

# **Tuen Mun Road Traffic Incident Independent Expert Panel**

## **屯門公路交通事故獨立專家小組**

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27 November 2003

The Honourable Tung Chee Hwa  
Chief Executive  
Hong Kong Special Administrative Region  
5<sup>th</sup> Floor, Main Wing  
Central Government Offices  
Lower Albert Road  
Hong Kong

Dear Chief Executive,

### **Report on Enhancement of Highway Safety**

We are pleased to submit the Report on Enhancement of Highway Safety (the Report). The Report outlines issues we have examined and contains recommendations to improve Hong Kong's highway safety, having regard to the traffic incident that occurred on Tuen Mun Road on 10 July 2003. Matters relating to the causes and liability of persons involved in the incident fall outside the Panel's terms of reference and do not feature in our review.

First, we would like to convey our most sincere sympathy to the families of those who unfortunately died in this incident, and hope that those who were injured have recovered fully and speedily.

The road transport system consists of three major components, namely, road users, road infrastructure and vehicle. The Panel has reviewed key safety issues relating to each of these three components. After assessing current measures and standards against international practices, we conclude that Hong Kong's highway design and traffic management measures are generally in line with international standards.

We have also analysed the traffic accident trends in Hong Kong and concluded that the safety of our road system is on par with that of other major cities. While our accident rates remain at a relatively low level, many have reached a plateau and shown little improvement for a number of years. The number of slight accidents and accidents involving public buses and public

light buses has shown a slight upward trend. This signals the need for improvement measures.

After reviewing the various factors contributing to traffic accidents, we note that driving behaviour has the greatest bearing on safety. To bring about a visible improvement in our safety performance, we should target efforts to promote good driving practices and foster a responsible and considerate driving culture. Looking ahead, we should aim to make Hong Kong's road system the safest, and the driving culture the most considerate and courteous, among major cities in the world.

The Panel appreciates that parapet design attracted much public attention following the July incident. We wish to point out that parapets provide only a passive line of defence to reduce the severity of accidents. No parapet can have the perfect height and containment level to provide the ideal protection to all vehicles under all conditions. We advocate a total safety management approach to deploy resources effectively to prevent catastrophic accidents.

Road safety is a vast subject covering a wide spectrum of issues and areas. On-going efforts by the Administration and all road users are vital for further enhancement of Hong Kong's road safety performance.

Yours sincerely,



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Dr Cheng Hon-kwan  
Chairman



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Ir Edmund Leung Kwong-ho  
Member



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Dr Wong Sze-chun  
Member

Encl.

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# Executive Summary

## APPOINTMENT OF THE INDEPENDENT EXPERT PANEL

1. A major traffic incident involving a container truck and a double-decked bus occurred on 10 July 2003 on Tuen Mun Road. The bus broke through a section of vehicular parapet on a section of highway above Ting Kau Village and plunged into the hillside beneath, resulting in 21 fatalities and 20 injuries. The incident raised concerns about the safety standard of Tuen Mun Road and the highway network in general. The Chief Executive appointed an Independent Expert Panel (the Panel) to examine and make recommendations on safety measures to prevent similar catastrophes. Issues relating to the causes and liability of persons involved in the incident were investigated by the Police and fell outside the Panel's terms of reference.

## THE PANEL'S WORK PLAN

2. The Panel inspected the incident site, the vehicles involved in the incident and the damaged parapet sections, and held regular meetings with relevant government departments to examine the latest developments and international practices of various road safety issues. To ensure public participation in the process, the Panel called for public views from 4 August 2003 to 3 September 2003, and held consultation sessions with the transport trade to more fully gather their views. The Panel studied the public views and suggestions carefully and thoroughly and has taken them into account in mapping out the recommendations.

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### JULY INCIDENT AND TRAFFIC ACCIDENT TRENDS

3. The Panel has examined different aspects of the July incident including highway design, traffic signs, parapet design, human factors, etc. to identify areas for improvement. In addition, the Panel analysed traffic accident trends to assess the safety level of Hong Kong's road transport system. The Panel notes that there was a drop in the total number of traffic accidents as well as the fatality and casualty rates in 2002 as compared with 1982. However, the increase in slight accidents and the relatively high involvement rate of public buses and public light buses in traffic accidents warrant attention. On international comparison, Hong Kong compares favourably with other major cities for the per population accident rate but less favourably in terms of the rate per kilometre of road.

### ENHANCING DRIVING BEHAVIOUR

4. The Panel has reviewed the major factors contributing to traffic accidents over the past ten years and notes that about 65% of the accidents are driver related. This points to the importance of fostering a more considerate and responsible driving culture through focused and sustainable publicity programmes launched by the Road Safety Council (RSC) in collaboration with District Councils, effective evaluation methodology to fine-tune publicity strategies and additional avenues to extend the coverage of publicity efforts.

5. While there is no imminent need to further tighten the driving test standards and requirements, the Panel recommends that the Government explore the feasibility of introducing mandatory courses for repeat traffic offenders, enhancing training for professional drivers, expanding the 'probationary' driving licence arrangement for motorcyclists to cover new private car and light goods vehicle drivers, and instituting a 'Quality Driving Instructor Course' to upgrade the skills of driving instructors.

### LEGISLATION AND ENFORCEMENT

6. Comprehensive legislation and effective enforcement are necessary to combat undesirable driving behaviour. The Panel notes that the Government has kept road safety related legislation under constant review to ensure that Hong Kong's road safety regime is on par with international standards and meets the changing needs of the community. New legislation imposing fixed penalties for some common traffic offences and creating a new offence against tailgating is under deliberation. The Panel recommends that preparations for the proposed legislative changes be expedited.

7. Road safety legislation and publicity programmes need to be complemented by an effective enforcement regime. To increase the deterrent effect, the Panel recommends that the Hong Kong Police Force (HKPF) continue to devise enforcement programmes in tandem with the publicity plans mounted by RSC, and to deploy advanced technology to facilitate traffic enforcement. In particular, the Panel recommends that the Speed Enforcement Cameras (SECs) for Tuen Mun Road and 59 other locations be put into operation as soon as possible. The Government should also extend SEC coverage to other parts of the strategic road network and those routes with speeding problems.

### TRAFFIC ENGINEERING AND MANAGEMENT

8. Safe transport infrastructure and an efficient traffic management system are important pillars of road safety. After examining highway design standards in Hong Kong and overseas, the Panel considers that Hong Kong's highway design meets international standards and places proper emphasis on road safety, despite the challenges presented by limited space and a hilly topography. Members point to the need to differentiate between requirements for safety and comfort in highway design and are of the opinion that a well-designed road should provide an acceptable level of safety with the intended level of comfort at an acceptable cost.



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9. The Panel points out the close relationship between highway design and speed, and the safety considerations concerning the design speed and posted speed limit. Members recommend that the Transport Department (TD) continue to conduct regular reviews of speed limits and, if necessary, adjust the speed limits to optimise traffic flow without compromising road safety.

10. Traffic signs and road markings are integral parts of the road system that convey important information to drivers on directions and driving rules. After examining the current practices, the Panel concurs that the signing arrangements in Hong Kong accord with international practices. The Panel notes that improvement measures arising from the 'Comprehensive Review of Directional Signing in Hong Kong' are in the pipeline. These include rationalisation of the route numbering system and provision of exit numbers on the strategic road network. The Panel calls for an early implementation of the improvement measures and the launch of publicity measures to keep motorists informed of changes in signing standards.

11. The Panel notes that some controls and restrictions on heavy vehicles and specific safety measures for franchised buses are already in place. The Panel recommends that the Government keep a close watch on the safety records of specific types of vehicles and take proactive steps to enhance their safety standards with participation of the relevant transport trades.

## VEHICLE CONTROL

12. Despite modern designs that have made vehicles safer, it is the way in which a vehicle is used and maintained that has the greatest bearing on safety.

13. Speeding is a common problem. For better speed control, the Panel recommends that appropriate speed display and control devices be installed in passenger services vehicles. Subject to an evaluation of the speed display units (SDUs) installed in green minibuses running overnight routes, Members recommend that the use of SDU be extended to other public light buses. The Panel also

recommends that newly-registered franchised buses be required to install speed limiters. Consideration should also be given to install speed limiters in other heavy vehicles, subject to consultation with the transport trade. As for tachographs, which can serve accident investigation and fleet management purposes, the Panel recommends that TD explore the fitting of such devices in franchised buses, and subject to evaluation of effectiveness, consider extending them to other types of passenger services vehicles.

14. Regular inspections and roadside enforcement are useful measures to ensure that vehicles are kept in good working order. The Panel recommends that temporary or permanent check sites for roadside enforcement be established close to major trunk roads or expressways and that joint roadside spot checks on heavy vehicles by HKPF and TD be stepped up. The feasibility of extending the stability test (tilt test) to heavy goods vehicles should also be explored.

### VEHICULAR PARAPET DESIGN

15. Parapets are protective devices designed to reduce the severity of an accident. They provide a passive line of defence and are not the cause or a contributory factor of an accident.

16. After examining local and international standards, the Panel considers that the existing parapet design standards adopted by the Highways Department (HyD) are generally in line with international practices. Taking into account the standards adopted for road design, and the measures put in place to control various types of vehicles and drivers, the Panel is of the view that the various types of parapets are suitable for general application and for uses on elevated structures in terms of containment capacity and height protection. However, there is room for enhancement at critical locations where penetration of the vehicular parapet may result in catastrophic consequences. The Panel advocates a total safety management approach and recommends that a proper risk assessment and cost benefit analysis be carried out before any parapet enhancement programme is implemented. The Panel considers

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that there is a strong socio-economic case to devote resources to a mixture of proven measures to reduce occurrence of accidents rather than to reduce the severity of low probability accidents.

17. On parapet design, the Panel notes that a strong parapet designed to a high containment level may stop a heavy vehicle in the desired manner, but may cause considerable damage to a small vehicle and subject the occupants to severe acceleration force and injury. Conversely, a parapet designed to a lower containment level for light vehicles would not perform equally well for larger vehicles that may penetrate the parapet. There is at present a technical dilemma for a parapet design to satisfy different containment levels at the same time. For enhancement of parapet design in the long term, the Panel recommends that HyD expand the range of containment levels, in particular at the high end, and review the parapet height requirements, having regard to the extensive use of double-decked buses and the maximum legislated vehicle weight permitted on the road system in Hong Kong. The Panel also recommends that HyD continue to monitor the development of multiple containment parapet overseas, and develop appropriate parapet designs for Hong Kong.

18. In anticipation of an expanded parapet hierarchy, and the possibility of introducing more height variations, the Panel recommends that detailed guidelines and analysis procedures be provided on the choice of containment level and parapet height.

19. As materials and workmanship have a bearing on the strength of the parapets, the Panel recommends that suitable testing requirements for fabricating the steel components used in vehicular parapets be included in the General Specification for Civil Engineering Works. HyD should conduct research work in collaboration with local tertiary institutions on new parapet designs and materials. Evaluation of parapet designs on the basis of damage information collected after traffic incidents should also be carried out to refine various types of parapet designs.

### TUEN MUN ROAD

20. Having examined past accident statistics, the Panel considers that Tuen Mun Road is intrinsically safe as seen by its accident rates, which are about average for all expressways, including those more recently built to current design standards. Bearing in mind the high proportion of heavy vehicles using Tuen Mun Road, there is no evidence indicating that heavy vehicles are more prone to accidents along Tuen Mun Road.

21. Noting that the major contributory factors of traffic accidents along Tuen Mun Road are driver related, the Panel considers that enforcement actions should be stepped up. The Panel recommends that TD and HKPF expedite the necessary preparatory work to bring the SEC system on Tuen Mun Road to full operation as soon as possible. The Panel further recommends that once the SEC system is in operation, HKPF should deploy more resources to patrolling, and to target at tailgating and careless lane changing which are the top two contributory factors of traffic accidents.

22. In regard to the geometric standards, the Panel notes that some sections of Tuen Mun Road fall outside the current standards because of the topography of the route. As worldwide highway design standards are being raised beyond the required safety margins to give a high level of comfort to motorists, the Panel considers that the marginally lower standards at a few locations on Tuen Mun Road mainly affect the comfort of motorists but not their safety.

23. For the traffic management system, the Panel considers that the traffic signing and road marking arrangements along Tuen Mun Road are effective. Although there is no intrinsic deficiency in the design at the incident site, the Panel considers it prudent to draw up a package of enhancement measures for the road section in the vicinity of the incident location, taking into account the recommendations made in the recent studies on traffic signing and road markings.

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24. Despite suggestions to ban buses and heavy vehicles including container trucks from using Tuen Mun Road, the Panel does not support this proposal. There is no evidence to show that these categories of vehicles are more prone to traffic accident along Tuen Mun Road. In addition, banning these vehicles from using Tuen Mun Road would have serious economic and social impacts on the northwest New Territories (NWNT). Tuen Mun Road is a vital route linking urban areas with the NWNT as well as the Lok Ma Chau Crossing. Any buses and heavy vehicles banned from using Tuen Mun Road would have to use other alternative routes, resulting in widespread traffic congestion and unnecessarily long travelling time, particularly during peak hours.

25. The Panel notes that improvement works carried out at different stages on Tuen Mun Road have resulted in gradual upgrading of standards along the road. Members recommend that a comprehensive road safety review be conducted for Tuen Mun Road, particularly from the drivers' perspective, to identify any possible safety enhancement measures. Improvement measures that can be implemented within a relatively short period, such as traffic management modifications, will be carried out as interim enhancement, while major engineering items will be covered under the Tuen Mun Road reconstruction and improvement project.

26. The Panel notes that the public is keen to see an early completion of the Tuen Mun Road reconstruction and improvement project. The Panel has worked closely with TD and HyD to identify opportunities for advancing the project. The Panel is pleased to note that by streamlining the planning and design process, the start of the Tuen Mun Road reconstruction and improvement project can be advanced by six months to mid-2005 for completion in phases between mid-2009 and mid-2011. The Panel recommends that HyD continue to refine the construction programme with a view to further reducing the construction period.

### MISCELLANEOUS ISSUES

27. Apart from the above focus areas, the Panel has also responded to miscellaneous improvement proposals concerning driver's health, safety of parapets and railings at specific locations, road maintenance, Government communication with the transport trade and driver associations, and the application of the 'two-second' rule. Public views and suggestions that were not related to highway safety or the Panel's scope of work were referred to relevant departments for follow-up action.

28. The rationale and details of the recommendations put forth by the Panel are covered in various chapters, while an overview is set out in the summary of recommendations.

## Chapter 1

# Introduction

## APPOINTMENT OF THE INDEPENDENT EXPERT PANEL

1.1 A major traffic incident occurred at 0630 hours on 10 July 2003 on Tuen Mun Road westbound above Ting Kau Village. A container truck with a 40-foot empty trailer collided with a double-decked bus. The bus carrying 40 passengers broke through a section of vehicular parapet and plunged into the hillside about 31 m beneath Tuen Mun Road. The traffic incident resulted in 21 fatalities, one of them being the bus driver, and 20 injuries.

