

# Towards safer buses

Our resident vehicle safety expert investigates the latest US bus safety plan, but urges that innovations are also needed in other overlooked areas in order to create a Vision Zero for motor coaches

AUTHOR BYRON BLOCH, AUTO SAFETY EXPERT, USA  
IMAGES COURTESY OF DAIMLER, VOLVO GROUP & PA PHOTOS





**F**ifteen passengers were killed in the New York Borough of the Bronx in March 2011 when a motor coach crashed and rolled over. In Virginia just a few months later, a motor coach ran off the road and overturned, killing four and injuring dozens. And all while the devastating crash of August 2008 was fresh in the memory, in which 17 passengers died and 39 were injured when a motor coach plunged off a bridge in Texas. Such instances are fortunately rare – there were fewer than 50 coach fatalities in the USA in 2009 yet they transport around 750 million passengers annually. But as our world

becomes ever-more crowded, transportation systems are going to have to keep pace and provide reliable and safe means to travel from city to city as well as from nation to nation.

Recent years have seen a tremendous rise in travel by motor coach as buses can route anywhere there are roads, they don't require expensive support facilities such as airports or networks of rail lines and stations, and they can economically transport from 40 to 60-plus passengers, in doing so keeping fares fairly low. Not as quick as aircraft for longer distances – nor as efficient as trains that avoid highway traffic congestion – inter-city motor

**Emergency workers at the scene of a bus accident that resulted in multiple deaths on US 75 in Sherman, Texas, in August 2008**

coaches can nevertheless be quickly added to the transportation mix in response to varying demands.

They have generally demonstrated that they are quite safe, too, although following accidents as tragic as those in Virginia, New York and Texas, there's inevitably an outcry that more must be done – that both the driver and the many passengers must be protected by crashworthy technology that ensures elimination of severe to fatal injuries. Coach safety is a worldwide issue, obviously, but in the USA there's now a united effort by the National Highway Traffic Safety Administration (NHTSA), the Federal Motor

Carrier Safety Administration (FMCSA), and the Federal Highway Administration (FHWA), focused on improving motor coach safety.

### Plan of action

In early 2009, the USDOT developed a Motorcoach Safety Action Plan to assess the causes of crashes, how passengers were killed or injured, and potential remedies. The Plan stated in its findings that, "The data show that driver fatigue, vehicle rollover, occupant ejection, and operator maintenance issues contributed to the majority of motor coach crashes, fatalities and injuries."

The USDOT prioritised seven action items. First, electronic onboard recorders should be required to monitor driver and vehicle performance. Second, texting should also be prohibited and mobile phone use limited. Third, lap-and-shoulder seatbelts for all passengers will also be required. Fourth, roof crush performance requirements should be developed to ensure structural integrity in the case of rollovers. Fifth, performance requirements in relation to stability control should be developed to reduce the likelihood of rollovers. Sixth, oversights of coach operators should be enhanced to ensure safe maintenance practices. And seventh, minimum knowledge requirements should also be established for operators.

As of mid-2011, the vehicle-specific areas in DOT rulemaking are for stability control, requirements for lap-and-shoulder seatbelts for passengers, and structural integrity in rollovers. The USDOT is considering whether to initiate rulemaking that would upgrade the fire safety and emergency evacuation standards.



Picture courtesy of David Karp/AP/Press Association Image

### Cause and affect

To address the root causes of crashes, the emphasis is on detecting and reducing driver fatigue, including strict limits on the hours of continuous driving, the elimination of driver distractions, improved training and monitoring to eliminate drug and alcohol influences, and skills and attitudes to reduce risk-taking.

Furthermore, NHTSA and the FHWA urge the development and implementation of stability control and collision avoidance and lane wandering-warning systems. There would also be upgraded requirements to improve tyre pressure monitoring and tyre performance in all weather conditions. Roads signs and lane markings would also become more effective in directing buses through highway entrances and exits.

There are also various recommendations for upgraded technology and testing requirements in an attempt to address the reasons

fatalities and injuries occur in crashes.

