道路安全研究小組
Community for Road Safety

LC Paper No. CB(4)1407/17-18(03)

Legislative Council Panel on Transport
Enhancement of Safety of Franchised Buses

Comments

Overview

Government's setting up of the Working Group (WG) is generally appreciated. Enhancement of bus safety will ultimately depend on the soundness of the adopted strategies and measures. In this regard, we would like to point out a number of issues which need to be adequately considered.

General

- The starting point of any safety strategies and measures would be historic bus crashes, injury patterns/mechanisms and safety risks. Such considerations are lacking in the paper.

- We recommend that the formulation of strategies and measures follows the Safe System approach, addressing the interaction of the bus, the road and users with adequate allowance for inevitable errors. There should be clear rationale for the mitigation of different safety risks of bus operation.

- The safety risk of bus operation is diversified and particular concerns in Hong Kong include:

    - Passenger losing balance: most frequent
    - Collision with pedestrians (cyclists): common and potentially severe
    - Rear-front collision: common and potentially severe
    - Head-on collision: less frequent but potentially severe
    - Collision with roadside objects: common and potentially severe
    - Rollover: sporadic but potentially catastrophic
    - Falling from height: possible but potentially catastrophic with very high number of fatalities

- Bus safety is about preventing any persons injured IN or BY a bus. This should be clearly defined.

- Aging population is certainly a factor in the conception of bus safety measures. Government's policy to encourage elderlies using buses should be accompanied by adequate considerations for their safety in all aspects. Similarly, more consideration should be given to passengers with special needs i.e. pregnant women, children, persons with impaired mobility etc.

- A programme of continuous monitoring and research needs to be in place to determine the effectiveness and benefits of the proposed measures. Quantification of results is important.

- The WG only consists of representatives from Government, bus operators and manufacturers. There appears to be a lack of participation from outside parties with relevant expertise in biomechanics, road safety, trauma and emergency medicine etc.

Comments on Individual Items

Electronic Stability Control (ESC)

- Adoption of ESC is supported, but it should be made clear that it is not effective for all rollover mechanisms.

Scenarios	Effectiveness	Remarks
Cornering at Inappropriate Speed	✓	Effective within limits.
Skidding	✓	
Swerving	✓	
Destabilisation by Roadside Features	X	Launching of a bus by sloping walls and end of safety barrier is an important factor for historic bus rollovers in Hong Kong. ESC may only help to prevent collisions preceded by skidding or swerving.
Falling from height	X	ESC may only help to prevent falling from height preceded by skidding or swerving.

✓ Useful X Not useful

Retarders for Capping the Maximum Speed

- No comment at this stage.

Bus Monitoring and Control System (BMCS)

- BMCS is important for the monitoring and promotion of safe driving. Equally important would be the setting of safe driving protocols or criteria based on historic crashes and safety risks. Such protocols may be general e.g. maximum bus speed on busy urban streets, or route specific, e.g. maximum bus speed along the dam of Tai Tam Tuk Reservoir (see Note 1).

- Compliance to legal speed limit is important, but is grossly inadequate alone to address many safety issues of bus operation in Hong Kong. Examples are busy urban streets and narrow hilly roads where safe speed is largely dictated by conflicts, pedestrians, road layout or the absence of safety barriers. This is also due to the weight of buses (>10 times of a car) and long braking distance (see Note 2).

- In order to reduce the risk of passengers losing balance, monitoring will also need to cover “jerks” (i.e. sudden movements or rate of acceleration/deceleration m/s^3) in addition to acceleration and deceleration rates.

Collision Alert and Lane Keeping Devices

- Any measures to reduce the risk of all types of collisions- rear-front, pedestrians etc. are welcome.

- Lane keeping devices appear to be beneficial for inattention, fatigue driving or poor lane discipline, but the precise purpose and expected benefits will need to be further studied.

Driver Monitoring Devices

- No comment at this stage.

Speed Display Unit

- The paper has not touched upon better speed display for bus drivers. Drivers' awareness of their speeds is critical to safe driving. Current analog (needle) display is not easy to read and drivers may not readily visualise speed difference up to 10km/h. Yet safety is very sensitive to speeds (see Note 3), especially in Hong Kong's urban street environment.

Recommendations: Adopt digital speed displays for bus drivers at an easily readable location.

- Rather than speculating whether SDU for passengers is useful or problematic, it will be worthwhile to explore the issue in more details:

  - SDU could help the recording of gross violation of speed
  - SDU may facilitate inspectors to check whether drivers conform to established safe speed at critical locations
  - SDU may facilitate research and formulation of safe driving protocols

Installation of Seat Belts on Passenger Seats

- Cl. 10 of the document states that "At present, all the exposed seats on FBs are installed with seat belts to prevent passengers from falling out from the seats." In reality, some exposed seats are not yet equipped with safety belts and these should be the priority in any program of retrofit.

Exposed seats not equipped with seat belts

- Cl. 15 stipulates a comparison with overseas practices and states that "According to the transport authorities of those jurisdictions, the urban buses are typically used for short journeys, in terms of both time and distance, and undertaken at moderate speeds on urban routes."