1.2 The Government was deeply concerned about this serious traffic incident which not only brought about losses of precious lives, but also raised concerns about the safety standard of Tuen Mun Road and the highway network in general. The Chief Executive, Mr Tung Chee Hwa, has appointed an Independent Expert Panel (the Panel) to address these important issues.

## MEMBERSHIP

1.3 The Panel was chaired by Dr Cheng Hon-kwan, who is currently the Chairman of the Transport Advisory Committee. The other two members were Ir Edmund Leung Kwong-ho, Past President of the Hong Kong Institution of Engineers, and Dr Wong Sze-chun, Associate Professor in the Department of Civil Engineering of the University of Hong Kong. The Panel members were selected for their knowledge of Hong Kong's transport system, experience in different engineering disciplines and expertise in transportation, highway design and traffic management. Please see **Appendix I** for biographical notes on Members.

## TERMS OF REFERENCE

1.4 Having regard to the circumstances of the traffic incident on Tuen Mun Road on 10 July 2003, the Panel was tasked to examine and make recommendations to the Chief Executive on safety measures to prevent similar catastrophes. While a wide spectrum of issues and subjects have a bearing on highway safety, given the time constraint, the Panel focused on key items which were of concern to the public and required immediate attention.

1.5 Issues relating to the causes and liability of persons involved in the incident were investigated by the Police and fell outside the Panel's terms of reference.

## MODUS OPERANDI

1.6 The Panel was supported by a secretariat. Government departments including the Highways Department (HyD), the Hong Kong Police Force (HKPF) and the Transport Department (TD), provided Members with information on current practices/standards and the latest developments regarding various road safety issues. They also conducted researches into specific areas for the Panel's deliberation.

## WORK PROGRAMME

1.7 The Panel worked under a very tight schedule in the past four months. They held their first meeting on 28 July 2003 to map out their work plan, and inspected the incident site, the two vehicles involved in the traffic incident and the damaged parapet railings and posts on 29 July 2003. Members had since held regular meetings with relevant government departments to examine various road safety issues. To ensure public participation in the process, the Panel called for public



views from 4 August 2003 to 3 September 2003 and met with representatives of the transport trade to gather their views. With the benefit of public views and information gathered from an extensive review of road safety issues, the Panel mapped out its recommendations and submitted a report to the Chief Executive in November 2003.

## OVERVIEW OF THE REPORT

1.8 Following a brief introduction in this Chapter, Chapter 2 outlines the Panel's work in the past four months. An account of the July incident is given in Chapter 3. Chapter 4 covers a detailed analysis of traffic accident trends in Hong Kong to identify potential areas for improvement. The Panel then examines road safety issues relating to the three major components of the road transport system, namely, road users, the road environment and vehicles. Given that human factors contribute to a high percentage of traffic accidents, public education and driver training are discussed in Chapter 5. Road safety publicity has to be supplemented by an effective enforcement programme. The Panel therefore examines the legislative and enforcement regime in Chapter 6. Issues on traffic engineering and management that define the road environment are discussed in Chapter 7. The subject of vehicle control is examined in Chapter 8. Although vehicular parapets only provide a passive line of defence, and cannot be a contributory factor of an accident, the Panel considers it prudent to devote a full Chapter 9 on various aspects of parapet design, which have attracted public attention after the incident. Improvement measures for Tuen Mun Road are given in Chapter 10. Miscellaneous improvement proposals are set out in Chapter 11. Chapter 12 contains a summary of recommendations put forth by the Panel.

## Chapter 2

# Methodology

2.1 As investigation of liability issues fell under the purview of the Hong Kong Police Force (HKPF), a detailed analysis of the causes of the traffic incident was left to HKPF. Nonetheless, the Panel had examined the factual account of the incident, the environment of the incident site, the mechanics of the vehicles and the street furniture involved to identify factors which might affect highway safety, and to propose corresponding improvement measures.

2.2 The Panel's deliberation went beyond Tuen Mun Road and covered other high-speed roads and locations with characteristics similar to the incident site. The Panel examined key elements of road safety, reviewed current standards and international practices, and considered public and expert views to come up with recommendations to improve highway safety in general. The following outlines the Panel's work in the four-month period.

## FIRST MEETING

2.3 The Panel held their first meeting on 28 July 2003 to agree on the scope of work and work plan. It was agreed that the Panel would examine different safety aspects, including driving behaviour, highway design, traffic management and regulation, and vehicular parapets, taking into account special characteristics of the road system in Hong Kong.

## SITE VISIT

2.4 The Panel had a site visit on 29 July 2003 to obtain first-hand information on the incident site and the damaged vehicles and parapet. The Panel examined the design and highway facilities for the incident site, including the signage leading to the site, and inspected the hillside at Ting Kau Village where the double-decked

bus landed. Following the site visit, the Panel inspected the container truck and the bus involved in the incident at the Siu Ho Wan Vehicle Detention Pound, and the damaged parapet railings and posts at the Tsuen Wan Police Station. The Panel's observations are set out in Chapter 3.

## COLLECTION OF PUBLIC VIEWS

2.5 The Panel had kept track of views expressed by different sectors in the media and at other open fora since the incident occurred. To facilitate public participation in the process, the Panel called for public views on ways to enhance highway safety from 4 August 2003 to 3 September 2003. An invitation for written submissions was published in three Chinese newspapers and one English newspaper. Letters were also sent to professional bodies in the engineering, transport and construction fields, engineering departments of local academic institutions, transport trade associations, franchised bus companies, driving schools and other relevant organisations such as the Road Safety Council appealing for suggestions. A list of these organisations is set out in **Appendix II**. The Panel received 93 written submissions from different sectors during the one-month consultation period. The Panel also briefed the Transport Advisory Committee and consulted Professor Richard Allsop of University College London, an expert on traffic safety and management in the UK.

2.6 The Panel attaches great importance to the views of the transport trade personnel who are frequent users of the road and key stakeholders of highway safety improvement measures. To gauge their views more fully, the Panel invited 90 transport trade organisations representing taxis, public light buses, light goods vehicles and heavy vehicles to attend three consultation sessions designated for different trades on 19 September 2003. Please refer to **Appendix II** for the invitation list and organisations participated in the consultation sessions.

2.7 The views collected through written submissions and consultation sessions were analysed and classified into five main categories –

- ❑ driving behaviour;
- ❑ enforcement;
- ❑ traffic engineering and management;
- ❑ parapet design issues; and
- ❑ other miscellaneous items.

A categorised summary of the public views is set out at **Appendix III**.

2.8 The Panel considered the views and suggestions fully and carefully, and took them into account when formulating the improvement measures. The Panel's responses to the views are set out in individual chapters covering different key areas and a quick reference to the relevant paragraphs is provided in **Appendix III**. The Panel would like to express profound gratitude to all those who have expressed their views and shared their thoughts.

## REGULAR MEETINGS WITH RELEVANT DEPARTMENTS

2.9 The Panel held regular meetings with the relevant government departments including the Highways Department (HyD), HKPF and the Transport Department (TD) to collect information about current practices/standards and the latest developments of various road safety issues including –

- ❑ accident and parapet damage statistics;
- ❑ highway and parapet designs;
- ❑ traffic management;
- ❑ legislation and enforcement;
- ❑ management and control of different classes of vehicles;
- ❑ training for drivers; and
- ❑ public education and publicity.

2.10 Through a detailed analysis of the information collected from the submissions and the consultation process, and in-depth discussions with government departments, the Panel identified areas for improvement and mapped out enhancement recommendations for both Tuen Mun Road and the highway network in general.

2.11 The Panel kept the public abreast of their work through media briefings at key junctures. The Panel briefed the media on their scope of work and work plan after the site visit on 29 July 2003. They shared with the media the public views collected after the consultation with transport trade organisations on 19 September 2003 and briefed the media on the key recommendations on the release of the report.

## Chapter 3

# The Incident

### AN ACCOUNT OF THE INCIDENT

3.1 On the morning of 10 July 2003, a fine and clear day, a KMB double-decked bus of Route 265M (registration mark JU 4667) was on its normal haul from Lai Yiu Tsuen, Kwai Chung to Tin Shui Wai. At 0630 hours, when the bus was on Tuen Mun Road above Ting Kau Village, a collision occurred between it and a container truck (a tractor with an empty trailer, with registration marks JE9488 and 39401T respectively). The bus veered off through the parapet and plunged 31 m down to Ting Kau Village below. After the incident, the container truck stopped at the hard shoulder and across the nearside lane, adjacent to the parapet (**Figure 3.1**).

#### The bus

3.2 The bus plunged head-down after the collision, and its front part was crushed beyond recognition (**Figure 3.2**). The extent of the crushing was more severe at the upper than the lower deck. Most seats were detached or distorted as a result of the impact force. For the 40 passengers on board, 20 died, and 20 were injured. The driver of the bus died instantly.

Figure 3.1 – The container truck after the collision





Figure 3.2 – The damaged bus in police detention pound

3.3 The bus was relatively new (**Figure 3.3**). Information about the bus is set out below –

- ❑ Make : Neoplan (manufactured in 2000)
- ❑ Dimensions : 12 m (L) x 2.5 m (W) x 4.35 m (H)
- ❑ Centre of Gravity : 1.985 m above the ground (at its worst case with a fully laden upper deck and empty lower deck)
- ❑ Axle Weights :
  - 16 340 kg (unladen)
  - 23 200 kg (laden)
- ❑ Seating capacity :
  - Upper deck 59
  - Lower deck 31
  - Standees 36



Figure 3.3 – Record photo of a Neoplan bus

### The container truck

3.4 The container truck was made up of a tractor and a semi trailer. The semi trailer was empty at that time. The weights of the tractor and the trailer were 6 690 kg and 6 830 kg respectively. The tractor was first registered on 9 June 1992, and the trailer on 10 August 1999. This category of vehicle is subject to an annual examination when its licence is renewed.



Figure 3.4 – The damaged driving cab of the container truck

3.5 The damage to the container truck was relatively light (**Figure 3.4**). Only the nearside of the tractor was dented. The driver was not injured and was able to assist the police with the investigation at the scene. He also passed the alcohol test.

### The road

3.6 Tuen Mun Road was designed during the period of the late 1960's and the early 1970's as a high capacity dual three-lane 15 km highway connecting Tsuen Wan and Tuen Mun. The road was built to cope with the expected traffic volume arising from the then newly developed Tuen Mun satellite town. Construction of the Tsuen Wan bound carriageway started in 1974 and was completed in 1978. The carriageway was situated on higher terrain. The Tuen Mun bound carriageway was mostly supported on columns and its construction was completed in 1983.

3.7 The stretch of road at the incident spot was subsequently widened to accommodate the slip road leading to the Tai Lam Tunnel approach road of the Tsing Long Highway (**Figures 3.5 and 3.6**). It was a three-lane carriageway with a slight left curve which should not offer any obstruction to the sightline. The road was wide as there was a hard shoulder almost one lane wide between the nearside lane and the parapet plus a taper of the slip road of almost equal width.





Figure 3.5 – An aerial photo of Tuen Mun Road at the location of incident (by courtesy of Ming Pao)

Figure 3.6 – Tuen Mun Road from Ting Kau Village



### The scene

3.8 On the morning of the incident, the weather was fine, and the road surface was dry. The incident happened at the spot where the nearside lane was widened to accommodate a slip road leading to the Tsing Long Highway. The speed limit in force was 70 km/h. The gradient of the road was gentle downhill. No traces of oil slick or other substance which would reduce the normal level of friction were observed. The road surface was constructed with an asphalt wearing course. The section of the road concerned was resurfaced in 1999. Previous records showed that this was not an accident black spot.

3.9 At the time of the incident, the bus was travelling along the nearside lane, and the container truck was in the middle lane. A collision occurred between the vehicles with the points of impact being the nearside front of the container truck behind the driver cab and the offside front bumper of the bus. There were tyre marks on the road surface from the container truck, and some tyre marks left by the

bus on the curb under the parapet. The front bumper of the bus was found at the point where the container truck rested.

3.10 The truck and the bus travelled together for a short distance, across the initial section of the slip road and then across the hard shoulder, before the bus plunged down to Ting Kau Village below. The truck stopped across the hard shoulder, right at the parapet in front of the gap in the rails cut open by the bus. The point where the bus plunged was about 50 m past the road sign gantry located at the start of the slip road to Tsing Long Highway.

### The parapet

3.11 The parapet was a three-rail steel parapet, which is generally adopted for the whole of Tuen Mun Road wherever parapets are required. Beneath the parapet, there was a concrete curb. The three steel rails were bolted to the posts, which were in turn welded onto base plates bolted to the curb. The base plate and the bottom part of the post were protected with concrete. All the rails as well as the posts were constructed of steel box sections. Spigot and socket joints were provided at intervals to allow for the expansion and contraction of the jointed sections of the rails due to temperature changes. **Figure 3.7** shows a typical parapet of similar design.

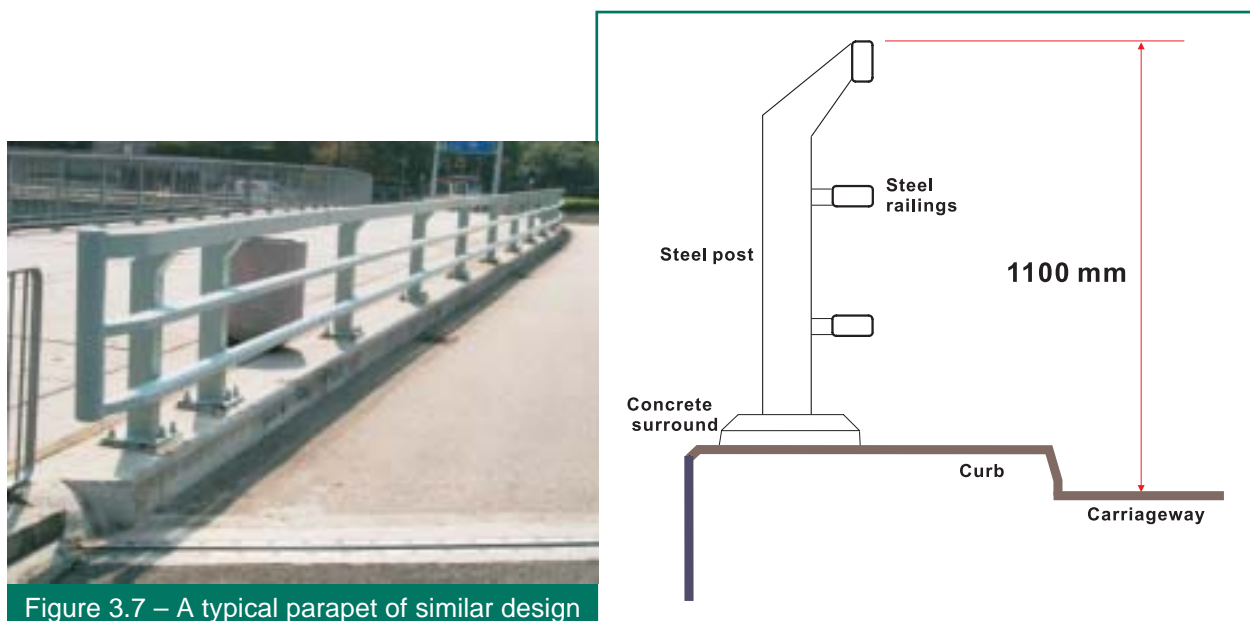


Figure 3.7 – A typical parapet of similar design

3.12 In the incident, a total of 13.35 m of this parapet were damaged, along with four supporting steel posts (**Figures 3.8 and 3.9**). Two of the posts were sheared off the base plate at the welded joint and fell to Ting Kau Village below (the concrete protection blocks were smashed entirely), and another two posts (one preceding, another ensuring the two sheared off posts) were bent. Some of the rails were snapped at the position where they were bolted to the posts, and some were split at the expansion joint and fell to Ting Kau Village below. Not all of these sections were recovered afterwards. Some of the bent rails remained on the posts and a segment of broken rail recovered showed that it was bent through almost 180 degrees in a direction opposite to the impact.