**Fire safety:** Fire safety will be improved by measures to prevent flammable fluid leakage and overheating of brakes and other components, including those that can electrically overheat or short-circuit and arc. There will be tougher flammability requirements for interior fabrics and foams, and for isolating and automatically extinguishing any onboard or under-bus fires.

**Structural upgrades:** NHTSA will need to develop performance requirements to evaluate and ensure roof structural integrity in rollover accidents. As with any vehicle – whether car, SUV, truck or motor coach – it is absolutely critical to maintain the occupants' 'survival space' from being crushed, intruded into, or disintegrated. This requires innovative designs and technology from a 'clean sheet of paper' to protect the driver and passengers in frontal impacts, side impacts, rear impacts, and rollovers.

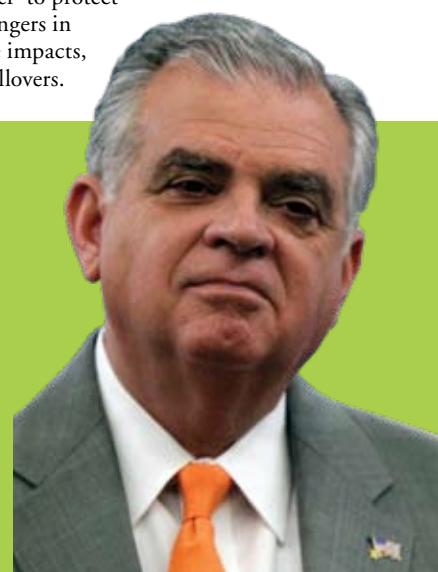
Emergency personnel investigate the scene of a bus crash on I-95 in the Bronx borough of New York – 15 people died when the bus flipped onto its side and was sliced in half by the support pole for a large sign

## Sudden impact

**>>** In September 2011 at the Motorcoach Safety Summit, US Transportation Secretary Ray LaHood reiterated his intention to get tough on coach/bus operators that were failing in their duties to provide sufficient levels of safety. And he and his FMCSA colleagues have wasted no time in shutting down those who flagrantly endanger lives. North Carolina-

based United Tours, Inc was deemed to be an "imminent hazard" for its use of non-qualified drivers and failure to comply with federal records-of-duty reporting requirements. FMCSA also issued an unsatisfactory safety rating and out-of-service order on another North Carolina's Sky Express, for multiple violations: driver qualification requirements; drug and alcohol compliance;

hours-of-service; and vehicle maintenance. These are just two instances of many. "We will use every resource at our disposal to pursue and remove from our roads unsafe, reckless bus companies," LaHood says. In addition to more stringent operator spot checks, USDOT is also raising the bar to ensure bad eggs in the industry don't simply reincarnate themselves under a new guise.





**Dynamic rollovers:** Will this lead to dynamic crash testing for all of these crash modes? And what about the mismatch issue with smaller or larger vehicles, and will that require underrun prevention measures? Will there be a dynamic rollover test at 50mph or higher, with anthropomorphic test dummies to validate that the various body structure and crashworthiness safety technologies are effective?

**Ejection via windows:** As has too often happened in recent bus rollover accidents worldwide, such as the New York tragedy in March 2011, the passengers were partially or totally ejected from the bus out onto the road, resulting in severe injury or fatal consequences. The usual ejection portal is through the large window openings when the windows completely pop out or are totally shattered.

A particular dilemma, though, is the need for large picture windows for passenger enjoyment of the scenery, plus the need for those large windows to possibly serve as escape routes in the event of an accident emergency –

(Main) The Front Collision Guard on Mercedes-Benz coaches spreads the force of an impact into the frontal structure in the event of a head-on collision (Top inset) Volvo's full-scale rollover test, which verifies the function of three-point seatbelts (Bottom inset) The Volvo 9900 was the first bus equipped with FUPS (Front Underrun Protection System)

versus the need for the large glass panes to stay intact and fully retained to prevent passengers from being ejected. Laminated glass will likely need to be mandated as well as requirements that will ensure retention to the bus body even as the body structure distorts during the rollover. This issue is important – whether or not there may also be seatbelts required on that motor coach – as a feature that could help to prevent the passengers from partial or complete ejection from the rolling bus.

