Auto Manufacturer's Liability in Pedestrian Injury Cases– Effect of Automobile's Front Structure Design

Over the years, there have been several product liability litigations regarding pedestrians being injured and the front structure designs of the vehicles being alleged as the significant factor. This topic was the subject of intense research many years ago and there may be US legislation in the near future. I have been involved with this topic both as a researcher as well as a product development engineer at an automobile manufacturer.

This note is intended to present some facts on the topic of pedestrian-versus-vehicle impacts. What role does the front structure of an automobile have in pedestrian and cyclist injuries? What are the laws? What is the current state of knowledge and what should be expected in the near future?

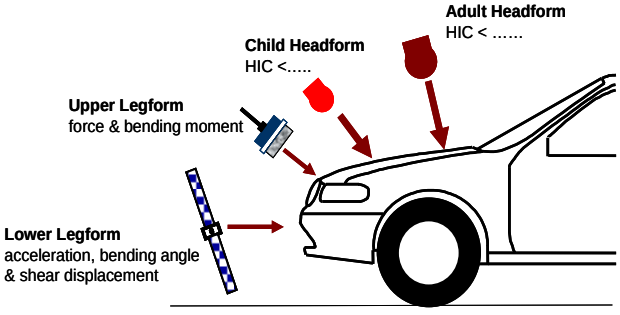
The Law

Present:

There is no US law *(or Federal Motor Vehicle Safety Standard*) governing automobile design for improving pedestrian protection. In the early 80s, an Advanced Notice of Proposed Rulemaking (ANPRM) was issued by the National Highway Traffic Safety Administration (NHTSA) but was cancelled. Other countries (Japan, European countries, etc) have such laws in place.

Future:

It is likely that later this year the NHTSA will issue a notice of proposed rulemaking requiring that structural components in the front parts of automobiles be designed to meet certain performance criteria when tested as specified (similar to the rules in other countries as described in www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29registry/gtr9.html). Briefly, these tests represent (a) headforms of an adult and a child striking designated parts of the vehicle's upper front; and (b) adult legforms impacting lower front surfaces. The effect of these requirements may be that the vehicle manufacturers have to (a) control the structural stiffness of the components in the impact zones (hoods, fenders, headlights, etc); and/or

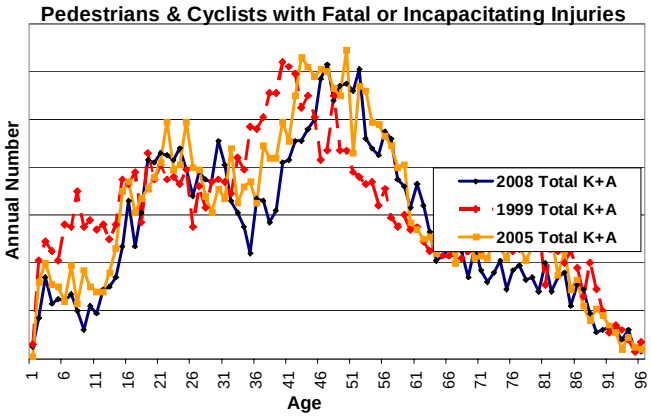


(b) provide adequate ‘crush space’ underneath the struck surfaces. This necessary crush space may not be designed in to some vehicles and the manufacturers may instead meet the law by ‘active systems’ to ‘pop up’ the hood when impact with a pedestrian is detected or with ‘hood airbags’.

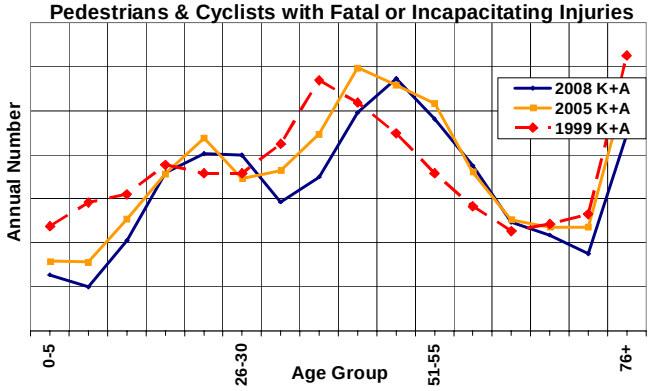
Statistics on pedestrian fatalities and incapacitating injuries

Distribution with Age:

The annual number of *fatalities (known as ‘K’ in database) and incapacitating injuries* (‘A’) among pedestrians and cyclists has decreased in the USA over the past years.