Figure 3.8 – The broken parapet

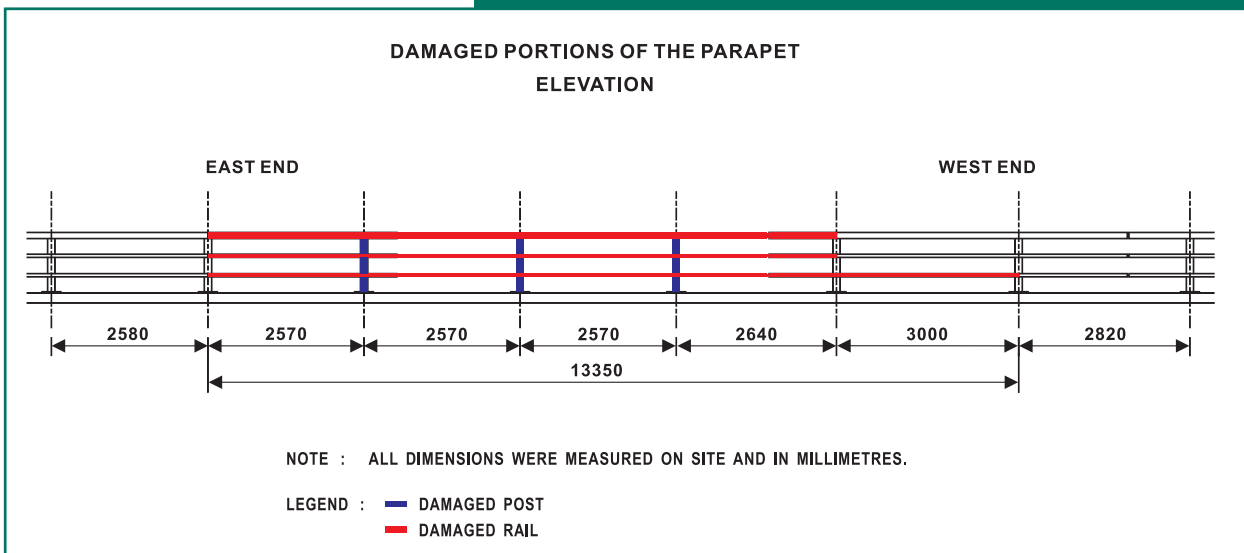


Figure 3.9 – Elevation of the parapet showing damaged portions

## Chapter 4

# Traffic Accident Trends in Hong Kong

### INTRODUCTION

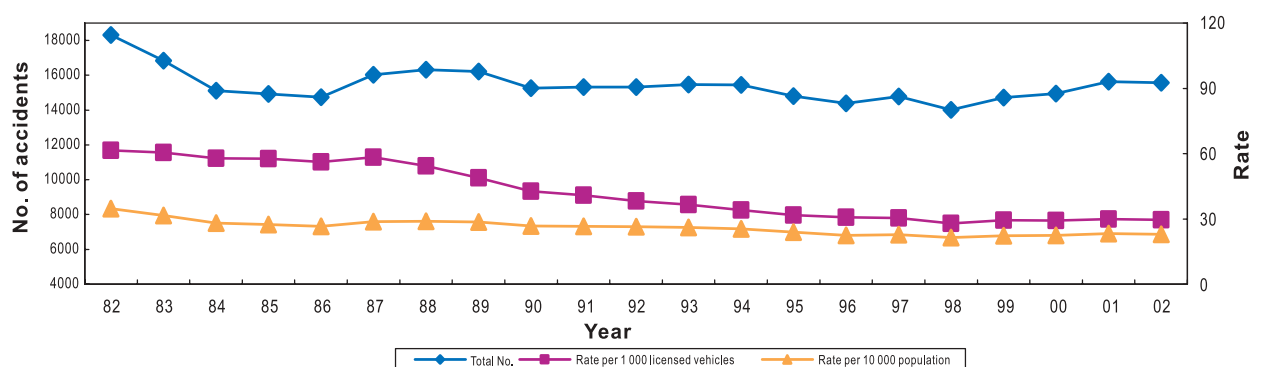
4.1 With a total area of 1 102 km<sup>2</sup>, Hong Kong has a population of 6.8 million and 522 912 licensed vehicles as at 30 June 2003. The length of public roads runs to 1 932 km, with 111 km being expressways. Against this background, the Panel has reviewed the accident rates and trends in Hong Kong in the past two decades, and compared the records with those of other major cities to assess the safety level of the road transport system in Hong Kong.

4.2 Members recognise that there are different parameters for monitoring accident trends and assessing road safety performance. Other than total number of accidents, accident rates can be compared against different levels of population, motorisation and road network built, i.e. in terms of *number of accidents per million population, per thousand licensed vehicles, per kilometre of road or per million vehicle-kilometre respectively*. As each parameter has its advantages and limitations, the Panel has reviewed the accident trends using various parameters to arrive at a more comprehensive analysis.

### OVERALL TREND

4.3 The historical trend of the *total number of traffic accidents (Figure 4.1)* provides a comparison of road safety performance over a period of time. From 1982 to 2002, the *number of accidents* dropped by about 15%. However, a slight

Figure 4.1 – Total number of accidents in Hong Kong (1982 - 2002)

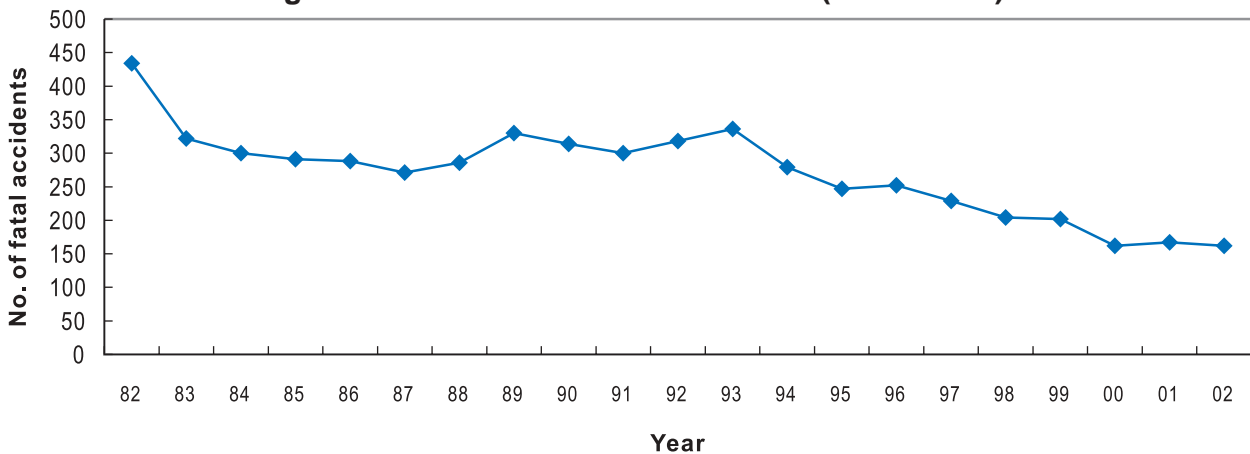


upward trend was observed since 1998. In terms of *accident rates per 10 000 population* and *per 1 000 vehicles*, they have reached a plateau for quite a number of years.

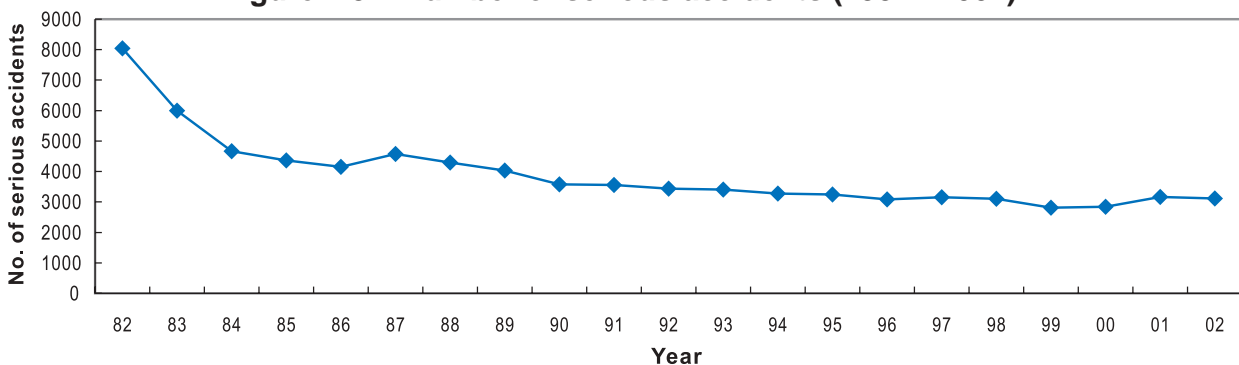
## SEVERITY TREND

4.4 During the same period, the *number of fatal<sup>1</sup> and serious<sup>2</sup> accidents per year* reduced by 63% (from 434 to 162) and 60% (from 8 043 to 3 118) respectively. Both show a downward trend with the drop stabilising in the past few years as shown in **Figures 4.2 and 4.3**. On the other hand, the *number of slight<sup>3</sup> accidents per year* increased by about 25% from 9 836 to 12 296 as shown in **Figure 4.4**.

**Figure 4.2 – Number of fatal accidents (1982 - 2002)**

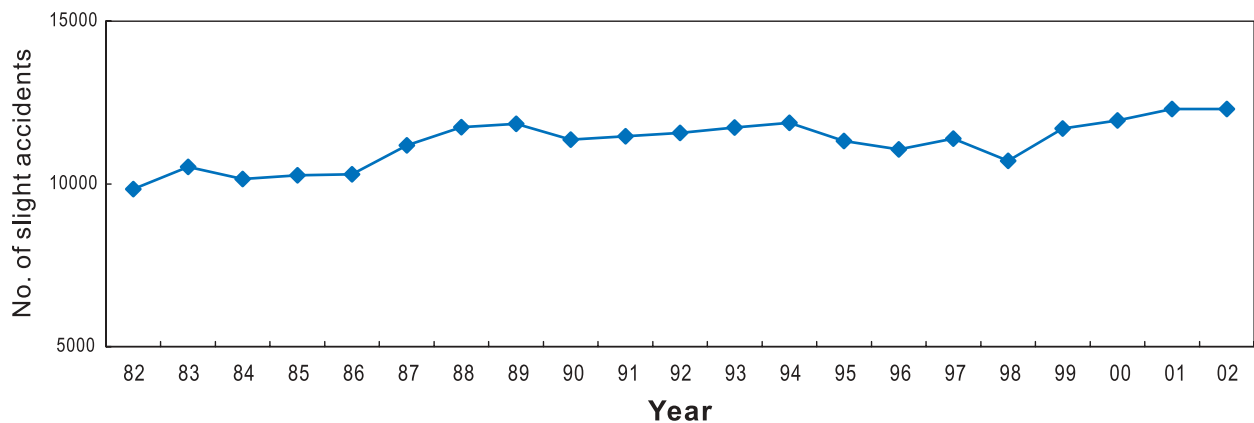


**Figure 4.3 – Number of serious accidents (1982 - 2002)**



- <sup>1</sup> A fatal accident is one in which at least one person is killed immediately, or is injured and subsequently dies of his injuries within 30 days of the accident.
- <sup>2</sup> A serious accident is one in which one or more persons is injured and detained in hospital for more than 12 hours.
- <sup>3</sup> A slight accident is one in which one or more persons is injured but not to the extent that detention in hospital is required for more than 12 hours.

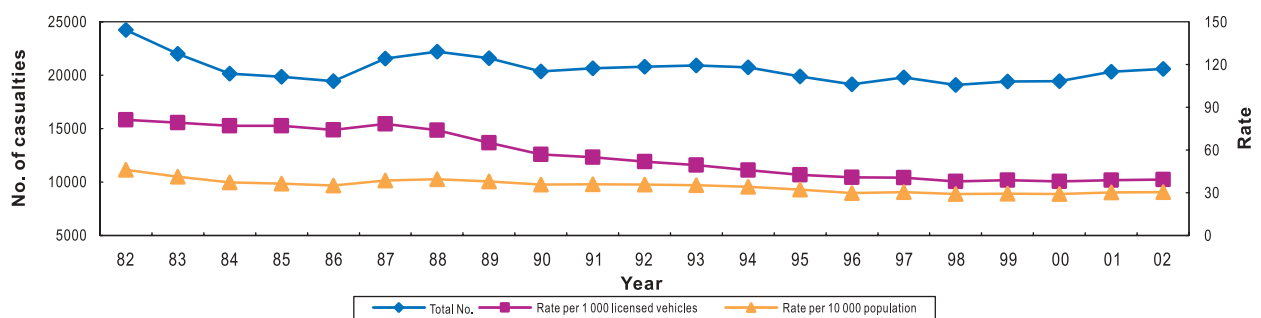
**Figure 4.4 – Number of slight accidents (1982 - 2002)**



## CASUALTY TREND

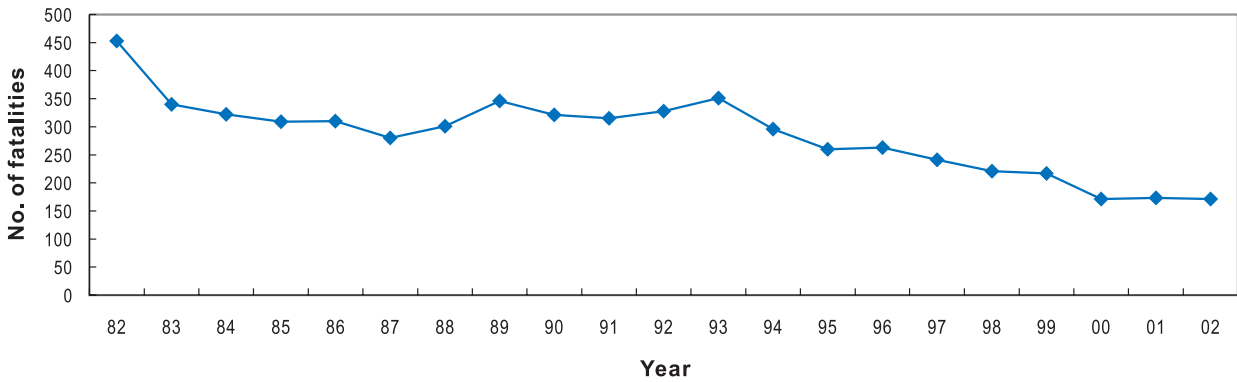
4.5 The *number of casualties* involved in traffic accidents between 1982 and 2002 exhibits a trend similar to that of the total number of traffic accidents. During the period, the total number of casualties dropped from 24 222 to 20 600, representing a 15% reduction, as illustrated in **Figure 4.5**.

