Weijermars & Van Schagen, 2009). However, the new 30-km/h zones have a low-cost design (Infopunt DV, 2000); in these zones speed reducing measures were only used at 'dangerous' locations. The low-cost design is not the intended final situation, but a transition phase that is used to quickly construct many Zones 30 at relatively low cost in order to speed up making the urban road categorization visible.

How safe are residential areas?
As illustrated above, 1998, 2003 and 2008 were important years in the development of urban residential areas. Below, we will present some Dutch crash data about the safety developments in this ten-year period. We will focus on casualties (fatalities and inpatients) and serious crashes (with at least one inpatient or fatality).

Numbers of casualties
In 1998, there were 464 casualties (fatalities and inpatients) in streets with a 30 km/h speed limit, which was around 7% of the total number of casualties in urban residential areas. In 2003 and 2008, these numbers were 656 (10%) and 892 (13%) respectively. The rise in the number of casualties in streets with a 30 km/h speed limit is mainly caused by the (strongly) increased length of these streets. The number of casualties increased by 41% between 1998 and 2003, and by 36% between 2003 and 2008. In these periods, the road length increased by 227% and 73% respectively. This makes the increase in road length much greater than the increase in the number of casualties, which means that the number of casualties in streets with a 30-km/h speed limit has, relatively speaking, developed in a positive way.

Crashes per road length
In 1998, 48 serious crashes were registered per 1,000 kilometres of road length with a 30 km/h speed limit (crash density). In 2003 and 2008 the numbers of crashes were 21 and 17 respectively. On roads with a limit of 50 or 70 km/h, there were 115 serious crashes per 1,000 km of road length in 1998, and these numbers are 131 and 205 for 2003 and 2008 respectively. This shows that the crash density has decreased on roads and streets with a 30 km/h speed limit, while it is still increasing on roads with a limit of 50 or 70 km/h.

Involvement of cyclists or pedestrians
The positive development in the number of serious crashes cannot be found in the number of serious crashes that involve at least one cyclist or pedestrian. In 1998, a cyclist or pedestrian was involved in 42% of serious crashes on streets with a 30 km/h speed limit. In 2003 and 2008, this share had increased to 50% and 59% respectively. A cyclist or pedestrian was involved in 27% of the fatal crashes in 1998, in 54% of those in 2003 and in 52% of those in 2008. This shows that in later years, cyclists and pedestrians are involved in serious crashes more often than in 1998. This number of serious crashes per 1,000 kilometres of road length decreased from 20 in 1998 to 10 in 2008. However, this 50% decrease is lagging behind compared to the 65% decrease in the total crash density on these streets.

Crash rate
No reliable data is available for the amount of traffic on streets and roads with various speed limits. Therefore, it is not possible to determine the crash rates (crashes per vehicle kilometre) for these types of roads.

What is the safety effect of a 30 km/h area?
The fact that 30 km/h areas have a positive road safety effect has been established in many Dutch and foreign studies. The average number of injury crashes decreases by about 25% when a residential area with a speed limit of 50 km/h is redesigned as a Zone 30 (Elvik, 2001); the dispersion of this average is more than 20%. Vis & Kaal (1993) found a decrease of 22% (with a dispersion of 13%) in the number of injury crashes in 150 Dutch 30 km/h areas. The large dispersions of crash reduction are mainly due to the large differences in the characteristics of the areas studied; these are especially the size, the building density, the nature of the chosen speed reducing measures, and the traffic volume. Wegman et al. (2006) estimate that in 2002 alone, 654 casualties (fatalities and in-patients) were saved in the Netherlands (around 3% of the total number in 2002 in the Netherlands). Weijermars & Van Schagen (2009) estimate that in total between 51 and 77 fatalities were saved in the period of ten years between 1998 and 2008.

What is the maximum size of a residential area?
According to the requirements of Sustainable Safety, residential areas should be 'as large as possible'; there is no more exact indication. Their size is dependent on the structure and density of the road network; this is often determined by geographical features. In practice, the size therefore varies considerably, from 0.2 km^2 to 2 km^2. Quality of life (noise level, ease of crossing the road, emissions) does not allow more than 5,000 motor vehicles travelling through a 30 km/h street per 24 hours. Large areas can also comply with this by increasing the number of entries to the area to be proportional to the area size (for example 2 entries for 0.2 km^2 and 16 for 2 km^2). General rule is that for a Zone 30 larger than 2 km^2 it is not possible anymore to keep the 24-hour traffic volumes at an acceptable level (Van Minnen, 1999). For a residential area larger than 1 km^2 the surrounding roads will have (too) many motor vehicles per hour. This will make it more difficult for especially pedestrians and cyclists to cross these roads.

