1 Introduction

Approaching from the rural road with a velocity of about 100 km/h or more, it often takes a long time and distance before drivers reduce their speed to an urban compatible level, when reaching the limits of villages or towns.

For instance when driving in 4\textsuperscript{th} or 5\textsuperscript{th} gear it takes between 400 and 600 meters (!) to reduce speed from 100 km/h to 50 km/h just stepping off the gas-pedal without braking (deceleration values \(\approx -0.7 \text{ to } -0.5 \text{ m/s}^2\); [SALLABERGER 1994]). Additionally the effect of psychologically caused speed reduction when the visual width of the road decreases does just barely work or not at all until the road actually seems to close in on the driver, i.e. mostly not before reaching the first buildings (compare [BERGER 1998]).

Fig. 1: The actual speed level in rural villages, where no speed-reducing measures have been taken, is about 20 to 25 km/h higher than the legal velocity [ZIBUSCHKA 1996]
Therefore, it doesn't take wonder, that the actual speed level of cars in rural villages and towns is much higher than the prescribed speed-limit of 50 km/h. Fig. 1 shows the results of speed measurements in 22 rural villages in Lower Austria, where no special speed-reducing measures have been taken. The potential of speed reduction is about 25 km/h at the edge of the urban area (when arriving the village) and about 20 km/h in the central areas.

Especially in the country the transition from the typical rural road to the street within the village is not a continuous one, as it is in the outskirts of big cities, but performs with a sudden change. So it is very important to provide village-compatible speed from the point on, where the first houses are situated.

One efficient measure to achieve this goal is the implementation of raised traffic islands at the village-limits. The common idea of those so called "braking-islands" is to reduce velocity by the narrowing of the visual width and, more and more by creating an artificial chicane.

Actually the islands are built with a lot of different shapes in Austria. Some are slender and/or longitudinal orientated without influencing the driving course. Other islands are broad and, avoiding the island one or both lanes of the road are set to the side, producing more or less sharp bends and forcing drivers to slow down.

By now no technical guideline that generally describes the influence of the islands shape on velocity exists in Austria. In fact, sometimes the islands do look like being designed according to the saying *if the island is of no use, at least it doesn't hurt.*

So we encouraged one of our students to do his thesis by investigating the influence of braking islands’ shape on car velocity [LINAUER 1998].
2 Method

A significant sample of car velocity curves nearby 5 braking-islands was surveyed. The velocity curves of about 700 vehicles were researched by using a laser-gun, continuously from hundred meters or more before the island, passing the island and as long as possible after the island.

The velocity curves as measured consisted of the car distances (recorded each 0.3 seconds) and the particular velocities. To get comparable curves, each recorded data-sample was expressed by a polynomic function of 6\textsuperscript{th} order (Fig. 2). The accuracy of the velocities calculated this way in all cases was better than ± 3 km/h.

Fig. 2: Car velocity-curve as recorded and expressed by a polynomic function of 6\textsuperscript{th} order

For the velocity-curve sample of each braking-island the following parameters were analysed:

- \( V_{\text{min}} \) minimum velocity
- \( V_{\text{m}} \) medium velocity
- \( V_{85} \) 85%-velocity (exceeded by 15% of all drivers)
- \( V_{\text{max}} \) maximum velocity

The investigated braking islands had different shapes (Fig. 3 and Figs. 4 - 7).

<table>
<thead>
<tr>
<th>Island</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.1</td>
<td>approaching lane set to the side to a minimal extend; straight lane leading out of the village</td>
</tr>
<tr>
<td>No.2, 4</td>
<td>approaching lane set to the side to a medium degree; straight lane leading out of the village</td>
</tr>
<tr>
<td>No.3</td>
<td>both, approaching lane and lane leading out of the village are set to the side to a medium degree</td>
</tr>
<tr>
<td>No.5</td>
<td>approaching lane extremely set to the side; straight lane leading out of the village</td>
</tr>
</tbody>
</table>

Fig. 3: The different shapes of the investigated braking islands
Fig. 4: Island no.1 entering the village

Fig. 5: Island no.2 leaving the village

Fig. 6: Island no.3 entering the village
To get a practicable instrument for classifying the islands shapes, an island-parameter $p_i$ is introduced. It describes the proportion between the length of the island and the distance which the lane is set to the side (Fig. 8):

$$p_i = \frac{l_v}{2t_v}$$

$l_v$ length of the lane influenced by the island  
$t_v$ distance which, avoiding the island, the lane is set to the side

The practical consequence of the introduced parameter is to give the planning engineer an idea of the connection between the islands design and the achievable reduction of speed.
3 Results

Fig. 9 shows the result of the car-sample, investigated passing island no.5 towards the village, where the approaching lane is extremely set to the side. It is remarkable, that the velocities nearby the island are very close together (between 31 an 48 km/h). Even about 100 m after passing the braking-island the $V_{85}$ has hardly increased above 50 km/h and the maximal velocity is not much higher than 60 km/h.

Fig. 9: Distribution of velocity-curves nearby island no.5, entering the village

Leaving the village by passing the island on the straight lane, the velocities are much higher (Fig. 10).