**Figure 4.5 – Total number of casualties (1982 - 2002)**

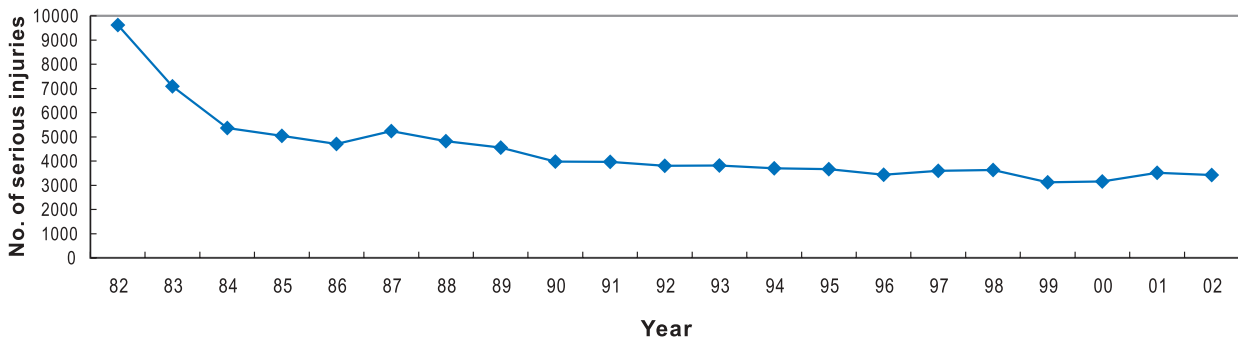


4.6 During the same period, the number of fatalities and serious injuries fell from 453 to 171 and from 9 615 to 3 426 respectively (see **Figures 4.6 and 4.7**). However, the number of slight injuries increased by 20% from 14 154 to 17 003 (see **Figure 4.8**).

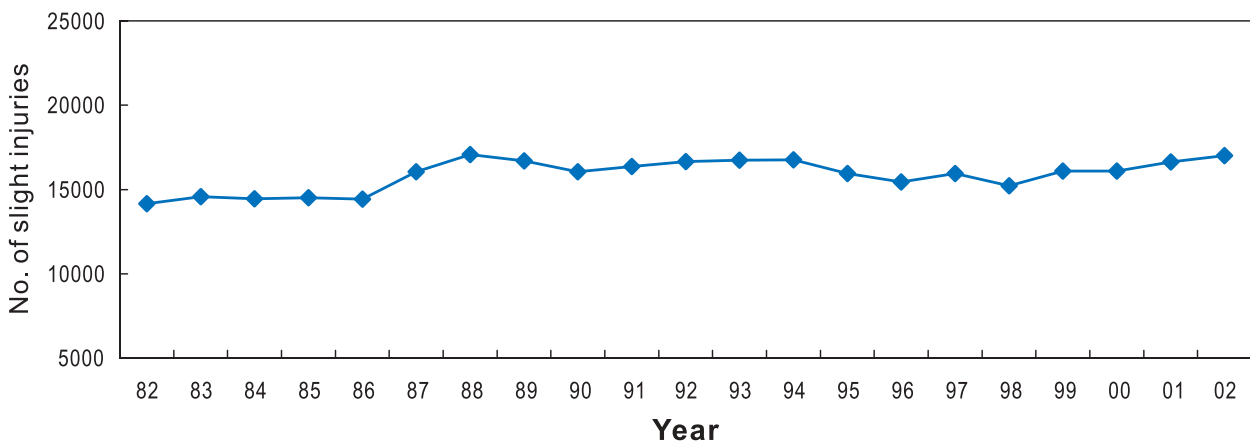
**Figure 4.6 – Number of fatalities (1982 - 2002)**



**Figure 4.7 – Number of serious injuries (1982 - 2002)**



**Figure 4.8 – Number of slight injuries (1982 - 2002)**



## VEHICLE INVOLVEMENT TREND

4.7 Apart from reviewing the number of traffic accidents and their severity, the Panel has also examined the vehicle involvement rates to assess whether a particular vehicle type is more prone to traffic accidents. For a better appreciation of the mix of vehicles in Hong Kong, the number of different types of licensed vehicles as at 30 June 2003 is set out in **Figure 4.9**.

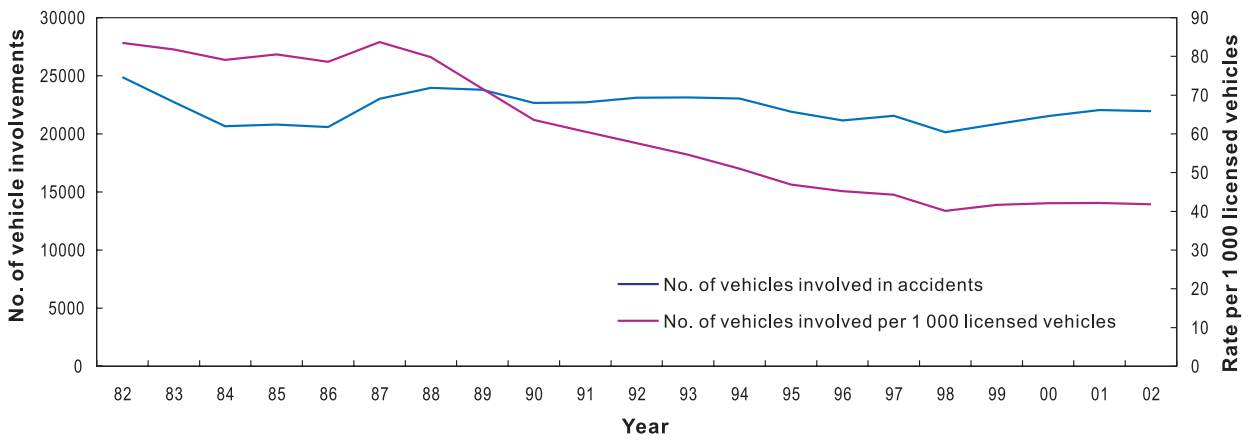
**Figure 4.9 – Number of different types of licensed vehicles as at 30 June 2003**

Motor cycle/tricycle	29 163
Private car	338 534
Taxi	17 997
Government vehicle	6 776
Light goods vehicle	68 275
Medium goods vehicle	38 428
Heavy goods vehicle	3 333
Light bus	6 297
Franchised bus	6 281
Non-franchised bus	6 594
Private bus	478
Special purpose vehicle	756
<b>Total</b>	<b>522 912</b>

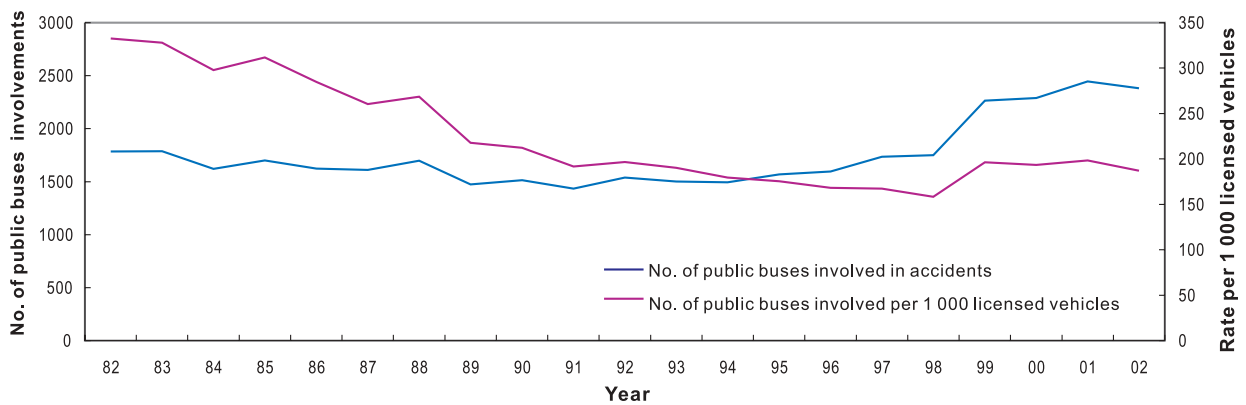
4.8 From 1982 to 2002, the *total number of vehicle involvements* in accidents dropped by 12% from 24 882 to 21 967, as shown in **Figure 4.10**. As there was an increase in the total number of licensed vehicles from 297 997 to 525 111 during the same period, *the involvements per 1 000 vehicles* dropped even more significantly by 50%, from 83.5 to 41.8. However, the Panel notes that in recent years, some vehicle classes such as public buses and public light buses recorded an increase in the absolute number of accident involvements as shown in **Figures 4.11 and 4.12** respectively. This development warrants our attention.



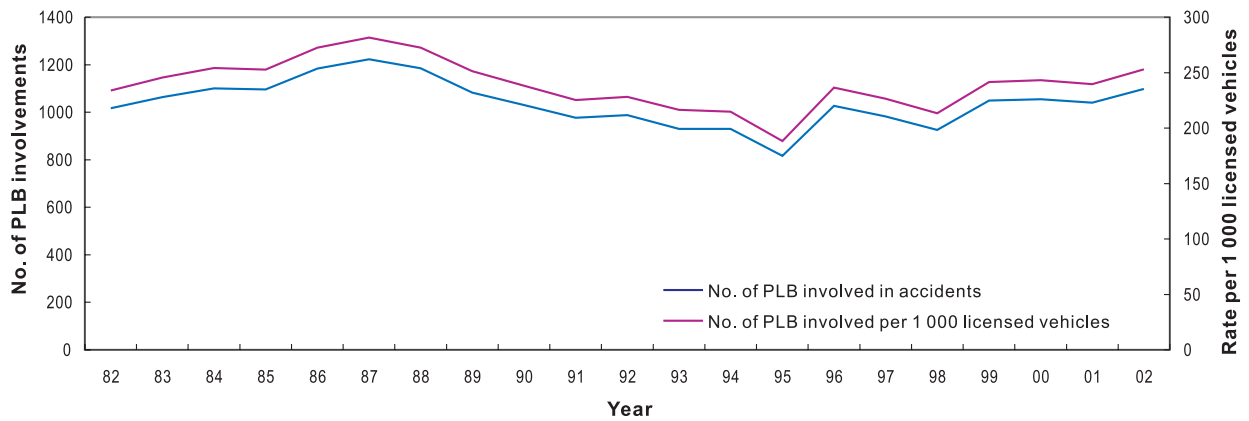
**Figure 4.10 – Number of vehicles involved in accidents in Hong Kong (1982 - 2002)**



**Figure 4.11 – Number of public buses involved in accidents in Hong Kong (1982 - 2002)**



**Figure 4.12 – Number of public light buses (PLB) involved in accidents in Hong Kong (1982 - 2002)**



## COMPARISON OF TRAFFIC ACCIDENT RATES WITH OTHER MAJOR CITIES

4.9 The Panel has also compared Hong Kong’s road safety performance with other major cities for bench-marking purposes. **Figures 4.13 and 4.14** show Hong Kong’s ranking among other major cities in terms of *road traffic fatality rate per million population and per kilometre of road*. Similar comparisons on the *number of road accidents per year* are shown in **Figures 4.15 and 4.16**. Hong Kong has one of the lowest rates in terms of *fatalities per million population and accidents per 1 000 population*. In terms of *fatalities and number of accidents per kilometre of road*, Hong Kong is one of the cities with higher rates, probably because the total length of roads in Hong Kong is relatively short but the road usage is high. The Panel notes that the per vehicle-kilometre accident rate is another commonly used parameter. As data on this parameter for major overseas cities are not readily available, no comparison is made in this report.