Which road structure is suitable for a residential area?
Traffic engineers usually make a distinction between three specific road structures for residential areas: 1) a grid or lattice structure (Alexander, 1966), 2) a tree or organic structure (Reichow, 1959), and 3) a mixed or 'limited access' structure (Marks, 1957); see *Figure 1*. According to Dijkstra (2000), history teaches us that road safety in residential areas is best served by a system based on limitations of entry and speed; this is the case in the organic structure and the limited access structure.

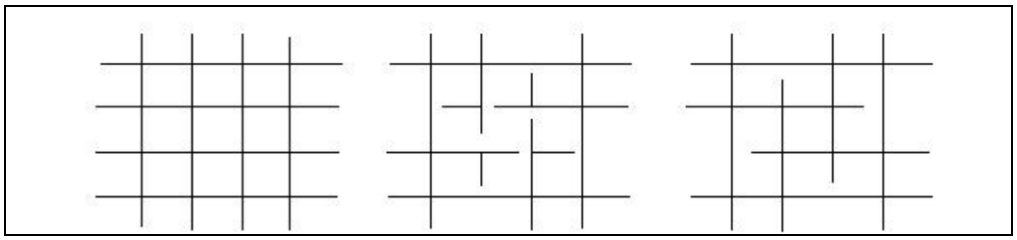

Figure 1. *Traffic structures, from left to right: grid or lattice, organic or tree, mixed or limited access.*

The quality of life and accessibility are optimal in a grid structure in which the traffic is dispersed over many streets. The construction and maintenance costs of the traffic structure are most favourable for the 'limited access' structure because of the lesser total road length in the area. If all the features of these structure types are considered, the 'limited access' structure scores positively in all aspects (Dijkstra, 2000).

How can you keep out through traffic in an existing structure?

It is possible to keep through traffic out of a residential area by making direct routes impossible or unattractive. This can be done by introducing detours, or by taking speed reduction measures such as speed humps, road narrowing, or zigzagging the road axis. These ways of limiting car traffic are not allowed to limit the area's accessibility for cyclists and pedestrians. Extra short cuts and priority regulation must prevent delay along bicycle routes.

How much extra travel time is there for emergency services and buses?

Larger Zones 30 lead to longer travel times for emergency services and buses. An emergency vehicle needs 11 seconds more in a 0.25 km^2 area, up to 31 seconds in a 2 km^2 area. A bus needs an extra minute in a 0.7 km^2 area. All these extra travel times have been calculated in comparison with an area the same size in a 50-km/h area.

Do drivers indeed keep to the 30 km/h limit?

During the first period after the introduction of the 'Zone 30' measure, speed measurements were conducted (Vis, 1991) in areas that had been redesigned according to the Dutch *Manual for 30 km/h measures* (VenW, 1984). At that time, the driving speed of 85% of the motor vehicles then decreased to below 35 km/h in practically all the investigated areas. From 1998 onward, many low-cost design areas have been implemented. The speed reduction measures in those areas have been limited to a small number of relevant locations. The Dutch Traffic Safety Association (3VO, 2004) has conducted measurements throughout the Netherlands in dozens of 30-km/h areas, among which the low-cost design areas. Only 14% of motor vehicles drove slower than 30 km/h, but a vast majority of 85% did not drive faster than 45 km/h. According to a study of the characteristics of low-cost design areas (Steenaert, Overkamp & Kranenburg, 2004) residents accept that a speed is higher than 30 km/h on some road segments as long as speed reduction measures have been implemented at intersections. The Bureau Traffic Enforcement of the Public Prosecution Service of that time (Plasmans & Tuinenburg, 2006) evaluated enforcement projects that had been carried out in fourteen 'Zone 30' areas. Their report states: "Low-cost design areas in particular turn out to be complaint locations; a road which has the entire Sustainable Safety design often has no complaints at all. Enforcement in these low-cost design streets often has a temporary positive result". On average, each project had a duration of six months and after this period enforcement was still carried out regularly until the infrastructure at that location had been adapted. The average percentage of vehicles driving faster than 30 km/h was 40% before and 20% after the enforcement projects had been carried out. The importance of road design is also reported by Berends & Stipdonk (2009). Their conclusion is that half of the increase in the number of cyclist casualties in residential areas can be explained by the road design. Here they refer to a road where the design is not reasonably expected to result in a maximum speed of 30 km/h (incredible speed limit).

Is the speed hump necessary as a speed limiter?

The 'classic' speed hump often gets a lot of criticism. Speed measurements have shown that the 'classic' speed hump is the most effective of all speed reducing measures (Vis, 1991). For the time being, there is no good alternative for the speed hump so long as automatic speed limiters are not commonplace. The actual designs and location of speed humps sometimes deviate from the design

guidelines (CROW, 2002). A better application of these guidelines would prevent a lot of nuisance for residents and those travelling through.
Restraint is required when using speed reduction measures on the surrounding through roads, especially at places where there are many crossing movements. Too many impediments to the traffic flow on these through roads can, after all, result in cars using roads and streets that they are not intended to.

