Crumple zone

The crumple zone of an automobile is a structural feature designed to compress during an accident to absorb energy from the impact. Typically, crumple zones are located in the front part of the vehicle, in order to absorb the impact of a head-on collision, though they may be found on other parts of the vehicle as well. Some racing cars use aluminum or composite honeycomb to form an 'impact attenuator' for this purpose.

It was an inventor Bela Barenyi who pioneered the idea that passengers were safer in a vehicle that was designed to easily absorb the energy from an impact and keep that energy away from the people inside the cabin. Barenyi devised a system of placing the car's components in a certain configuration that kept the kinetic energy in the event of a crash away from a bubble protecting the car's occupants. Mercedes obtained patent from Barenyi's invention way back in 1952 and the technology was first introduced into production cars in 1959 in the Mercedes-Benz 220, 220 S and 220 SE models.

Function:

Crumple zones work by managing crash energy, absorbing it within the outer sections of the vehicle, rather than being directly transmitted to the occupants, while also preventing intrusion into or deformation of the passenger cabin.

This better protects car occupants against injury. Thisis achieved by controlled weakening of sacrificial outer parts of the car, while strengthening and increasing the rigidity of the inner part of the body of the car, making the passenger cabin into a 'safety cell', by using more reinforcing beam sand higher strength steels. Volvo introduced the side crumple zone; with the introduction of the SIPS (Side Impact Protection System) in the early 1990s.The purpose of crumple zones is to slow down the collision and to absorb energy.

It is like the difference between slamming someone into a wall headfirst (fracturing their skull) andshoulder-first (bruising their flesh slightly) is that the arm, being softer, has tens of times longer to slow its speed, yielding a little at a time, than the hard skull, which isn't in contact with the wall until it has to deal with extremely high pressures. Seatbelts restrain the passenger so they don't fly through the windshield, and are in the correct position for the airbag and also spread the loading of impact on the body. Seat belts also absorb energy by being designed to stretch during an impact, so that there is less speed differential between the passenger's body and their vehicle interior.

In short: A passenger whose body is decelerated more slowly due to the crumple zone (and other devices) over a longer time, survives much more often than a passenger whose body indirectly impacts a hard, undamaged metal car body which has come to a halt nearly instantaneously. The final impact after a passenger's body hits the car interior, airbag or seat belts, is that of the internal organs hitting the ribcage or skull. The force of this impact is the mechanism through which car crashes cause disabling or life threatening injury. The sequence ofenergy is dissipating and speed reducing technologies - crumple zone - seat belt - airbags - padded interior, are designed to work together as system, to reduce the force of this final impact.

A common misconception about crumple zones is that they reduce safety by allowing the vehicle's body to collapse, crushing the occupants. In fact, crumple zones are typically located in front and behind of the main body (though side impact absorption systems are starting to be introduced), of the car (which forms a rigid 'safety cell'), compacting within the space of the engine compartment or boot/trunk. The marked improvement over the past two decades in high speed crash test results and real-life accidents also belies any such fears. Modern vehicles using what are commonly termed 'crumple zones' provide far superior protection for their occupants in severe tests than older models, or SUVs that use a separate chassis frame and have no crumple zones.