**Figure 4.13 – Fatality rate per million population in different cities**

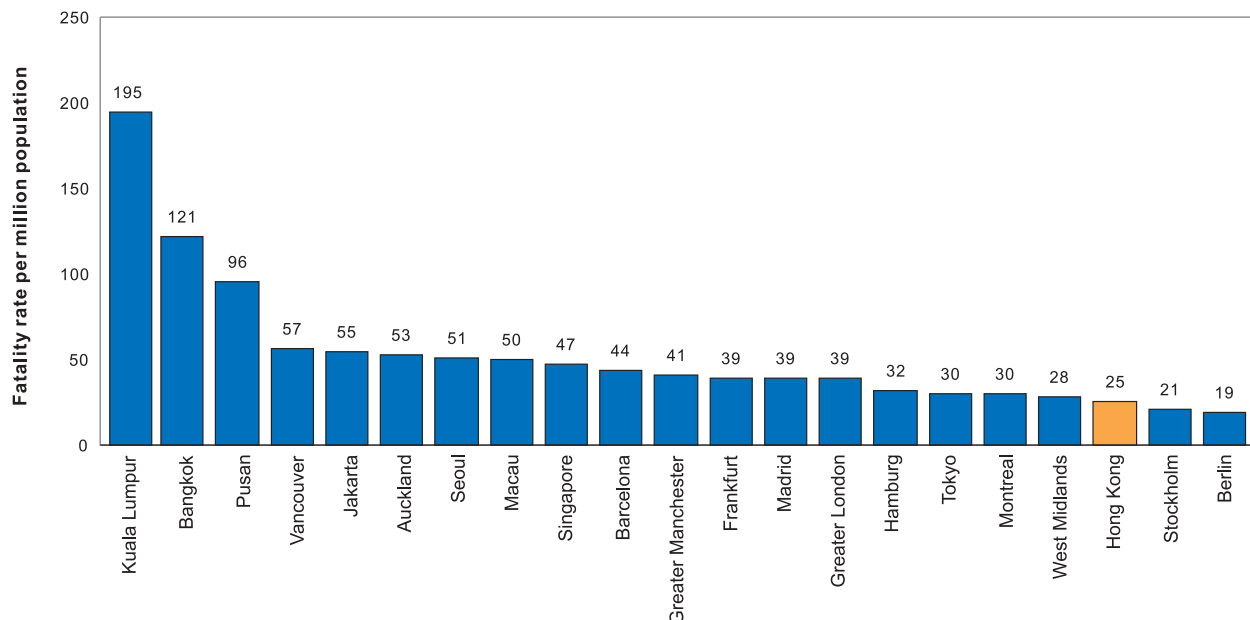


Figure 4.14 – Fatality rate per kilometre of road in different cities

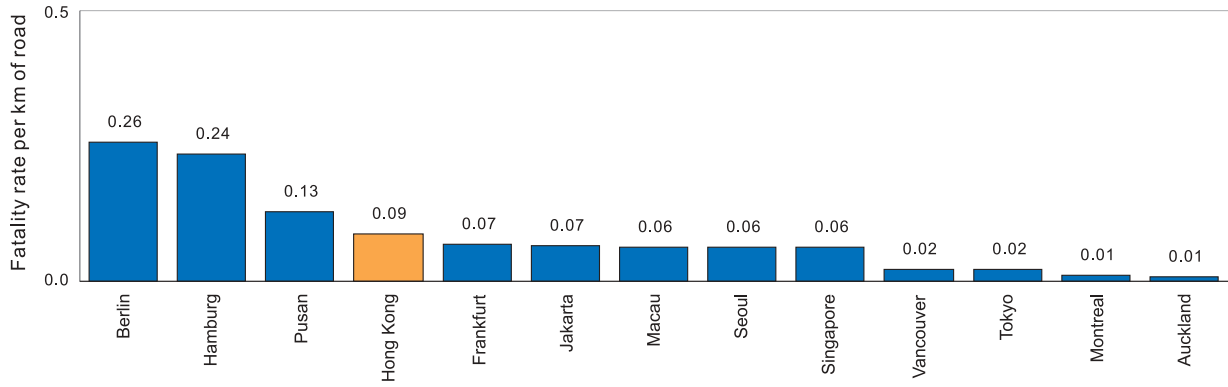


Figure 4.15 – Accident rate per 1 000 population in different cities

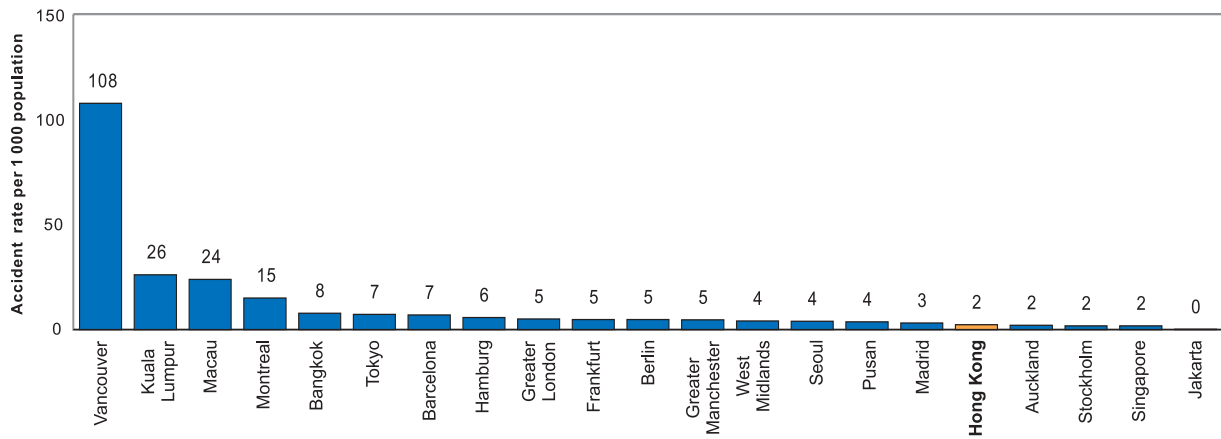
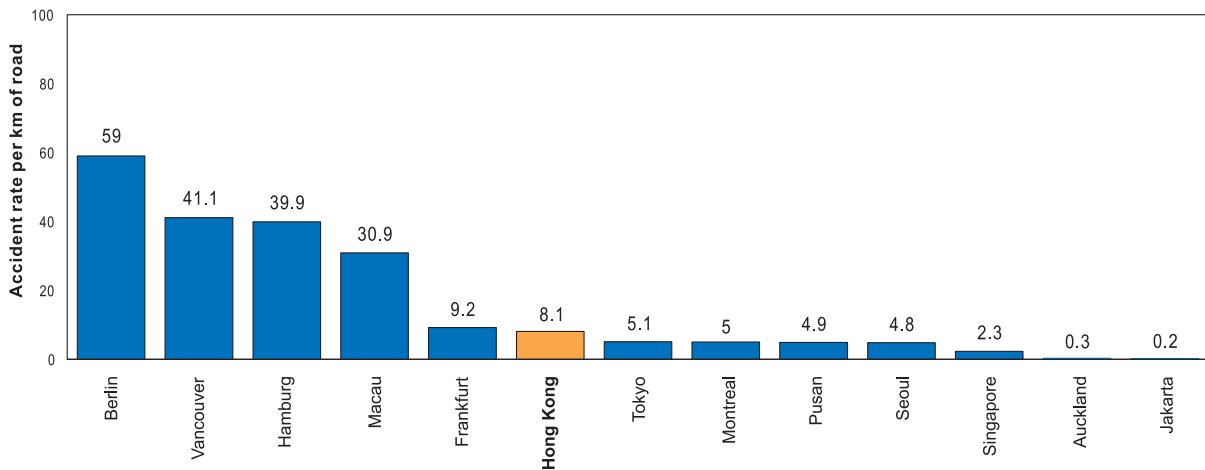


Figure 4.16 – Accident rate per kilometre of road in different cities



### OBSERVATIONS

4.10 The Panel concludes that despite an increase in population and vehicles, there has been a reduction in the total number of traffic accidents and fatalities in the past two decades. A similar reduction was recorded for the casualty rates. **However, the increase in slight accidents and in the number of accidents involving public buses and public light buses warrants attention.**

4.11 As for international comparison, Hong Kong's road safety performance is on par with other major cities. Hong Kong compares favourably with other cities for the per population accident rate but less favourably in terms of the rate per kilometre of road. **The Panel considers that there is always room for improvement.**

## Chapter 5

# Driving Behaviour

### INTRODUCTION

5.1 Road environment, vehicles and road users are all part of the road transport system. Among them, the human factor is the most complex and dynamic. Whether the road users follow traffic rules and adopt a careful and considerate driving attitude has a great bearing on road safety. Therefore, the Panel considers it vital to focus on ways to improve the driving attitudes of the motoring community.

### IMPACT OF INAPPROPRIATE DRIVING BEHAVIOUR ON ROAD SAFETY

5.2 The Panel has reviewed the major contributory factors of traffic accidents in Hong Kong in the past ten years (i.e. 1993 - 2002) and notes that, on average, about 65% of accidents are driver related. Inappropriate driving behaviour commonly exhibited by drivers includes –

- driving too close to the vehicle in front;
- turning or reversing negligently;
- careless lane changing;
- driving at an inappropriate speed;
- failing to obey traffic signals; and
- late use of or failing to use indicators.

## COMMUNITY VIEWS ON CAUSES OF TRAFFIC ACCIDENTS IN HONG KONG

5.3 Following the Tuen Mun Road incident on 10 July 2003, views were sought on ways to improve road safety from members of the public, including professional bodies, tertiary institutions and trade associations. A large number of those who made written submissions perceived that traffic accidents in Hong Kong were related to inappropriate driving behaviour. Common bad practices cited include driving at an inappropriate speed; prolonged occupation of the fast lane; tailgating; changing lanes without warning; overtaking using the slow lane; heavy vehicles ignoring light vehicles; failing to allow traffic to filter; and jumping red lights. Many considered that these problems were common along Tuen Mun Road.

5.4 The Panel received the following suggestions on measures to improve driving behaviour and the code of conduct for drivers –

- ❑ require drivers with 12 driving offence points to take a refresher course;
- ❑ impose mandatory driving courses for drivers of high-risk vehicles;
- ❑ require learners to attend improvement/advanced driving courses including driving on expressways;
- ❑ upgrade training of drivers, including drivers of buses and heavy vehicles;
- ❑ review training/test requirements to include elements of driving attitude;
- ❑ upgrade training/standard of driving instructors;
- ❑ review traffic blackspots and educate drivers; and
- ❑ launch education and publicity campaigns to improve driving behaviour and the general attitude of road users.

## IMPROVEMENT MEASURES

5.5 The Panel considers that in order to improve driving behaviour and foster a considerate and responsible driving culture, the following measures would be most effective –

- publicity;
- driver training; and
- strengthened enforcement.

## SUSTAINABLE PUBLICITY PROGRAMME TO IMPROVE DRIVING BEHAVIOUR

5.6 The Panel notes that publicity is one of the major non-engineering ways of influencing road users. It plays an important role in promoting road safety concepts, building awareness and promoting safety messages within the general community.

5.7 The Road Safety Council (RSC), which comprises both government and non-government representatives, is responsible for developing the annual road safety campaign, as well as monitoring and coordinating publicity activities. Road safety publicity in Hong Kong generally focuses on three main areas –

- changing road users' attitude to make the road network safer for all;
- alerting the public about ways to prevent traffic accidents; and
- making road users aware of new legislation.

5.8 The RSC conducts year-round activities using various media including TV and radio announcements, outdoor advertisements, teaching kits, posters and pamphlets, and community outreach activities such as large-scale publicity events.

5.9 Since 2001, the RSC has adopted 'Smart Driving' as the main theme of its road safety campaign. The campaign aims to promote good and safe driving practices and highlights bad driving behaviour that increases the risk of accidents for drivers and other road users. The Panel notes from a recent survey that the campaign has been successful in raising alertness among various audiences. However, the effectiveness of the campaign in bringing about changes in actual driving behaviour requires further assessment.

5.10 Recently, a Working Group on a 'Smart Driving Publicity Strategy' campaign has been set up by the RSC with representatives from the Environment, Transport and Works Bureau, the Transport Department (TD), the Hong Kong Police Force (HKPF), the Information Services Department and three non-government organisations. The campaign will place greater emphasis on promoting 'smart driving behaviour' and encouraging drivers to abandon bad driving habits. **The Panel endorses this approach.**

5.11 The Panel is also pleased to note that the RSC has taken the initiative to develop a new Vision and a new Symbol to motivate the public, the Government and other relevant parties to focus their efforts in enhancing road safety. Competitions on the design of the Vision and the Symbol for the road safety campaign will be organised by the RSC in late 2003 and early 2004 respectively. The new designs will be used in all the activities, publications and publicity programmes of the RSC starting from mid-2004.

5.12 Following the Tuen Mun Road incident, the RSC revised its 2004 annual publicity programme. Professional drivers, and drivers of heavy goods vehicles and passenger services vehicles were identified as target groups for the publicity and education programme. More emphasis will also be accorded to driving on expressways. **The Panel fully supports the RSC's initiatives.**

5.13 Road safety programmes are more likely to be successful if they address specific driving behaviour in a sustainable manner. Otherwise, drivers tend to revert to previous bad practices over time. The ultimate goal of the publicity and education programme is to change motorists' driving behaviour to make them careful and considerate to all road users.



**5.14 The Panel recommends that, to ensure continuity, consideration be given to drawing up a longer term programme extending beyond the normal annual cycle. In addition, collaboration with District Councils should be actively pursued to extend the reach of road safety campaigns.**

5.15 The Panel considers that there is a need to measure the effectiveness of the publicity programme properly, particularly in respect of individual and self-employed drivers, to ensure that appropriate promotional strategies are adopted for different audiences.

**5.16 The Panel recommends that in addition to measuring public awareness of the publicity programmes, an evaluation methodology involving targetted surveys of the driving population be devised to assess the effectiveness of the programmes. Research on the evaluation methodology can be conducted in conjunction with local tertiary institutions.**

5.17 Apart from the publicity programmes conducted by the RSC, TD publishes the Road Users' Code that contains comprehensive guidelines for road users under most road and traffic conditions. TD has been making efforts to foster the road safety message to the public transport trade. For instance, a 'Road Safety Forum for Franchised Buses' is organised with participation of all franchised bus companies and HKPF. The forum has focused, among other things, on accident prevention measures for franchised buses. Between 2002 and July 2003, TD has organised eight road safety seminars for franchised bus drivers to promote road safety awareness and proper driving behaviour. TD also holds regular meetings with franchised bus companies to discuss bus safety issues. For other road passenger transport, including non-franchised buses, public light buses and taxis, TD has conducted a series of seminars and workshops for operators and drivers with road safety as one of the major discussion topics. TD also publishes regular newsletters to enhance communication with members of the trade. Information relating to measures and practices to enhance road and passenger safety is disseminated through these newsletters.

5.18 The Panel notes that the road safety seminars and meetings organised by TD are mainly targetted at companies with large vehicle fleets and transport trade associations. Self-employed or individual drivers without affiliation to any such associations may face practical difficulties in attending seminars and meetings of this nature.

5.19 **The Panel considers that there is a need to reach out to self-employed or individual drivers, and recommends that additional avenues be identified to extend the coverage of the publicity work to cover them.**

5.20 **Regarding the approach to be adopted for publicity programmes, the Panel recommends that, apart from condemning aggressive driving behaviour, consideration be given to promoting good driving practices and fostering a considerate driving culture. A few examples of good practices are listed in Figure 5.1.**

**Figure 5.1 – Examples of good driving practices**

**(A) Lane-changing discipline**

- (i) Always use the left-most lane unless you are overtaking.
- (ii) Before changing lanes, check your mirrors and glance over your shoulder to check road conditions. Indicate your intentions well in advance.

**(B) Expressway driving**

- (i) On entering an expressway, start matching your speed to the speed of vehicles on the expressway along the slip road.
- (ii) When driving on the expressway, give due consideration to other vehicles entering the expressway from the slip road.

**Figure 5.1 – Examples of good driving practices (Cont'd)**

**(C) Stay alert**

- (i) Other drivers' intentions can often be anticipated. Look out for signs, e.g. changes in the position of vehicles in lanes; drivers looking in their mirrors; and positions of the driver's hands on the steering wheel.
- (ii) Look out for inattentive drivers, especially those talking on mobile phones or turning to talk to passengers, as well as vehicles wandering in and out of lanes or following too close to the cars in front.
- (iii) When being caught in slow moving or stationary traffic, watch out for motorcycles, which may be making their way in-between lanes.

