10. Side Impact Solutions
Seriousness of Side Impact [1]

• Small survival space
• Few energy-absorbing structures
• Little time and space to ensure the maximum functionality of restraint systems

⇒ According to the Insurance Institute for Highway Safety (IIHS) statistics, in the U.S., each year more than 9000 passenger vehicle occupants die as a result of side impacts.
Seriousness of Side Impact [1]

- Head injuries are the leading cause.
- The increasing number of high-riding vehicles on the road these days increases this risk, making it more likely that the front end of a striking vehicle in a side impact will make contact with the heads of occupants in the vehicle that is struck.

Fifth Gear – When an SUV rams a smaller car
http://www.youtube.com/watch?v=JXeKSDpFjlg
Countermeasures for Side Impact [1]

• Reinforcement of side structure
• Restraint system
• Vehicle height adjustment
Reinforcement of Side Structure [2]

- Reinforcement by adopting new material: SPCC $\rightarrow$ 60TRIP

Figure 3. Finite element model for side impact analysis.

Figure 4. Stress-strain curves of 60TRIP steel and the conventional steel SPCC at the strain-rate of 1/sec.
Reinforcement of Side Structure [3]

• Reinforcement by modifying the side structure

![Diagram of a car with highlighted parts for side impact design.](image)

1. Door beams
2. Reinforcing panels in the doors
3. Four-layered B-Pillar
4. Cross-member in the floor panel and elongated side member

*Figure 3- Side impact design*
Reinforcement of Side Structure [4]

- Reinforcement by actuator
- It was assumed that the sensor would deliver a trigger signal at least 100ms before the actual impact will happen.
Reinforcement of Side Structure [4]

In blue the reference model (no actuator) is shown, the model with the pre-crash system implemented is shown in red.

Figure 6. Actuator performance. Intrusion reduction at the B-pillar and where the passenger sits.

The key idea of the intrusion reduction is that the car gives a stiffer response to the impact, therefore more energy is transferred to the barrier, it deforms more, especially in its stiff lower region, the barrier’s bumper.

Figure 7. Barrier deformation: (capture at 80ms): a) front view; b) ISO view.
Restraint Systems: Side Airbag

Without side airbag

With side airbag

Side Airbag Effectiveness
http://www.youtube.com/watch?v=6zIcEYCQBJY

IIHS researchers concluded that side airbags protecting the torso reduced deaths by 26%, and side airbags protecting the head reduced deaths by 37%.

Figure 4 – Window bag/driver airbag and knee bag
Height Adjustment: Pre-Crash Dipping Nose (PCDN) [5]

- Vehicle height adjustment prevents the struck vehicle from being impacted at its weakest side structure, i.e., the door.
- By using radar and controlling the suspension systems of high-profile vehicles, the front end of SUV's can be lowered to the level of a passenger car in the event of a crash, giving the occupants in the passenger car a four-times better chance of surviving. The SUV then automatically resumes its original height in less than 20 seconds.
Volkswagen and Daimler Chrysler have developed and installed systems on the struck vehicle using an air spring with a high pressure tank or hydraulic actuator of active body control (ABC), respectively.

Figure 3. Volkswagen Phaeton equipped with the pre-crash recognition system and actuators.

Figure 6. Phaeton before (left figure) and after lifting up the body (right figure).
Height Adjustment: 피해차 보호 수단 [6]

• This lift up mechanism shifts the collision point of the SUV bumper from Phaetons door down to the sill board (stiff part below the door).
• From a mechanical point of view the lift up is very challenging. Due to the strong requirements extreme short action time (of approximately 300 ms), the high mass of the Phaeton body (of around 2,000 kg) and high lifting up distance of 100 mm.

Figure 5. Scheme of the activated chassis.

Figure 7. Activation of Air Spring.
References