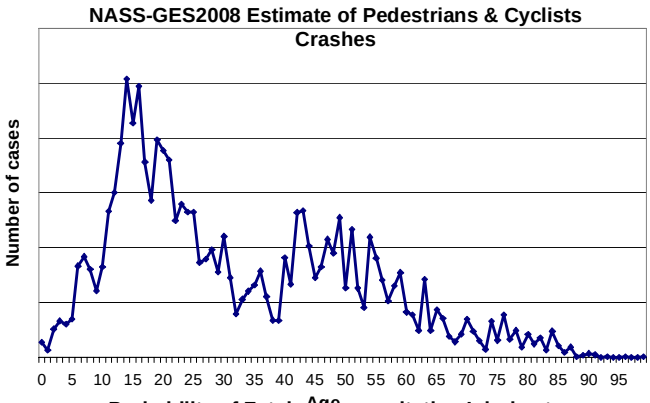


This decrease has not been uniform across the entire population of road users. The data from the Fatal Accident Reporting System for the years 1999, 2005 and 2008 is shown here by age and also by age groups.



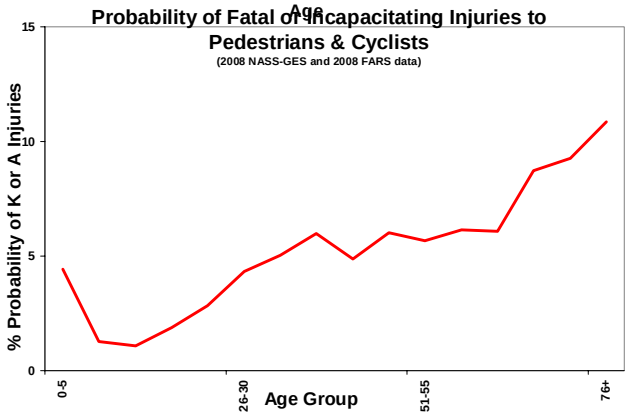
Total Number

The total number of pedestrian and cyclists crashes has also decreased in the US during this period (estimated distribution from the NASS GES 2008 shown here). But, the data shows that children and young adults are more likely to be involved as a pedestrian or cyclist in crashes with automobiles.



Probability of Fatality or Incapacitating Injury

The probability of fatality or incapacitating injury per crash rises with age (except for very young children). This indicates



that an older pedestrian or cyclist is relatively more likely to suffer fatal or incapacitating injury if impacted by an automobile.

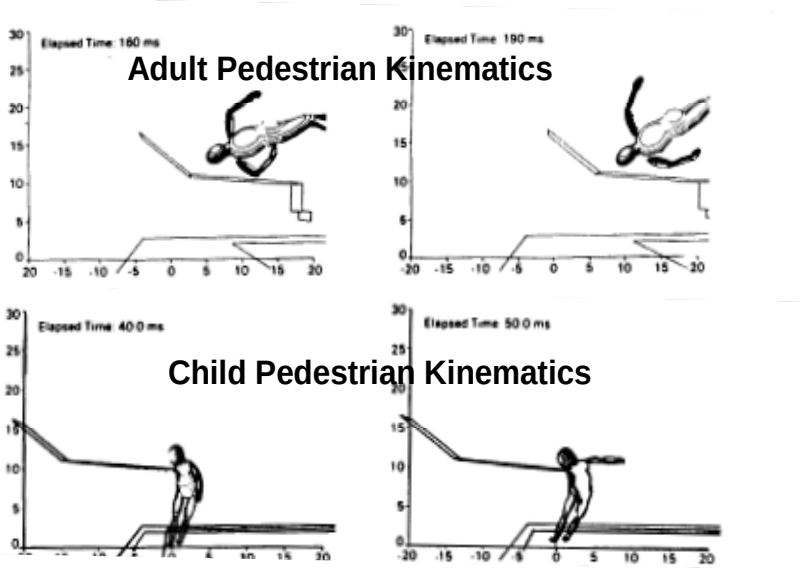
Research - effects of vehicle design on injuries

Multiple research publications exist in the literature on this topic, many from the 1970s and the 80s.