**(D) Safe speed**

- (i) Keep a safe distance from the vehicle in front. A good guideline is to maintain a distance of a 2-second time gap away from the vehicle in front. Double the time-gap under wet weather.
- (ii) Maintain a consistent speed where conditions permit.

**(E) Others**

- (i) Do not drive alongside other vehicles, particularly large trucks, for longer than necessary, because the truck drivers may not be able to see you. Also, other vehicles at your side may block your escape route in case of emergencies.
- (ii) When approaching a stationary or slow moving traffic, use your hazard flashers to warn other up-coming vehicles behind that you are slowing down.
- (iii) If a driver feels tired while driving, he/she should find a safe place to park the vehicle and take a break before continuing the journey.
- (iv) Give way to buses waiting to move out from stops.
- (v) Give due consideration to vehicles which have indicated their intention to change lanes.

## DRIVING TEST AND TRAINING REQUIREMENTS

5.21 The Panel believes that publicity programmes, seminars and talks are no substitute for formal courses of instruction and driving tests, particularly as a basis to ensure that drivers acquire the correct habits and attitudes from the start.

5.22 The Panel has reviewed the existing driving test and training requirements in Hong Kong and found them comparable to those of overseas countries such as Singapore and the United Kingdom. There is no imminent need to further tighten driving test standards and requirements. However, the Panel considers that the Government should take action to tackle driving attitude problems in the following ways, as discussed in paragraphs 5.23 to 5.33 below –

- ❑ mandatory courses for repeat traffic offenders;
- ❑ pre-service training for drivers of passenger services and commercial vehicles;
- ❑ Skills Upgrading Scheme for passenger services transport trades;
- ❑ probationary driving licence for new private car and light goods vehicle drivers; and
- ❑ Quality Driving Instructor Course.

### Mandatory courses for repeat traffic offenders

5.23 The introduction of the Driver Improvement Scheme in September 2002 aimed to promote road safety and make drivers more law abiding through a better understanding of what proper driving behaviour and attitudes should be. Many developed countries have introduced similar schemes for some years and such schemes have been effective in reducing traffic accidents and inducing positive change to the driving attitudes. Currently, motorists are encouraged to join the Driver Improvement Scheme on a voluntary basis, except for those who are directed by the court.

**5.24 The Panel recommends that the Government explore the feasibility of requiring drivers who have accumulated a certain number of 'Driving Offence Points' (for instance, 8 points or above, at the time when TD issues warning letters to such drivers) to attend the Driver Improvement Scheme on a mandatory basis to be trained on good driving practices.**

### **Pre-service training for drivers of passenger services and commercial vehicles**

5.25 Recently, TD has developed proposals to revise the entry requirements for taxi drivers. Under the new proposals, all applicants for a taxi driving licence will be required to attend a mandatory pre-service training programme before they can qualify for a taxi driving licence. This means that all new taxi drivers in future will undergo proper training on driving attitude and behaviour before they are permitted to drive a taxi.

**5.26 The Panel recommends that TD review the effectiveness of the pre-service training requirement and consider extending it to drivers of public light buses followed by other professional drivers, in light of experience gained from the taxi scheme.**

### **Skills Upgrading Scheme for passenger services transport trades**

5.27 Currently the Vocational Training Council, supported by TD, is developing a Skills Upgrading Scheme for the passenger services transport trades (including taxis, public light buses, and non-franchised buses). The Scheme, scheduled for launch in early 2004, will provide comprehensive training to taxi, public light bus and non-franchised bus drivers. It will help improve driving attitude, knowledge of traffic rules and regulations as well as road safety concepts and skills for handling accidents and emergencies on roads. The Government will provide financial incentives (reimburse up to 70% of the training fee for the Scheme) to drivers from these passenger services transport trades who attend the Scheme on a voluntary basis.

5.28 **The Panel recommends that the content of the Skills Upgrading Scheme be reviewed to ensure that sufficient emphasis will be placed on promoting good driving practices and that recognition be given to drivers who have completed the course to increase the incentive for enrolment. The Panel also recommends that the Government explore with the relevant organisations the development and introduction of similar skills upgrading training for drivers of the trucking industry, in light of experience gained from the passenger services transport trades.**

### **Probationary driving licence for new private car and light goods vehicle drivers**

5.29 Hong Kong's expressway network is expanding rapidly. However, learners of all types of vehicles are not required to acquire field training on expressway before being issued with a driving licence. The Panel recognises that there are practical difficulties to include expressways as part of the training and testing requirements in Hong Kong, and notes that certain roads with speed limits of 70 km/h are open to learner drivers to practise their driving skills.

5.30 **The Panel recommends that the Government explore the feasibility of expanding the existing 'probationary' driving licence arrangement for motorcyclists to cover new private car and light goods vehicle drivers. The proposed arrangement would allow drivers who have passed the driving test to obtain on-the-road practical experience, including expressway driving experience, during the 'probationary' period before being issued with a full driving licence.**

### **Quality Driving Instructor Course**

5.31 At present, there are two designated driving schools in Hong Kong. Learner drivers can also receive driver training from private driving instructors.

5.32 The Panel considers that there is a need to upgrade the skill level of driving instructors in tandem with the overall direction of enhancing road safety in Hong Kong.

5.33 The Panel recommends that TD explore the feasibility of introducing a ‘Quality Driving Instructor Course’ to ensure that driving instructors have the proper knowledge and teaching skills to pass on good driving practices to their students. The Course should aim to enhance the professional competency of driving instructors, including teaching skills, defensive driving skills, proper driving attitude and good practices, traffic rules and regulations, and the handling of emergency and accident situations. The Panel also recommends that recognition be given to driving instructors who have completed the course.

### Enforcement

5.34 Apart from enhanced training, the success of any road safety initiatives also depends on a properly formulated enforcement programme. This will be discussed in detail in Chapter 6.

## Chapter 6

# Legislation and Enforcement

## INTRODUCTION

6.1 To cultivate a considerate and responsible driving culture, enforcement and public education have to go hand-in-hand. Apart from mounting promotional efforts to change the mindset of the motoring community as set out in Chapter 5, comprehensive legislation and effective enforcement are necessary to combat undesirable driving behaviour. The Panel has reviewed road safety related legislation and enforcement measures to identify areas for further improvement.

## LEGISLATION

### Traffic offences

6.2 Major traffic offences are provided for in the Road Traffic Ordinance (Cap. 374) and the associated regulations listed in **Figure 6.1**. The enforcement agents are the Hong Kong Police Force (HKPF).

**Figure 6.1 – Road Traffic Ordinance (Cap. 374) and the associated regulations**

Road Traffic Ordinance (Cap. 374)	
Section 36	Causing death by dangerous driving
Section 37	Dangerous driving
Section 38	Careless driving
Section 39	Drink/drug driving
Section 39A	Driving with alcohol concentration above the prescribed limit
Section 41	Driving in excess of speed limit
Section 55	Restriction on motor racing



**Figure 6.1 – Road Traffic Ordinance (Cap. 374) and the associated regulations (Cont'd)**

<b>Road Traffic (Traffic Control) Regulations</b>	
Regulations 18 & 59	Failure to comply with traffic signals, signs and road markings
<b>Road Traffic (Expressway) Regulations</b>	
Regulations 12 & 13	'Not confining to nearside lane' and 'Overtaking from the nearside'

6.3 To ensure that Hong Kong's road safety regime is on par with international standards and meets the changing needs of the community, the Panel notes that the Government has kept relevant legislation under constant review. Amendments have been introduced in previous years to curb undesirable driving habits and to raise safety requirements. Details of the amendments are set out below.

### **Seat belt**

6.4 Seat belts can protect motorists and passengers and reduce the chance of death or serious injury in case of accidents. In 1983, legislation was first introduced on compulsory fitting and wearing of seat belts for drivers and front seat passengers in private cars. Since then such a requirement has been progressively extended to include drivers and front seat passengers of all types of vehicles. The seat belt legislation was further extended to cover rear seat passengers of private cars and taxis in June 1996 and January 2001 respectively.

6.5 In view of the relatively high rear seat casualty rate for accidents involving public light bus (PLB) and given that PLB is a popular mode of public transport, the Government considers it necessary to install passenger protection equipment, including seat belts and high back seats, on new PLBs to enhance passenger safety. The Panel notes that legislative amendments to this effect were passed by the Legislative Council in November 2002. To allow sufficient time for the vehicle manufacturers to develop and produce the new passenger protection equipment,

the Government intends to bring the amendments into effect in August 2004. **The Panel welcomes this move.**

6.6 There are suggestions to require passengers of all public transport vehicles to wear seat belts and to ban standing passengers. The Panel has reservations about extending the compulsory requirement of fitting and wearing seat belt beyond taxis and PLBs to buses and banning standing passengers in view of operational difficulties and traffic implications. The Panel also notes that some bus companies have installed seat belts on seats of higher risk exposure.

### Drink driving

6.7 Driving under the influence of alcohol is dangerous, as alcohol impairs judgement of speed and distance, slows down reaction time, affects co-ordination of body movements, blurs vision and gives a false sense of confidence. A legal limit of alcohol concentration in a driver's blood, urine and breath was first introduced in December 1995. Since 1 October 1999, the legal limit has been tightened up from 80 mg to 50 mg per 100 ml of blood to increase the deterrent effect on drink driving.

6.8 The Panel notes that since the introduction of the drink driving legislation in December 1995, the percentage of drivers involved in traffic accidents who had consumed alcohol showed a downward trend from 10.2% in 1996 to 6% in 1998. After the legal limit of alcohol concentration had been tightened up on 1 October 1999, the percentage of drivers involved in traffic accidents who had consumed alcohol dropped further from 4.2% in 1999 to 3.2% in 2002.

### Dangerous driving

6.9 The offence of 'reckless driving' was changed to 'dangerous driving' with effect from 1 July 2000 to address the difficulty in prosecuting reckless driving arisen from the need to prove the driver's subjective mental state. The test for dangerous driving is more objective, as it places the emphasis on actual driving behaviour rather than the driver's state of mind. Two criteria have been laid down for dangerous

driving – one is whether the driver’s driving standard is far below that of a competent and careful driver, and the other is whether the driver’s driving manner would cause obvious danger to others, or himself, or serious damage to property.

6.10 The Panel notes that before the new legislation came into effect, the number of reckless driving cases from July 1999 to June 2000 was 170. After the new legislation took effect on 1 July 2000, the number of dangerous driving cases rose from 169 in 2000 to 222 and 237 in 2001 and 2002 respectively.

### Use of hand-held mobile phone while driving

6.11 Overseas researches show that use of mobile phone while driving increases the risk of collision by four to six times mainly due to distraction and its possible effect on drivers’ reaction time in emergency situations. The use of hand-held mobile phones while driving is prohibited in Australia, Malaysia, Singapore and Switzerland.

6.12 Use of hand-held mobile phones while driving has been prohibited in Hong Kong since 1 July 2000. The prohibition was further extended to the use of hand-held telecommunication equipment, such as radio phones used in taxis, on 1 July 2001. **The Panel agrees that such legislative changes can reduce distraction to drivers and are in line with international practices.**

### Probationary driving licence for motorcyclists

6.13 An analysis of the road traffic accidents in Hong Kong reveals that motorcycles have a much higher accident involvement rate than that of private cars and light goods vehicles. Amongst motorcyclists, inexperienced drivers, i.e. those with one year or less driving experience, is five times more prone to traffic accidents than experienced drivers. In light of these, a probationary driving licence scheme was introduced to motorcyclists on 1 October 2000. Under the scheme, holders of the probationary driving licence are subject to additional driving restrictions during the one-year probation period, including the requirement to display a “P” plate on the motorcycle and prohibitions on carrying passengers and driving at a speed

above 70 km/h (even when the prescribed speed limit of the road sections concerned exceeds 70 km/h).

6.14 The Panel notes that between 1997 and 2000, the average accident involvement rate of motorcyclists with less than one year driving experience was 4.9 times higher than experienced motorcyclists. Between October 2000 to 2002, after the implementation of the probationary driving licence scheme, the average accident involvement rate of probationary motorcyclists reduced by about 60%. The Panel considers this a marked improvement which demonstrates the effectiveness of the scheme in reducing traffic accidents involving inexperienced motorcyclists. It also has the advantage of allowing new drivers to obtain on-the-road experience, including expressway driving experience, before being issued with a full driving licence, as discussed in Chapter 5. **The Panel recommends that the Government explore the feasibility of expanding the existing probationary driving licence scheme for motorcyclists to new private car and light goods vehicle drivers.**

### Higher penalties for excessive speeding

6.15 Speeding is one of the major contributory factors of traffic accidents. The Panel notes that since January 2001, the Government has increased the fixed penalty for speeding by more than 30 km/h from \$450 to \$600. The penalties for speeding by more than 45 km/h has also been revised upwards with an increase in fine from \$800 to \$1,000 and an increase in driving offence points from 8 to 10.

### Legislative amendments under deliberation

6.16 The Panel notes that some legislative amendments are under consideration by the Administration. One of them concerns failure to keep a safe distance from the vehicle in front which is often the cause of multiple collisions. At the moment, this act does not constitute any specific offence under the law, and can only be prosecuted under 'careless driving', of which the collection of evidence is rather complicated. HKPF are reviewing the feasibility of introducing a new offence against 'failing to keep a safe distance' or 'tailgating', to simplify the prosecution process.

6.17 Other proposed legislative changes under deliberation include imposition of fixed penalties for failing to drive in the nearside lane of an expressway and using hand-held mobile phone while the vehicle is in motion. **The Panel recommends that preparations for the proposed legislative changes be expedited.**

6.18 There are suggestions for a hefty increase in fines and a much harsher driving offence point system. **Members consider that the Government should continue to monitor the enforcement statistics and accident trend, and to make adjustment on the penalty level where necessary.**

## ENFORCEMENT

6.19 Road safety legislation needs to be complemented by an effective enforcement regime to achieve the intended effect. Many submissions to the Panel, including those from transport trade associations, pointed to the need to step up enforcement for abrupt lane changing, tailgating, speeding and other undesirable driving behaviour to increase the deterrent effect. The Panel has examined the current enforcement regime and identified areas to be further strengthened.

6.20 The Panel has also reviewed enforcement statistics. Although the total enforcement figures have shown a downward trend, enforcement statistics for certain offences, namely, speeding, lane discipline offences, drink driving and using hand-held mobile phone while driving, remain static.

### Selective Traffic Enforcement Policy

6.21 The Panel notes that HKPF have since 1993 been adopting a Selective Traffic Enforcement Policy (STEP) to target offences that are known to be causes for traffic accidents. There are annual reviews on the list of priority offences under STEP to ensure an efficient allocation of resources and to enhance the effectiveness of enforcement efforts.

