Vehicle design for pedestrian protection

Principles

- Enhance driver’s ability to see pedestrians
  - Headlights
  - Rearview cameras
- Assist driver with braking
  - Simple and dynamic brake assist
  - Automated braking with pedestrian detection
- Distribute the force of impact
  - No sharp edges, corners or protrusions
- Extend the time to bring the pedestrian up to vehicle speed
  - Surfaces that crush under the force of impact with pedestrian
Vehicle design for pedestrian protection

1965
“Unsafe at Any Speed”

1970s
Research Safety Vehicles

1980s
NHTSA research to support regulation

1987-1994
EEVC Working Group 10

1997
EuroNCAP adds pedestrian protection assessments

2005
European and Japanese regulatory requirements

2008
Global Technical Regulation 9

2015
NHTSA proposes adding pedestrian protection and autobraking assessments to NCAP beginning 2018

2016
IIHS begins evaluation of vehicle headlights

2018
US regulatory requirement for rearview cameras

2015
EuroNCAP adds assessments of autobraking for pedestrians

2016
EuroNCAP adds assessments of autobraking for pedestrians

2018
US regulatory requirement for rearview cameras
Countermeasures for pedestrian tests

- Soft hood and grille
- Soft bumper
- Metal components replaced with breakaway plastic
- Crushable fender mounts
- Breakaway headlights
Head contact locations relative to GTR zone

Wrap distances (mm)
MGA Research

10+: +80,000 ms
Rate: 1000
Exp: 400 µs

HC2340 - 6-C Child
Relationship between test performance and fatality rate

Pearson Correlation 0.6 (p=0.15)
Correlations of real-world pedestrian injury rates to risk of severe head injury

<table>
<thead>
<tr>
<th>pedestrian injury rate</th>
<th>correlation</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>fatal</td>
<td>0.60</td>
<td>0.1521</td>
</tr>
<tr>
<td>incapacitating</td>
<td>0.76</td>
<td>0.0462</td>
</tr>
<tr>
<td>combined</td>
<td>0.74</td>
<td>0.0549</td>
</tr>
</tbody>
</table>
Volvo's pedestrian airbags may already be on their way out

As proof of just how quickly automotive technology can advance, just check out the Volvo V40. Developed with an external airbag aimed at better protecting pedestrians in the event of a collision, this innovative safety device could be phased out soon in place of more advanced active safety technologies like pedestrian detection and auto braking.
Leg impact test zone definition (GTR 9)
May not result in countermeasures across the full width
Visibility advantage provided by technology

Rear visibility in typical SUV: 2013 Chevrolet Equinox LTZ
Rearview cameras prevented collisions

Percent of participants who hit stationary object, by technology condition

<table>
<thead>
<tr>
<th>Technology Condition</th>
<th>Bar Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td>100</td>
</tr>
<tr>
<td>sensors</td>
<td>80</td>
</tr>
<tr>
<td>camera</td>
<td>40</td>
</tr>
<tr>
<td>camera + sensors</td>
<td>70</td>
</tr>
</tbody>
</table>
Role of darkness in pedestrian crashes

Percent of pedestrian crashes occurring in non-daylight conditions
BMW 3 series halogen and Toyota Prius v LED

Low beams
BMW 3 series halogen and Toyota Prius v LED

High beams
Differences in low-beam headlight illumination

Honda Accord

Mercedes C300
First headlight release
March 30

- Midsize moderately priced and luxury/near-luxury cars
- 31 vehicle models
- 82 headlight combinations
  - 1 good
  - 17 acceptable
  - 20 marginal
  - 44 poor
## Estimated annual target population for forward collision warning/mitigation systems

*Status Report May 20, 2010*

<table>
<thead>
<tr>
<th></th>
<th>all</th>
<th>injury</th>
<th>fatal</th>
</tr>
</thead>
<tbody>
<tr>
<td>without pedestrian identification</td>
<td>1,165,000</td>
<td>66,000</td>
<td>879</td>
</tr>
<tr>
<td>additional with pedestrian identification</td>
<td>39,000</td>
<td>22,000</td>
<td>2,932</td>
</tr>
</tbody>
</table>
Preliminary results of IIHS pedestrian AEB tests

20 km/h toward stationary pedestrian

- Equipped with pedestrian detection: Yes/No
- Issued warning: Yes/No
- Initiated braking: Yes/No
- Avoided collision: Yes/No

Graph showing the results of pedestrian AEB tests at 20 km/h.
Vehicle and pedestrian movement

Single-vehicle pedestrian crashes, front of passenger vehicle

<table>
<thead>
<tr>
<th></th>
<th>Crashes</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>63%</td>
<td>72%</td>
</tr>
<tr>
<td></td>
<td>29%</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>4%</td>
<td>16%</td>
</tr>
</tbody>
</table>
EuroNCAP test scenarios
Automatic emergency braking with pedestrian detection

- Adult crossing from near passenger-side of the road
- Child running from between parked cars on passenger-side of the road
- Adult running from driver-side of the road
More information and links to our YouTube channel and Twitter feed at iihs.org