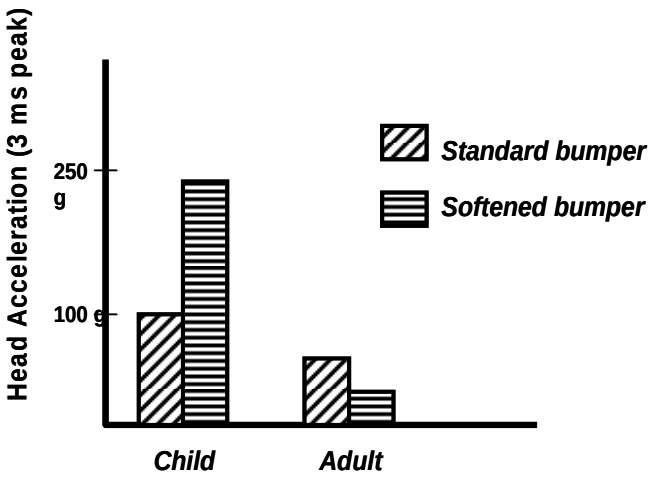
The components of front (and other) structure of an automobile are designed to meet multiple requirements, including those for protecting its occupants (*e.g. by absorbing vehicle's crash energy, deciding airbag deployment, reducing vehicle damage in low speed crashes, etc*). Since the crash energies in pedestrian and cyclist impacts are much lower than those involved in protecting the vehicle occupants, it may be possible in some cases to decouple the 'structure design domain' for these two categories. As a severe generalization, the parts likely to affect a pedestrian's impact severity are the outer surfaces (*such as the hood, fenders, pillars, frame around the windshield, etc*) or components (*such as antenna, headlights, etc*) in the impact zone. Some of these may also affect the aerodynamics and the 'style' that are often linked to the commercial success of an automobile.

The practice of improving crash protection by structural design involves selecting designs that minimize[1] the rate at which the impacted person's crash energy is dissipated. Since in product engineering, all existing requirements need to be met and all likely crash scenarios have to be taken into account, simply reducing the stiffness of any (or all) of the struck components of a vehicle may not be acceptable and may not necessarily reduce the impact severity for all pedestrians and cyclists.

As another consideration in improving pedestrian and cyclist safety, it is necessary to take into account children as well as adult populations. Many factors come into play. In a paper presented[2] at the Stapp Car Crash Conference, it was demonstrated that due to the anatomical differences, an impacted child will have different kinematics and different impact pattern than an adult impacted by the same vehicle.



The effect of these differences in the anatomy and the impact kinematics make it likely that some design changes to the front structural components will produce contradictory results for these two segments of population. According to the published data in that paper, the evaluated design changes may increase the probability of head injury for child pedestrians.



The above are just a few of the findings regarding the possibilities and the conflicts inherent in improving safety of pedestrians and cyclists by changing the structural properties of an automobile's front end. There are numerous other combinations of crash scenarios, person's size and age and other factors that can contribute to the crash outcome. In the arenas of product liability as well as in insurance and negligence claims, each crash case needs to be individually investigated to determine the specific contributing factors.

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1. Verma, M. Lange, R., Mcgarry, D., "A Study of US Crash Statistics from Automatic Crash Notification Data", Paper 07-0058, *Enhanced Safety of Vehicles Conference, Lyon, France,* 2007.
2. Verma, M. and Repa, B., "Pedestrian Impact Simulation- A Preliminary Study", Paper 831601, *Stapp Car Crash Conference*, San Diego, 1983.