Fig. 10: Distribution of velocity-curves nearby island no.5, leaving the village
A comparison of the investigated velocities nearby the researched islands to the velocities previous implementing the islands (measured by the local road authorities nearby the town sign at the begin of speed-limit 50 km/h) is presented in Table 1. As island no.1, with the approaching lane minimal extending, did barely alter the velocities, the other islands effected remarkable speed reductions.

Table 1: Velocities of cars approaching from the rural road, measured near the town sign before implementing the islands and at the islands after

<table>
<thead>
<tr>
<th>island no.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_m$ [km/h] previous</td>
<td>54.0</td>
<td>58.0</td>
<td>60.0</td>
<td>65.0</td>
<td>65.0</td>
</tr>
<tr>
<td>subsequent</td>
<td>54.1</td>
<td>48.4</td>
<td>44.1</td>
<td>47.2</td>
<td>40.1</td>
</tr>
<tr>
<td>difference</td>
<td>±0%</td>
<td>-17%</td>
<td>-27%</td>
<td>-27%</td>
<td>-38%</td>
</tr>
<tr>
<td>$V_{85}$ [km/h] previous</td>
<td>62.0</td>
<td>67.0</td>
<td>70.0</td>
<td>76.0</td>
<td>77.0</td>
</tr>
<tr>
<td>subsequent</td>
<td>61.0</td>
<td>54.5</td>
<td>50.5</td>
<td>55.2</td>
<td>44.6</td>
</tr>
<tr>
<td>difference</td>
<td>-2%</td>
<td>-19%</td>
<td>-28%</td>
<td>-27%</td>
<td>-42%</td>
</tr>
<tr>
<td>$V_{max}$ [km/h] previous</td>
<td>70.0</td>
<td>88.0</td>
<td>86.0</td>
<td>95.0</td>
<td>97.0</td>
</tr>
<tr>
<td>subsequent</td>
<td>76.2</td>
<td>59.3</td>
<td>56.1</td>
<td>65.8</td>
<td>46.9</td>
</tr>
<tr>
<td>difference</td>
<td>+9%</td>
<td>-33%</td>
<td>-35%</td>
<td>-31%</td>
<td>52%</td>
</tr>
</tbody>
</table>

Braking-island's effectiveness:

- The implementation of island no.1 (minimal extended lane) did not decrease the car velocities at the city limit.
- The islands no.2, 3 and 4 (approaching lane set to the side to a medium degree) caused a speed reduction of about a fifth to a quarter in medium speed, up to a third in maximum speed.
- Island no.5 with the extremely extended lane effected a speed reduction of more than a third in medium speed and halved the observed maximum speed.

Additionally:

- Island no.3 (both lanes extended symmetrically) keeps low velocity-level of cars leaving the village up to passing the island and avoids misuse of entering drivers by passing the island on the wrong left side, a fact observed sometimes at islands with straight exiting lane.

The main result is the island dimension-graph (Fig. 11), which has been developed from the summarised results of the islands speed measurements. Both, the assumed medium velocity and the 85%-velocity are drawn as a graph of the island parameter $p_i$, representing the islands shape.

For instance, a $V_{85}$ of 50 km/h can be achieved by implementing an island with a parameter of $\approx 7.5$. This could be an island which influences the direction of the lane over 53 meters and where the lane at the middle of the island is set to the side 3.5 meters.
Fig. 11: Dimension-graph for braking-islands (t_v should be at least equal to the width of the lane)

\[ V_{ss} = 14.797 \ln \left( \frac{l_v}{2t_v} \right) + 19.779 \]
\[ R^2 = 0.9098 \]

\[ V_m = 12.907 \ln \left( \frac{l_v}{2t_v} \right) + 17.753 \]
\[ R^2 = 0.9693 \]
4 Conclusions

Raised traffic islands situated at the town limits are a very effective measure to effect an urban compatible car-velocity after approaching from the rural road. Avoiding the island at least the approaching lane has to be set to the side. The better solution is to extend both lanes to provide the urban street from acceleration manoeuvres of drivers leaving the village and to avoid misuse of entering drivers by passing the island on the wrong side with high velocity.

Braking-islands with well-chosen shapes effect speed reductions of a third up to the half of the previous velocities of cars approaching the domestic area from the rural area. A very positive effect of increased road safety within the villages can be estimated.

The dimension-graph for braking-islands presented in the paper can be very helpful for the planning engineers to choose the right island shape to get the aspired subsequent velocity.

Sources:

Abstract

High vehicle velocity is one of the most affecting factors of road safety in urban areas. Approaching from the rural road, it often takes long time and distance before drivers reduce their speed to an urban compatible velocity. So a reinforced implementation of raised traffic islands especially at the limits of villages an towns in rural regions of Austria can be observed over the last years. The common idea of those so called "braking-islands" is to reduce velocity when leaving the rural area and reaching the city limits (or vice versa to keep velocity down until reaching the open area). But the islands are built with a lot of different shapes. Some are slender and/or longitudinal orientated, to reduce the visual width of the road without influencing the driving course. Other islands are broad and, avoiding the island one or both lanes of the road are set to the side.

The presentation describes the influence of the island's shape on car velocity, investigated by measuring vehicle speed nearby the islands (before, at, after). As an output of these investigations an island-parameter is introduced, which describes the proportion between the length of the island and the distance which the lane is set to the side. It should help the planning engineers to choose the right island shape to get the subsequent velocity they want.