- In Hong Kong, bus operation is highly heterogeneous encompassing both urban routes and routes using expressways and high speed dual carriageway roads. On urban routes, operating buses at "moderate speeds" may help to alleviate the extent for retrofit of safety belts. Limiting bus speeds through urban areas is also in line with other safety objectives.

- We have repeatedly pointed that the upper deck front row seats are intrinsically unsafe in collisions with a tall vehicle or tall objects, even if seat belts are worn. This is due to the lack of structural protection or crumple zone. Passengers can be crushed with severe trauma as demonstrated by many historic bus crashes. As stated in Cl. 13, "If all passenger seats on the upper deck are retrofitted with seat belts, … the passenger carrying capacity may need to be reduced by 7 to 8 passengers". If this is the case, consideration should also be given to strengthening the bus front with some additional space

in front of the front row seats. For new buses, bus front design should be revisited with a view to better protect these bus passengers for typical collision scenarios.

- In the conception of any seat belt retrofits, adequate consideration should be given to their benefits and inadequacies for different scenarios:

Scenarios	Effectiveness	Remarks
Harsh braking	✓	Standing passengers and boarding/alighting passengers are still susceptible to injuries
Emergency braking	✓	
Collision with vehicles/objects	✓	
Collision with a tall vehicle/object	#	Upper deck front row passengers may still be seriously injured
Side collision by another vehicle	#	Passengers directly affected by the impact may still be seriously injured due to the fragile bus body
All rollovers	✓	Unrestrained passengers may injure other passengers
Rollover	#	Column of passengers on the down side may still be seriously injured due to the fragile bus body
Rollover onto objects	#	One or more columns of passengers on the down side may still be seriously injured due to the fragile bus body
Multiple rollover	#	All passengers may still be seriously injured due to the fragile bus body
Falling from height	#	All passengers may still be seriously injured due to the fragile bus body

✓ Useful # Helpful with limitation

Training for Franchised Bus Captains

- Training will need to be closely related to the recommended safe driving protocols. Drivers are more likely to conform if they understand the rationale.

Others

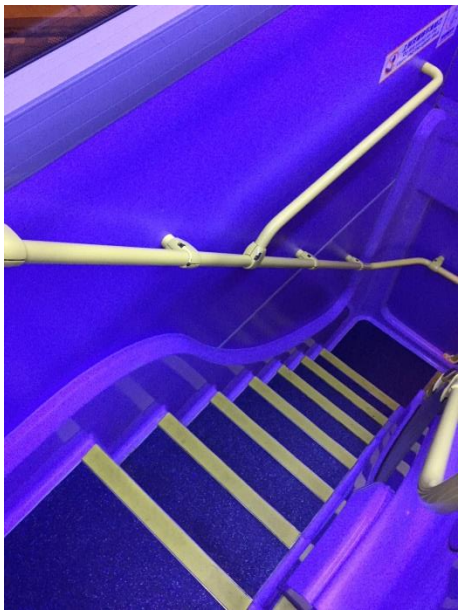
- A lot of considerations have been given to the design of the interiors of modern buses, yet there are deficiencies which should be addressed. As pointed out, the starting point would be historic injury cases and predictable safety risks.

- Slender arm rests is a potential safety hazard when passengers lose balance i.e. slips, trips, falls.


Slender arm rests

- Loss of balance on staircase remains a serious concern. The whole issue should be reviewed with respect to injury mechanisms and patterns in order to generate new solutions such as:

- More forgiving fittings
- Design to better restrain passengers
- More effective education or reminder messages



New ideas should be explored e.g. providing a wavy (corrugated) surface on the side wall to assist passengers keeping balance while descending a staircase

Notes

1. The masonry wall of Tai Tam Tuk Reservoir is unlikely to be able to contain a double decker bus in a collision at the legal speed limit of 50km/h or even much low speed. However, there is a tendency for buses to speed up on the dam and speeds up to 60km/h have been observed. One side of the dam is a 30m vertical drop and the other side is deep water of the reservoir. This is an example where route-specific safe driving protocol is needed to reduce undue risk on particular sections of a bus route.

2. Buses require 60 to 70 percent of stopping distance in an emergency at typical travelling speeds in the urban areas.

COMPARISON OF STOPPING DISTANCE

	Deceleration Rate* m/s2	Total Stopping Distance at Speed**			
		30 km/h	40 km/h	50 km/h	60 km/h
Car	7	13m	20m	28m	37m
Bus (Emergency)	2.7	21m	34m	50m	68m
Bus (Comfortable)	1.1	40m	67m	102m	143m

* Based on The Canadian Transit Handbook

** Inclusive of reaction time of 1s for an alert driver

Note: Metro trains generally have deceleration rate at 1.35m/s2 to avoid passengers losing balance

3. A recent report by OECD (2018) concluded that a 10% decrease in mean speed leads to 20% decrease in injury crashes and a 40% decrease in fatal crashes. It was pointed out that even small changes in driving speeds can have a substantial effect on road safety.