## Vitally overlooked areas

Although these areas need improvement, for accident avoidance and to improve crashworthiness, there are additional areas that also need safety improvements. Some of these suggestions overlap with those made over the years by the US National Transportation Safety Board (NTSB) – an independent and multidisciplinary investigative agency that conducts in-depth analyses of many transportation accidents.

**Perceive other vehicles:** The coach

drivers' ability to perceive and identify other vehicles and roadside objects all around the large, fast-moving buses, requires a system of mirrors and video cameras and displays – in addition to the windscreen and side windows – that will enable them to easily see the adjacent and approaching traffic. It is critical to see any vehicles in adjacent lanes, plus fast-approaching vehicles from the rear. Coach buses should use retroreflective tape so they can be more readily perceived by other motorists in the dark of night and inclement weather. The use of radar, laser and infrared sensors – as noted on the Mercedes-Benz Safety Coach concept – could give the driver a display that shows what's around the moving bus in every direction for at least 100 yards. And simple measures such as an adjustable steering wheel and adjustable pedals will enable drivers of various sizes to be positioned where they can see better and effectively reach all controls.

**Seatbelts:** Seatbelts can be effective restraints in many crash situations, and

## Protect and serve

» A system designed to monitor and enforce traffic around a stopped school bus has been launched by an Arizona-based company. The American Traffic Solutions (ATS) CrossingGuard system comprises high-resolution cameras mounted to the front and rear driver's side of the bus. When the school bus extends its stop arm, the system automatically detects if a vehicle passes the stopped vehicle within the enforced zone. To allow the bus driver to stay focused on the road and the children on the bus, the CrossingGuard system does not require any action by the driver

to activate it. High-quality violation images of a vehicle's license plate and a video that captures the entire violation event, is able to provide law enforcement agencies with the evidence they need to effectively prosecute the offender.

It is hoped the new system will enable school districts to meet the growing concerns from parents, PTAs and the community. "With roughly 26 million children riding school buses each day, it's a valuable tool for school districts, bus drivers and local law enforcement to deter these violations and ensure child safety," suggests James Tuton,



ATS president and CEO. "It is a direct response to customer needs and requirements for an automated, accurate and robust solution for detecting and enforcing these dangerous violations, which threaten the safety of our children. Road

safety cameras nationwide have helped make our roads safer by reducing red-light running and speeding. CrossingGuard can have the same impact, protecting the lives of the children who ride a school bus to and from school every day."



Autonomous Intelligent Cruise Control (left) and three-point safety restraints to provide added protection in the event of a rollover

Anti-lock braking (ABS), electronic-pneumatic brake control (EBS) and acceleration skid control (ASR) provide the basis for the ESP or brake assist on Daimler's Safety Coach concept, the innovations from which have now moved into the production Travego

have long been adopted for commercial aircraft and in some school bus jurisdictions. Combination lap-and-shoulder belts should be integrated within innovative seats that have sufficient strength and anchorages, plus seatback padding to enhance 'compartmentalisation' that also helps protect passengers. Seatbelt adjustability must accommodate variation from small children to shorter, elderly people, as well as to larger individuals. Three-point integrated seatbelts are optional in recent motor coach buses made by MCI Motor Coach Industries, and operated by Megabus in the USA and UK.

**Body structure:** Motor coach body structures will need to provide torsional stiffness, beam stiffness, and be strong enough to resist major intrusion into the survival space of the passengers in a variety of accident modes (frontal, side, rear, rollover). Looking back over 40 years of the International Enhanced Safety Vehicle (ESV) Conferences – and newly emerging technologies as well – the next-generation coach bus may have a lightweight tubular-member space frame, with rigid-foam filling and composite inserts that add stiffness and strength.

**Airbags:** Side-curtain airbags are effective for protecting occupants in side-impact accidents, and also to help prevent their ejection in rollovers. But suppliers should investigate innovative ways to integrate side-curtain airbags into each coach seatback, or airbags





## The fatigue timebomb

**>>** In response to the numerous inter-city bus accidents that have occurred this year in the USA, a new report highlighting driver fatigue as the single largest cause of these fatal bus crashes, *Sudden Death Overtime*, was released by the Amalgamated Transit Union (ATU).

