

# ⊕ Safer Roadside Crash Walls Would Limit Deceleration

These walls would protect both vehicle occupants and bystanders.

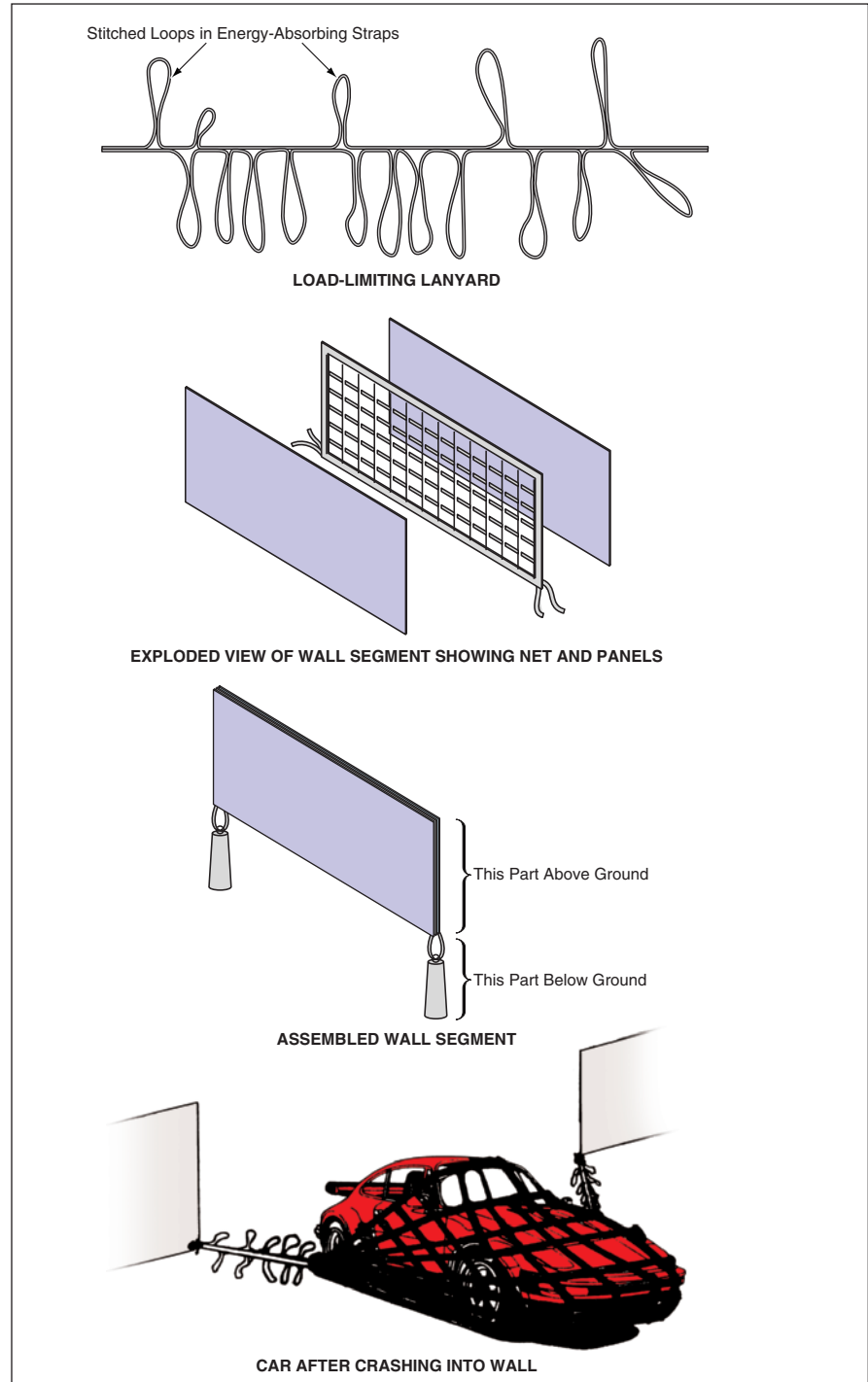
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The figure depicts the aspects of a proposed deceleration-limiting design for crash walls at the sides of racetracks and highways. The proposal is intended to overcome the disadvantages of both rigid barriers and kinetic-energy-absorbing barriers of prior design. Rigid barriers can keep high-speed crashing motor vehicles from leaving roadways and thereby prevent injury to nearby persons and objects, but they can also subject the occupants of the vehicles to deceleration levels high enough to cause injury or death. Kinetic-energy-absorbing barriers of prior design reduce deceleration levels somewhat, but are not designed to soften impacts optimally; moreover, some of them allow debris to bounce back onto roadways or onto roadside areas, and, in cases of glancingly incident vehicles, some of them can trap the vehicles in such a manner as to cause more injury than would occur if the vehicles were allowed to skid along the rigid barriers. The proposed crash walls would (1) allow tangentially impacting vehicles to continue sliding along the racetrack without catching them, (2) catch directly impacting vehicles to prevent them from injuring nearby persons and objects, and (3) absorb kinetic energy in a more nearly optimum way to limit decelerations to levels that human occupants could survive.

In slightly oversimplified terms, a crash wall according to the proposal would be made in segments, each segment comprising a sandwichlike structure that would contain an anchored energy-absorbing net that would capture and decelerate an impinging vehicle. The basic repeating structural unit of a net would be an energy-absorbing, load-limiting strap of a type that has been used before to dissipate kinetic energy in other settings. Such a strap is made by stitching loops in a strap made of a high-strength polymer [e.g., Kevlar (or equivalent) aromatic polyamide], such that the stitches can be ripped at a tensile load  $F_r$  somewhat less than the tensile force  $F_s$  that causes the strap to fail. When the tensile load applied to the ends of the strap reaches  $F_r$ , the loops begin to peel away and then continue to do so at a load level of  $\approx F_r$  until the strap reaches the limit of its extension (at which point there are no more loops available for ripping).

The energy-absorbing straps would be connected in series to form load-limiting lanyards with strokes longer than those of individual straps. The net would contain horizontal and vertical load-limiting

lanyards connected at their ends to a flexible framework of high-strength (non-load-limiting) net-support straps. At the ends of the wall segment, load-limiting lanyards would connect the lower



A Load-Limiting Lanyard would be made of series-connected energy-absorbing straps. Load-limiting lanyards would be assembled into a net. The net would be sandwiched between energy-absorbing panels and anchored to form a segment of a crash wall. The net would catch an impinging vehicle and dissipate much of its kinetic energy through ripping of the stitches in the load-limiting straps.

corners of the net to anchors buried in the ground.

The net would be sandwiched between thin energy-absorbing panels. The panel on the roadway side would be tougher than the panel on the side facing away from the road: the roadway-side panel would be capable of withstanding small impacts like those that occur many times during a race, and would be broken only by a significant impact like that of a crash. Moreover, the roadside surface of the panel could be coated with Teflon or an-

other similar material, which would prevent tangentially impacting vehicles from breaking into the barrier. At the ends of the wall segment, a thin-walled sacrificial aluminum tube would hold the net and panels upright until a vehicle crashed into the wall. Preferably, a pair of adjacent parallel walls would be erected with the joints between their segments staggered to ensure that a vehicle crashing at any position would be stopped by at least one of the walls. The segmented construction allows for rapid post-crash

cleanup and barrier repair, which is critical during televised racing events.

*This work was done by William C. Schneider and James P. Locke of **Johnson Space Center**. Further information is contained in a TSP (see page 1).*

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