6.22 Current enforcement focuses on expressways under STEP include –

- £ speeding;
- £ lane discipline offences;
  - › failing to confine to the nearside lane
  - › inappropriate lane changing
  - › tailgating
- £ drink driving;
- £ using hand-held mobile phone while vehicle is in motion;
- £ overloading and insecure load; and
- £ road work signage and lighting offences.

6.23 **The Panel endorses the STEP approach and recommends that HKPF continue to devise enforcement programmes in tandem with the publicity plan mounted by the RSC. Members consider that education for motorists on appropriate driving behaviour should be supplemented by enforcement as a deterrent.**

### Enforcement tools

6.24 Advanced technology can put roads under 24-hour surveillance and enhance enforcement efficiency. The Speed Enforcement Camera (SEC) system is a proven effective tool to deter speeding and enhance road safety. A pilot scheme on Tolo Highway (**Figure 6.2**) has been put into operation since early 1999. A study indicated



Figure 6.2 – Speed Enforcement Camera system

that, one year after the installation of the SEC system, the number of speeding related accidents on Tolo Highway reduced by 23%, and there was a 70% reduction in the number of vehicles exceeding 15 km/h of the speed limit.

6.25 The Panel notes that installation works for 75 additional locations for SECs are underway. Of the 16 SEC sites for Tuen Mun Road, 14 have been installed while the installation works for the remaining two would be completed before end 2003. As for the 59 locations outside Tuen Mun Road, the installation works for 22 sites have been completed and the remaining 37 are still ongoing. **The Panel recommends that TD work closely with the Highways Department, HKPF and other relevant parties to put these SECs into operation by early 2004.**

6.26 The Panel is aware that apart from the 75 locations on the existing road network, SECs will be installed along strategic routes, including the Deep Bay Link, Shenzhen Western Corridor and Route 9. **Members recommend that TD explore the feasibility of expanding the SEC coverage to new strategic road network (SRN) routes, existing SRN routes which do not have such systems as well as other routes with speeding problems.**

6.27 The Panel also recommends that, after the planned SECs have been put into operation, HKPF deploy more resources for mobile enforcement and patrolling to monitor other undesirable driving behaviour which cannot be captured by SEC such as abrupt lane changing and tailgating.

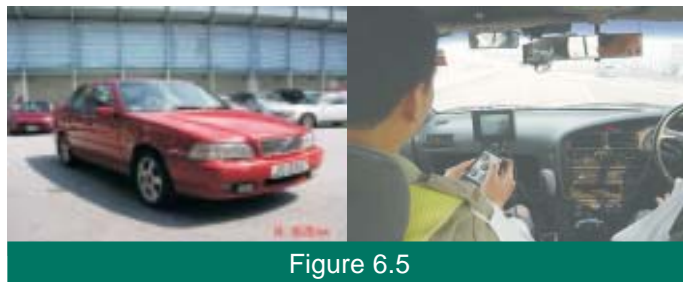
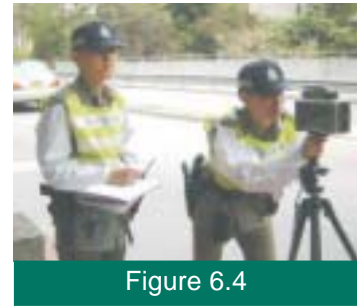
6.28 The Panel notes that apart from SECs, HKPF's enforcement efforts are aided by the following tools –

- £ portable Speed Detecting Radars (with camera) – introduced since 1991 for detection of speed violation offence (**Figure 6.3**);



Figure 6.3

- £ hand-held Laser Speed Detector – introduced since 1996 for detection of speeding and tailgating offences (**Figure 6.4**);
- £ overt/covert In-car Video System – introduced since 1989 for detection of speeding and offences relating to bad driving manner and lane discipline (**Figure 6.5**);



- £ Motorcycle Video System – introduced since 1999 for detection of speeding and offences relating to bad driving manner and lane discipline (**Figure 6.6**);
- £ Hand-held Drink Driving Screening Device – introduced in 1995 for detection of drink driving offence (**Figure 6.7**); and
- £ Red Light Camera (RLC) system – introduced in 1993 to deter drivers from red light jumping.



6.29 **The Panel recommends that HKPF continue to make good use of advanced technology and acquire additional equipment to facilitate traffic enforcement.**



6.30 The Panel received a suggestion from the public to adopt the ‘third party reporting’ system in New Zealand<sup>1</sup> to supplement HKPF’s enforcement efforts. The Panel notes that a similar reporting mechanism has been adopted in Hong Kong for years. Each of the five Police Traffic Formations has a Traffic Investigation Group responsible for the investigation of public complaints on undesirable driving manners. Members of the public can lodge complaints by e-mail, letter, fax, telephone or in person to any Police station or via the Transport Complaints Unit of the Transport Advisory Committee. In 2001 and 2002, a total of 4 769 and 5 241 traffic complaints were reported and investigated by HKPF respectively. However, many prosecutions failed because the complainants were unwilling to follow up and give evidence in court. **The Panel encourages the public to play its part and join hands with HKPF to combat undesirable driving behaviour.**

6.31 The Panel is of the view that enhancement of road safety is a continuous exercise requiring collaboration between the Government, road users and other related organisations. Apart from conducting constant reviews on existing legislation and deploying new strategy and advanced technology for effective enforcement, it is of utmost importance that the Government works closely with RSC, District Councils and other relevant parties to map out the directions for a sustainable road safety programme for the years to come.

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<sup>1</sup> Under the ‘third party reporting’ system used by the New Zealand Police, members of the public are invited to report undesirable driving behaviour via electronic means or a specific form. On receipt of such reports, the New Zealand Police will issue ‘advisory notes’ to the drivers concerned. The system is used for advising rather than instituting prosecution against the drivers.

## INTRODUCTION

7.1 Safe transport infrastructure and an efficient traffic management system are important pillars of road safety. The Panel has examined in depth issues concerning traffic engineering and management that define the road environment and shape the behaviour of road users. They include highway design standards, speed management, provision of traffic signs and road markings as well as other traffic control measures. As the July incident occurred on an expressway section of the Tuen Mun Road, the Panel has focused more on traffic engineering and management issues relating to the design of high-speed roads.

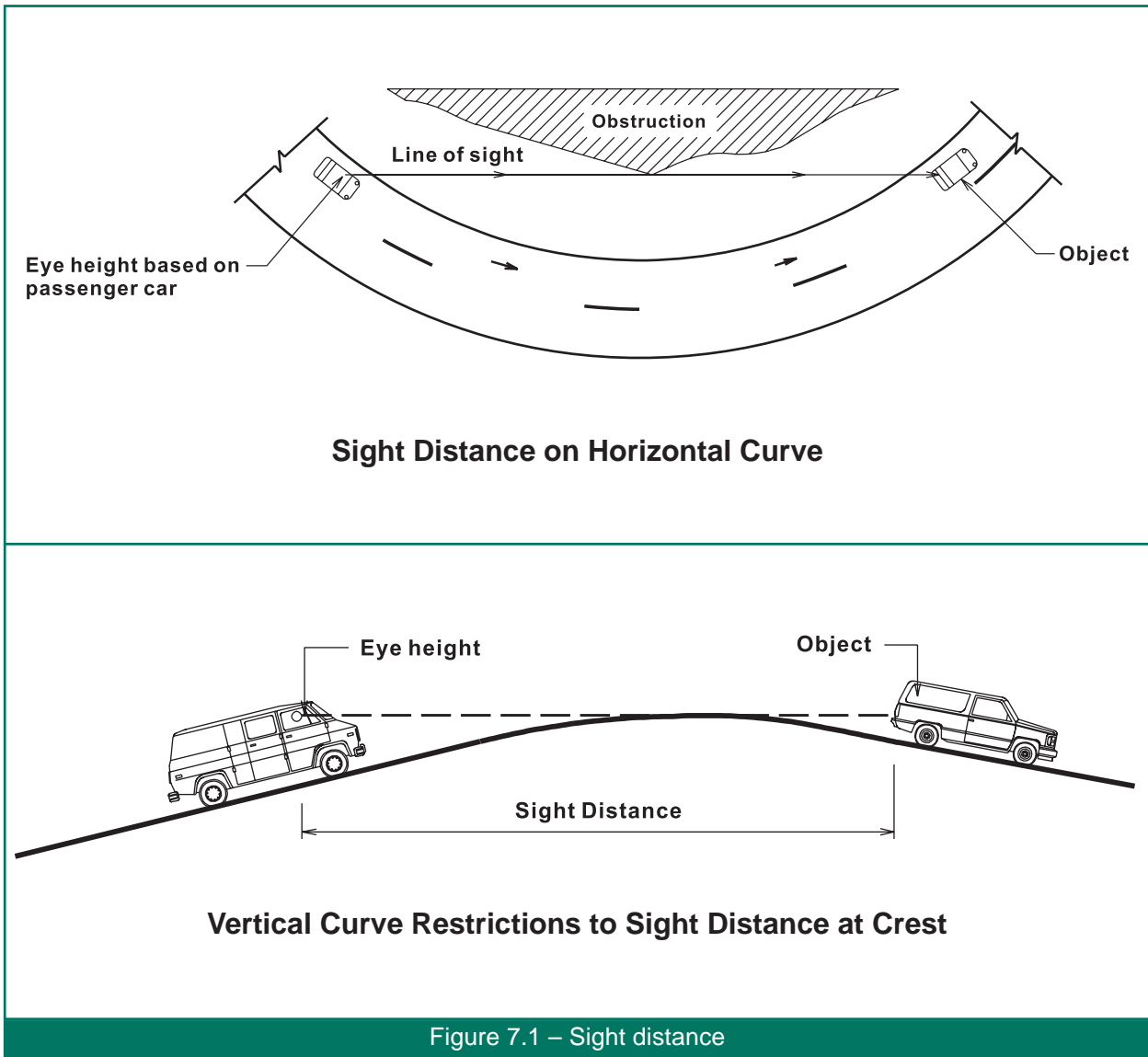
7.2 The Panel considers that Hong Kong's design standards meet international standards and place proper emphasis on road safety, despite the challenges presented by limited space and a hilly topography. Members point to the need to differentiate between requirements for safety and comfort in highway design standards which will be discussed in greater detail in the following paragraphs. The Panel has also reviewed various traffic management and control measures with reference to suggestions from the public, and put forth recommendations for further enhancement.

## HIGHWAY DESIGN

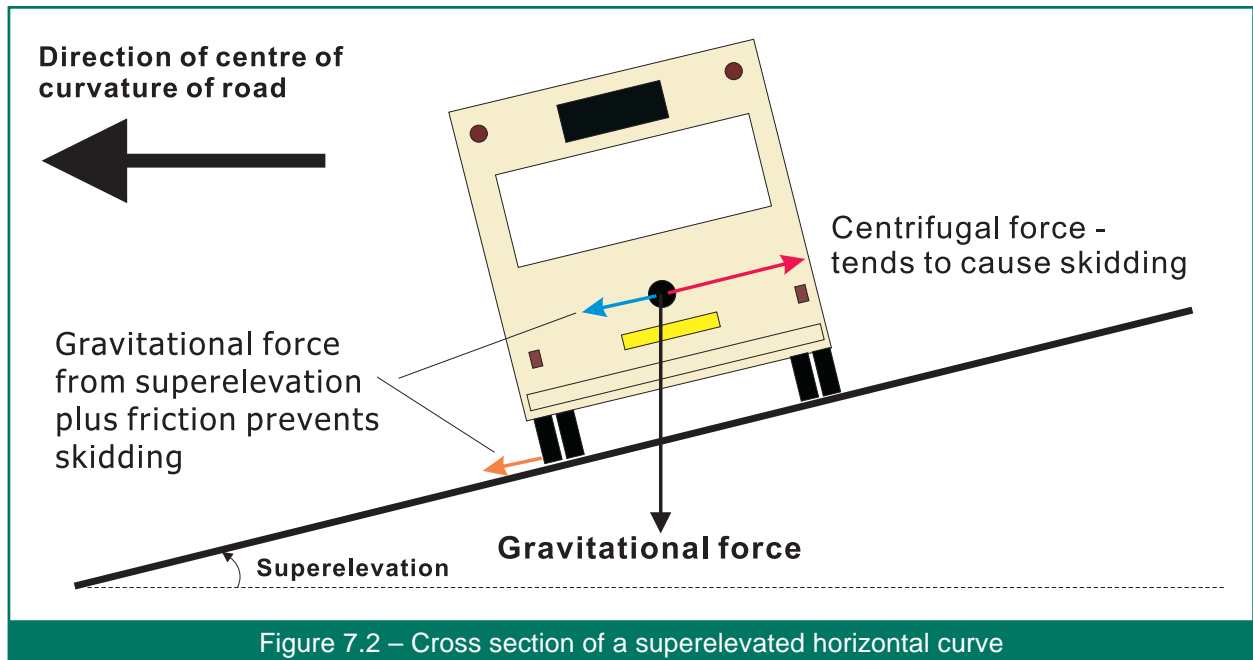
7.3 Highway design concerns the selection of a road's visible features and dimensions, which comprise road alignment factors and cross section elements. The road alignment is composed of various geometric parameters, including sight distance, gradient, horizontal and vertical curves and superelevation factors, which complement each other to serve the traffic in a safe, comfortable and efficient manner.

### Illustrations of different road alignment factors

Sight distance : The length of roadway ahead visible to the driver (Figure 7.1).

