Bus Seat Belts in Australia

Michael Paine
Consulting
Engineer
Sydney

Background

- Early in 1989 Australia was in the process of harmonizing with European coach occupant regulations (ECE Regulation 80) - including seats and seat belts designed to withstand 10g decelerations
- Late in 1989 two horrific coach crashes in New South Wales led to demands for improved bus occupant protection

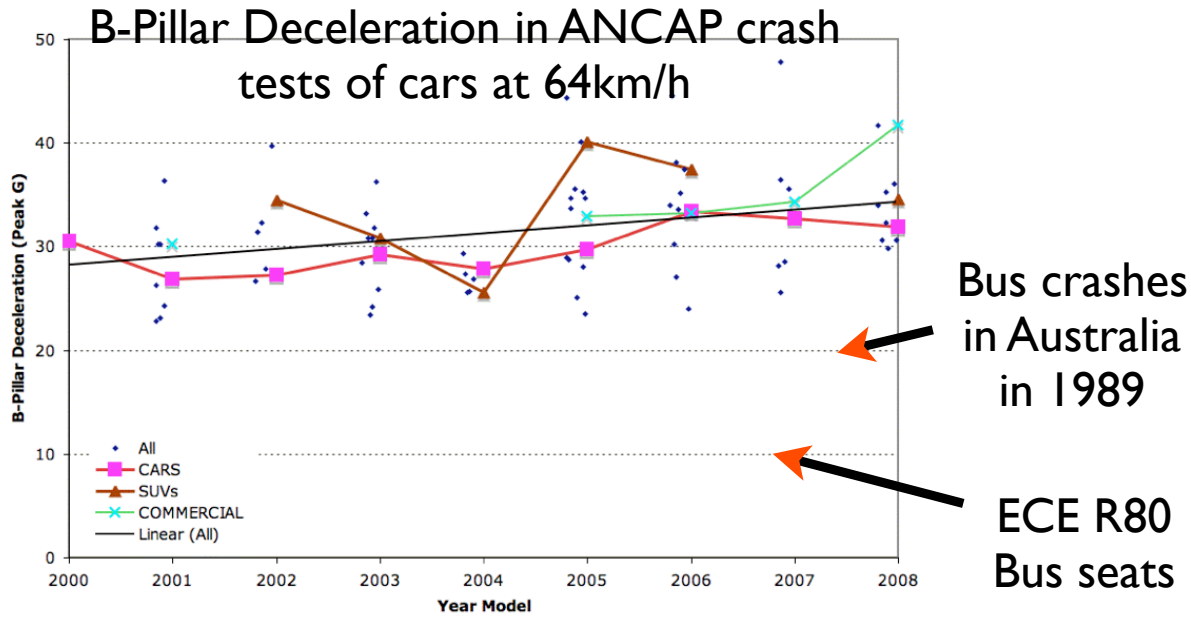
Grafton 1989, Bus & truck,
18 bus occupants killed

Kempsey 1989, Two Buses,
35 bus occupants killed

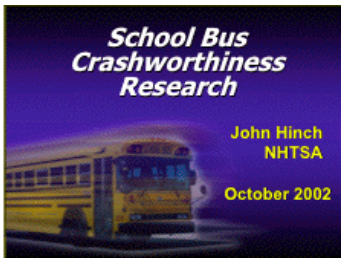
Crash Investigations

- Crash investigators found that ECE 80 would have made little difference to the outcome of these crashes - seats and seat belts would have failed
- A new approach was needed where all occupants were well restrained in 3-point seat belts and seats able to withstand at least 20g crash decelerations
- Car seats and seat belts are designed to withstand decelerations of 30g or more so it was not unreasonable to require that bus seats be designed for 20g decelerations

Crash Investigations



Bus Crash Tests



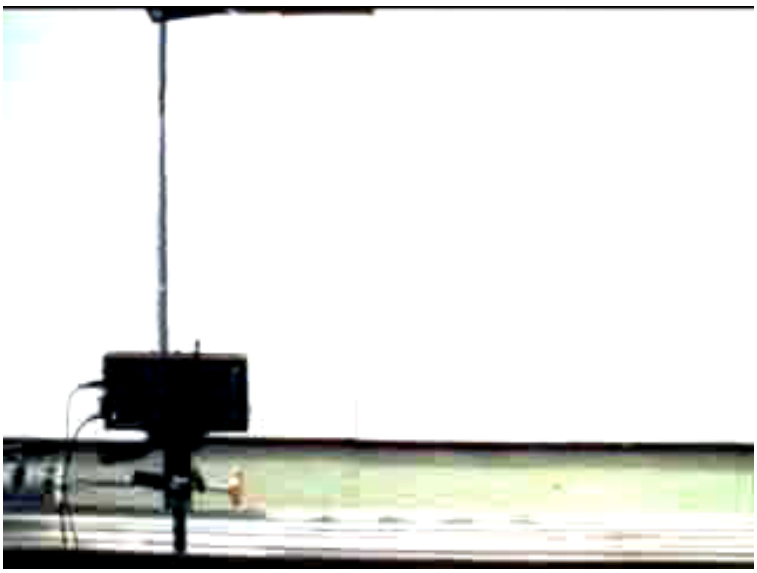
- Subsequent US crash tests of school buses have confirmed the high crash pulses in severe impacts of buses
- This full-frontal barrier test at 50km/h produced a Crash pulse of 12g (> ECE R80)
- This supports the 20g estimate for higher speed crashes

Australian Design Rule 68

- Developed in 1990 as a result of the Australian crash investigations and lab testing
- Requires three point seat belts mounted on seats (not bus frame).
- Applies to all Australian buses built from July 1994 (metro buses are exempt)
- Dynamic test with 20g deceleration.
- Seat assembly must withstand loads from restrained occupant and an unrestrained occupant striking the rear of the seat.

ADR 68 Dynamic Test

ADR68 Dynamic Test



Design of Seats

- Initial concerns about cost and weight of ADR 68 seats have proved to be unfounded.
- Government Crashlab assisted with the development and testing of prototype seats.
- Innovative flexible designs were developed that were lighter than the replaced seats

McConnell Seats

Demand for 3-point Seat Belts

- ADR 68 has led to strong consumer demand for three-point seat belts on coaches used for charter and excursions.
- A significant industry has developed in Australia for retro-fitting ADR 68 seats to older buses.
- National guidelines have been developed for this purpose & require 20g restraint systems

http://www.ntc.gov.au

Exposure to severe crashes

- Australian coaches have a relatively high exposure to head-on crashes with other heavy vehicles travelling at 100km/h
- 10g restraint systems could be expected to fail catastrophically in these crashes - resulting in severe or fatal injuries

Survival in severe crashes

- There is mounting evidence that ECE R80 does not ensure that bus occupants can survive high speed crashes.

Kempsey Australia1989
35 bus occupants killed
(2 buses - no seat belts)

Switzerland 2012
28 bus occupants killed
"Most of the passengers were wearing safety belts, but the impact of the crash may have rendered them useless…"
(1 bus, ECE R80)

Conclusions

- Australian regulations set world leading practice for bus occupant protection at 20g
- Innovative design has resulted in seats which are economical and lightweight (there is no economic reason for regulating lesser protection)
- There is very little difference in the cost of implementing ECE R80 and ADR68 but occupant protection provided by ADR68 is far better
- Australian Design Rule 68 should replace ECE R80 as the international standard for bus occupant protection (possible GTR?)

Thank you to my colleagues
Michael Griffiths and Bill Bailey
and to our client
the National Transport Commission

19th ESV paper 05-0017-O.pdf