According to the report, the National Transportation Safety Board (NTSB) estimates that 36% of motorcoach crash fatalities over the past decade have been due to driver fatigue. It is the number one cause of fatal accidents, far above

road conditions (2%) or inattention (6%).

"Hundreds of intercity bus companies – usually tiny operations that have only a few buses – get away with paying their bus drivers criminally low wages," suggests Lawrence J. Hanley, international president of the ATU (pictured left). "As a result, bus drivers are being forced to work 100 hours a week or more, often balancing two or three jobs, just to make a living. The unsuspecting customers get on these buses and disaster can strike."

The Motorcoach Enhanced Safety Act of 2011 makes some

long-overdue and important changes to regulations in the industry, but in the opinion of Hanley and the ATU doesn't however include a specific proposal to address driver fatigue. "At the end of the day, technical fixes such as seatbelts and driver training – while incredibly important – won't prevent crashes so long as drivers aren't stopped from getting behind the wheel on zero sleep," Hanley continues. "Any serious proposal to clean up the discount bus industry unequivocally has to include a solution for driver fatigue."

inflating downwards across the large windows. There could also be safety restraint netting that deploys when a crash occurs or an imminent rollover is sensed, inspired by side-window netting in NASCAR race cars.

**Padding:** As used for school buses and in some coach buses, the seats should serve to 'compartmentalise' and thus help restrain the passengers between well-padded seats and backrests. Interior energy-absorbing padding should be encouraged for overhead luggage racks and other rigid interior surfaces and edges by a safety standard (such as FMVSS 208) that mandates injury-tolerance limits for impacts by test dummies.

**Emergency exits:** Emergency escape doors, windows, and roof hatches must be securely latched and – in an emergency – easily identifiable and opened to serve as a quick egress. There must also be emergency lighting with independent power for both inside and outside the bus. Automatic collision notification (ACN) should be mandated to notify responders of any accident and its precise GPS location.

**Window issues:** The large swing-out windows in the bathroom have also been a hazard in some motor coach designs. There have, for instance, been accidents in the USA when, in a bus moving at highway speeds, a person using the bathroom leans momentarily against the large window panel, such as when the bus leans around a curve. Possibly unlatched for ventilation by a previous passenger, the top-hinged large window pane then swings



Byron Bloch (left) demonstrates (above) how large swing-out windows in coach restrooms can (and have) suddenly swung open, resulting in passengers falling out onto the road

outward, and the startled passenger tumbles out over the low-height sill and impacts the road with fatal consequences. To correct such swing-out window dangers, alternative designs could prevent the window from swinging out more than 4in except for emergency escape, and there could also be a guardrail to raise the height of the unsafely low sill to at least 46in. There

could be a recall campaign to correct this hazard, and a safety regulation to ensure such unsafe window designs won't occur again.

Motor coaches will continue to serve as a major mass-transportation vehicle worldwide, and it is imperative they continue to provide efficient and safe travel for all passengers in all nations. In conjunction with improvements in road design and construction – as well as other environmental and traffic improvements – motor coaches and their operators need to strengthen the requirements for driver training and monitoring, as well as for regular maintenance and repair.

To enhance the safety of motor coaches worldwide, there are now opportunities for manufacturers, Tier 1s and test facilities to innovate the advances (some of which are outlined here) that will ensure the maximum safety of the driver and all passengers in the billions of miles travelled annually. Motor coaches are an integral link in our worldwide transportation system, and the quest for Vision Zero requires a diligent pursuit of maximum safety in their design, construction, maintenance, and operation. Enjoy the trip, and let's all get there safely. ↗

- *Byron Bloch has been a US auto safety expert in design and crashworthiness for about 40 years. In 1999, he was one of the specialists selected to participate in the USDOT's Commercial Motor Vehicle Safety Workshop on reducing fatalities in truck and bus crashes. His website is [www.AutoSafetyExpert.com](http://www.AutoSafetyExpert.com)*