How much do measures in residential areas cost?
SWOV has estimated the costs of low-cost design 30 km/h areas at about €22,000 per kilometre. This measure costs €86,000 per casualty saved (deaths or in-patients) (Wesemann, 2000).

Conclusions and recommendations
The road categorization in Sustainable Safety aims to concentrate through traffic on motorways and other main roads. Through traffic is kept out of the residential areas and in those areas slower speeds are ensured, especially by speed reduction measures. Both road safety and the quality of life (noise level, road crossing, exhaust fumes) benefit. However, if a 30 km/h area is larger than 1 km^2, it puts a lot of traffic pressure on the surrounding through roads. We recommend taking this into account by limiting Zones 30 to a maximum of 1 km^2, or by adapting surrounding roads, especially improving their crossing facilities (Van Minnen, 1999). We also recommend using a 'limited access' traffic structure for a Zone 30. This is favourable for all aspects: road safety, quality of life, accessibility, and construction and maintenance costs (Dijkstra, 2000).

Publications and sources
(Most publications are in Dutch; SWOV reports contain an English summary)

3VO (2004). *Samenvatting van de meetresultaten*. Notitie. 3VO, Huizen.

Alexander, C. (1966). *A city is not a tree*. In: Design, No 206, February 1966, pp 46-55.

Berends, E.M. & Stipdonk, H.L. (2009). *De veiligheid van voetgangers en fietsers op 30km/uur-erftoegangswegen; De invloed van de inrichting van erftoegangswegen binnen de bebouwde kom op ongevallen tussen langzaam verkeer en motorvoertuigen*. R-2009-6. SWOV, Leidschendam.

CROW (2002). *Richtlijn verkeersdrempels.* Publicatie No. 172. CROW, Ede.

Dijkstra, A. (2000). *Veiligheidsaspecten van verkeersvoorzieningen in stedelijke gebieden.* R-2000-5. SWOV, Leidschendam.

Elvik, R. (2001). *Area-wide urban traffic calming schemes; A meta-analysis of safety effects.* In: Accident Analysis and Prevention, vol. 33, nr. 3, p. 327-336.

Infopunt DV (2000). *Sobere inrichting van 30- en 60 km/u-gebieden.* Infopunt Duurzaam Veilig Verkeer, Ede.

Marks, H. (1957). *Subdividing for traffic safety.* In: Traffic Quarterly, July, pp. 308-325.

Minnen, J. van (1999). *Geschikte grootte van verblijfsgebieden; Een theoretische studie met toetsing aan praktijkervaringen*. R-99-25. Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV, Leidschendam.

Plasmans, N. & Tuinenburg, D. (2006). *Eindevaluatie pilot subjectieve verkeersonveiligheid regio IJsselland*. Bureau Verkeershandhaving Openbaar Ministerie BVOM, Soesterberg.

Reichow, H.B. (1959). *Die autogerechte Stadt; Ein Weg aus dem Verkehrs-Chaos*. Otto Maier Verlag, Ravensburg

Steenaert, C., Overkamp, D. & Kranenburg, A. (2004). *Bestaat de ideale 30 km/h-wijk? Evaluatie van twintig sober Duurzaam Veilig ingerichte 30 km/h-gebieden.* Hoofdrapport. Ministerie van Verkeer en Waterstaat. Adviesdienst Verkeer en Vervoer, Rotterdam.

VenW (1984). *Handboek 30 km/uur-maatregelen.* Ministerie van Verkeer en Waterstaat, Den Haag.

Vis, A.A. (1991). *Effecten van inrichting tot 30 km/uur zone in 15 experimentele gebieden; Een evaluatiestudie op basis van integratie van resultaten uit verkeerskundige studies, bewonersonderzoeken en een ongevallenanalyse.* R-91-81. SWOV, Leidschendam.

Vis, A.A. & Kaal, I. (1993). *De veiligheid van 30 km/uur-gebieden; Een analyse van letselongevallen in 151 heringerichte gebieden in Nederlandse gemeenten.* R-93-17. SWOV, Leidschendam.

Wegman, F., Dijkstra, A., Schermers, G. & Vliet, P. van (2006). *Sustainable Safety in the Netherlands: evaluation of national road safety program.* In: Transportation Research Record no. 1969, p. 72-78.

Weijermars, W.A.M. & Schagen, I.N.L.G. van. (red.) (2009). *Tien jaar Duurzaam Veilig; Verkeersveiligheidsbalans 1999 - 2007*. R-2009-14. SWOV, Leidschendam.

Wesemann, P. (2000). *Verkeersveiligheidsanalyse van het concept-NVVP. Deel 2: Kosten- en kosteneffectiviteit; Beschrijving en berekening per maatregel en toetsing aan financiële randvoorwaarden.* D-2000-9II. SWOV, Leidschendam.