Safe speeds in a sustainably safe system

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- **Expertise**
  - physics, traffic theory, navigation safety, road safety, data, analysis

- **Team**
  - data-experts, civil engineers, psychologists, mathematicians, ...

- **Projects**
  - Pendant, SafetyNet, DaCoTA, SafetyCube, SaferWheels, SaferAfrica, ...

- **Methods**
  - In depth analysis, data matching, empirical research, instrumented bicycles, ...

- **Data sets**
  - Crashes, mobility, hospital, violations, fleet, driving license, infrastructure, ...
Risk, distance travelled and casualties

**Risk determined by conditions and properties:**
SPI’s, measures, factors

**Distance travelled**
- 18 min, 5.7 km
- 20 min, 6.0 km

**Casualties (road deaths, serious road injuries)**

**Dominant factor:** Vehicle speed & speed difference
How to achieve safe speeds always, everywhere?

300

80

180
How to achieve safe speeds always, everywhere?

Can we train all travellers, until they are perfect drivers, that obey all rules always?

Should we bet on intelligent vehicles that know and obey the speed limit?

Or should we design safe roads that enforce safe speeds?
A safe system starts with safe roads, but traffic is not uniform!
Traffic is not uniform!
Traffic is not uniform!
Sustainable safety in a nutshell

- As humans are fallible and vulnerable,
- ... although drivers should know and obey the rules, and enforcement efforts are essential,
- vehicles cannot ensure road safety for all, although it certainly helps (and has helped a lot).
- roads should be designed to meet the requirements for the road’s traffic function.
## How do safe speeds depend on road function

<table>
<thead>
<tr>
<th>Types of road and traffic</th>
<th>Safe travel speed (km/h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locations with possible conflicts between cars and pedestrians (low traffic volume $q$)</td>
<td>30 km/h</td>
</tr>
<tr>
<td>Intersections with possible side collisions between cars (and no possible conflicts)</td>
<td>50 km/h</td>
</tr>
<tr>
<td>and no possible conflicts as mentioned above!</td>
<td></td>
</tr>
<tr>
<td>Roads with possible frontal collisions between cars (and no conflicts as above)</td>
<td>70 km/h</td>
</tr>
<tr>
<td>Roads with no possibility of side or frontal collisions and safe roadsides (and no</td>
<td>$\approx 120$ km/h</td>
</tr>
<tr>
<td>conflicts as above, high $q$)</td>
<td></td>
</tr>
</tbody>
</table>

The design requirement: Safe roads should have a **safe and credible speed limit**, given the function of the road.
30 km/h roads (urban), some Dutch examples

Traffic structures: tree  limited access
30 km/h roads (urban), no credible speed limit
### 30 km/h roads (urban), properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
<th>SSA</th>
<th>SaCreD</th>
<th>extra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of road links</td>
<td>short/long</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Road width</td>
<td>narrow/wide</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Paving</td>
<td>pavers/asphalt</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Street lighting</td>
<td>low/high</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Surroundings</td>
<td>closed/open</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Connections to houses/shops</td>
<td>yes/no</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Road axis marking</td>
<td>no/special/yes</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Road side marking</td>
<td>no/yes</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Separate lanes</td>
<td>no/yes/green/water</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Priority intersections</td>
<td>no/yes/roundabout/priority bicycle lane</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Intersection layout</td>
<td>plateau/punaise/other color/roundabout/none</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic sign installations</td>
<td>no/yes</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Speed controlling measures</td>
<td>hump/road narrows/road axis shifts/none</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Pedestrian crossing possible</td>
<td>everywhere/specific (ZEBRA)/none</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Pedestrian lane</td>
<td>sidewalk/none</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Bicycle lane</td>
<td>none/coloured pavement/separate</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Car parking</td>
<td>parking spaces/along the road/none</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
30 km/h roads (urban), credible speed limit
30 km/h roads (urban), some Dutch examples
50 km/h roads (urban), some Dutch examples
60 km/h roads (rural), before

- Before sustainable safety:
- 80 km/h
- central marking
60 km/h roads, before-after

Wrong. Side strip too narrow

Right: side strip with correct width

Wrong: no marking at roadside, no speed hump (road width >4.5m)

Right: correct roadside marking line and speed hump
60 km/h roads, intersections, before-after

Wrong: unclear priority, no speed humps

Right: plateau speed reduction and clearly recognizable intersection
60 km/h roads, transition region, before-after

Wrong, roads look similar

Right, recognizable road design elements
60 km/h roads, transition region, before-after

Wrong: beacons on road surface

Right: beacons on the hard shoulder

Right: rumblestrips
80 km/h roads (rural), before

• Single central axis marking
• Solid side marking
• No correction strip
• No obstacle free hard shoulder
80 km/h roads (rural), before-after

Wrong: overtaking with possible countertraffic above 70km/h

The sign doesn’t prevent overtakings!

Right: physical barriers between directions
80 km/h roads (rural), before-after

Wrong: obstacle-free zone to narrow

Right:
• Double solid line road axis marking
• Dashed roadside marking + correction zone
• Obstacle free zone > 6m
Concluding remarks

- Roads need to be categorized by their functions.
- Speeds should match the road function.
- Road design should enforce those safe speeds.
- When road design cannot do the trick, we need enforcement.
- This is especially the case for high speed roads (motorways, highways).