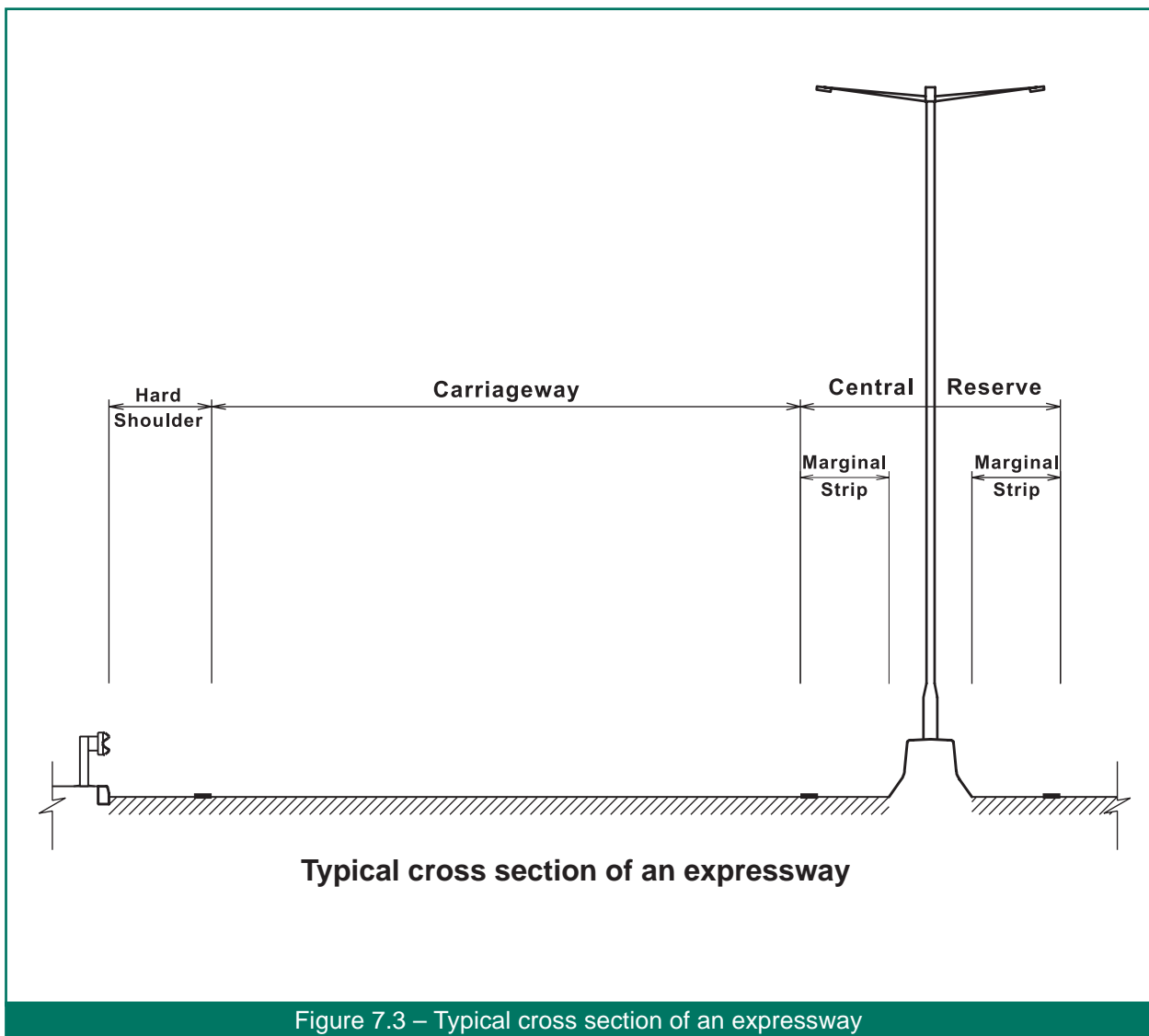


- Gradient** : The change in elevation per unit change in the length of roadway.
- Horizontal Curve (Bends)** : Circular arcs that connect straight sections of a road. The sharpness of a curve is measured by the radius of curvature - the shorter the radius, the sharper the curve.
- Superelevation** : Curves are banked (superelevated) so that the gravitational force associated with the weight of the vehicle can help counteract the centrifugal force which acts on objects travelling on a circular path. The frictional force between the vehicle's tyres and the road surface counteracts the centrifugal force to prevent the vehicle from sliding out of the curve. **(Figure 7.2)**



**Vertical Curve** : A vertical curve is either a hill crest or a sag. Vertical curves are designed so that a driver operating at the design speed<sup>1</sup> can react and brake to a stop on wet road surface within the sight distance.

7.4 Carriageway cross-section elements include carriageway width, marginal strip and hard shoulder width, and central reserve width. A typical cross section of an expressway is shown in **Figure 7.3**.



<sup>1</sup> Please see para. 7.16 for explanation of design speed.

7.5 Slip roads at diverging or merging points are defined by such factors as lengths of nose, taper, parallel lane and merging lane. They are illustrated in Figures 7.4 and 7.5.

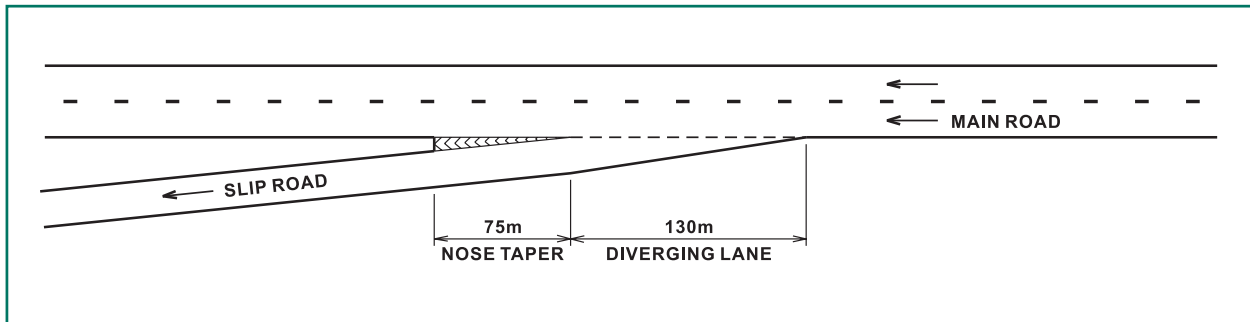


Figure 7.4 – Diagram to show a typical direct entry merging lane

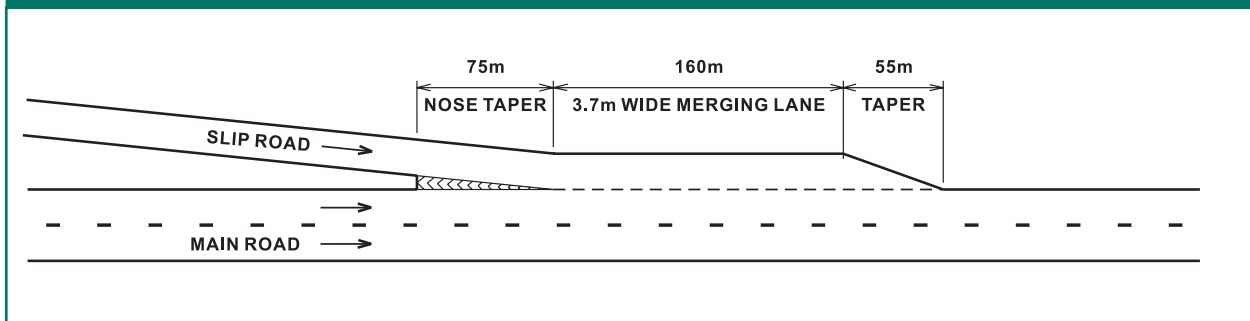


Figure 7.5 – Diagram to show different factors at a typical parallel merging lane

### Design standards and comparison with overseas countries

7.6 Highway design standards are guidelines for the selection of appropriate design elements to provide comfort, safety and convenience to road users. The current highway design standards in Hong Kong are set out in Volume 2 of the Transport Planning and Design Manual – Highway Design Characteristics published by the Transport Department (TD).

7.7 A comparison of the design standards in Hong Kong with those in the UK and USA is set out in **Figure 7.6**.

**Figure 7.6 – Comparison of highway design standards in Hong Kong, UK and USA**

**(a) Design speed**

	HK	UK	USA
Rural area	100 km/h	120 km/h	80 - 110 km/h
Urban area	70 km/h (80 km/h for new roads) or above	Less than 120 km/h	80 - 110 km/h

**(b) Sight distance**

Design speed (km/h)	Minimum sight distance (m)				
	HK		UK		USA
	Desirable	Absolute	Desirable	Absolute	
120	295	215	295	215	250
110	-	-	-	-	220
100	215	160	215	160	185
90	-	-	-	-	160
85	160	120	160	120	-
80	145	110	-	-	130
70	120	90	120	90	105

**(c) Gradients**

Design speed (km/h)	Maximum gradient				
	HK		UK		USA
	Desirable	Absolute	Desirable	Absolute	
120	4%	8%	3%	4%	-
110					5%
70 - 100					between 5% and 12%

**Figure 7.6 – Comparison of highway design standards in Hong Kong, UK and USA (Cont'd)**

**(d) Horizontal curve**

Design speed (km/h)	HK		UK		USA
	Desirable Minimum Radius	Absolute Minimum Radius	Desirable Minimum Radius	Absolute Minimum Radius	Minimum Radius
120	700 m	250 m	720 m	510 m	595 m
110	-	-	-	-	455 m
100	500 m	175 m	510 m	360 m	360 m
90	-	-	-	-	275 m
85	350 m	125 m	360 m	255 m	-
80	320 m	115 m	-	-	210 m
70	250 m	88 m	255 m	180 m	160 m

**(e) Vertical curve**

i) Minimum K value for vertical crest \*

Design speed (km/h)	Minimum K value for vertical crest			
	HK	UK		USA
		Desirable	Absolute	
120	182	182	100	95
110	-	-	-	74
100	100	100	55	52
90	-	-	-	39
85	55	55	30	-
80	55	-	-	26
70	30	30	17	17

ii) Minimum K value for vertical sag \*

Design speed (km/h)	Minimum K value for vertical sag			
	HK	UK		USA
		Desirable	Absolute	
120	37	37	37	63
110	-	-	-	55
100	37	37	26	45
90	-	-	-	38
85	26	26	20	-
80	26	-	-	30
70	20	20	20	23

\* The curvature of vertical curve should be as large as possible to provide for comfort and sufficient sight distance for safe stopping at design speed. The curvature should be derived from the appropriate K value where  $K = L$  (curve length in metres)/A (algebraic difference in gradients (%)).



**Figure 7.6 – Comparison of highway design standards in Hong Kong, UK and USA (Cont'd)**

**(f) Superelevation**

	Maximum superelevation		
	HK	UK	USA
Rural	7%	7%	8 - 10%
Urban	7%	5%	8 - 10%

**(g) Carriageway width**

	HK	UK	USA
Lane width	3.65 m	3.65 m	3.6 m

**(h) Verges and hard shoulders**

	HK	UK	USA
Verge	3.0 m	1.5 m	-
Hard shoulder	3.3 m	3.3 m	3.0 m

**(i) Minimum vertical clearance**

	HK	UK	USA
Minimum vertical clearance (m)	5.1	5.30 - 6.45	4.9

**(j) Minimum central reserve width**

	HK		UK		USA
	Rural	Urban	Rural	Urban	
Minimum central reserve (m)	3.2	2.3	4.0	3.0	3.0 - 9.0
Marginal strip adjacent to central reserve (m)	1.0	0.5	0.7	0.7	1.2

**Figure 7.6 – Comparison of highway design standards in Hong Kong, UK and USA (Cont'd)**

**(k) Connector road design speed**

Mainline design speed (km/h)	Connector road design speed (km/h)		
	HK	UK	USA
120	-	70 - 120	70 - 110
110	-	-	60 - 100
100	80 - 100	60 - 100	50 - 90
90	50 - 80	60 - 85	50 - 80
80		(for design speed 85 km/h)	40 - 70
70	-	-	40 - 60

**(l) Merging and diverging lanes**

	Entry merging lane			Exit diverging lane		
	HK	UK	USA	HK	UK	USA
Single lane width (m)	3.7	3.7	3.6	3.7	3.65	3.6
Two lane ramp width (m)	3.7	3.7	3.6	3.7	3.65	3.6
	each	each	each	each	each	each
Taper gradient			1:50			1:15
(i) Single lane	1:25	1:40	to	1:15	1:15	to
(ii) Two lane	1:25	1:40	1:70	1:15	1:15	1:25

7.8 The Panel notes that the Hong Kong standards are similar to those adopted in the UK. The major difference lies in the maximum gradient – the desirable and absolute maximum gradients of Hong Kong are 4% and 8% respectively while those of UK are 3% and 4%. The deviation is attributable to topographical differences between Hong Kong and the UK.

7.9 The Panel also notes that Hong Kong standards are comparable with the USA standards despite the following differences. The carriageway and hard shoulder widths in the USA are smaller than those in Hong Kong. The minimum sight

distance and the K value for vertical sag curves of the USA are greater than those of Hong Kong, but the maximum gradients and superelevation rate adopted in the US are also higher, denoting steeper road sections and sharper bends.

7.10 There are comments from the public on the inadequate length of merging lanes along the expressways in Hong Kong. The Panel notes that Hong Kong's standard for the length of such merging lanes is 205 m, lower than that of freeways and motorways in the US and UK, which ranges from 245 m to 385 m. The Panel considers that it is not practicable for Hong Kong to adopt overseas standards in this regard, given the constraints imposed by limited space and hilly terrain. Besides, the function and characteristic of freeways and motorways which are intended for inter-city traffic should be differentiated from expressways in Hong Kong that only serve intra-city traffic.

### Safety vs comfort

7.11 It is shown in **Figure 7.6** that many standards are specified by both 'desirable' and 'absolute' values, and the values adopted vary slightly from one country to another. 'Desirable' values offer a high level of comfort and considerable safety margins at the design speed. 'Absolute' values specify a lower level of comfort. It should be noted that slight deviations from the standards would not have a substantial impact on the safety of a road. For instance, current standards specify that the minimum carriageway width for three lanes should be 11 m. It does not mean that a carriageway of 10.5 m is unsafe.

7.12 The superelevation rate and the maximum value of side friction are two key elements of horizontal curve design. Design values are usually set at such a level to avoid giving the driver the discomfort of sliding on the car seat. This is a good illustration of how comfort is being taken into account in highway design.

7.13 A vertical curve is designed on the basis of providing road users a reasonable sight distance over a crest. For a given design speed, the required sight distance is set according to two assumptions: (i) the reaction time for a driver to brake his car to an emergency stop and (ii) the frictional force that can be generated

between the vehicle's tyres and the pavement surface. To provide considerable margins of safety in design, the assumptions are usually based upon a near-worst case scenario, i.e. drivers locking their brakes and skidding to a stop on a wet pavement. Under normal circumstances, the braking distance, and thus the sight distance required, should be shorter.

7.14 Highway design standards are a product of accumulated experience and a model of good practices at the time of design. Such standards and practices evolve with time, as the information, judgments and economic considerations that determine them keep on changing. Hence, when there is a change in design standards, it does not mean that existing roads which fall short of the revised standards are not safe. Theoretically speaking, more generous dimensions give rise to safer roads. However, no road is accident proof, no matter how generous the dimensions are, as accidents are multi-factor random events involving human elements, vehicles and the road. **In light of the above, the Panel considers that a well-designed road should be one that provides an acceptable level of safety with the intended level of comfort at an acceptable cost.**

## SPEED MANAGEMENT

7.15 There is a close relationship between highway design decisions and the speed. To enhance the readers' appreciation of the choice of design speed and posted speed limit for highways, explanations of the concepts of design speed and speed limit are set out below.

### Design speed

7.16 The design speed of a road is the speed chosen to correlate various design features, such as the minimum horizontal and vertical curvature and superelevation. It should be a realistic estimate of the speed adopted by vehicles. As pointed out in the section on highway design, many highway features have built-in safety margins to cater for near-worst case scenarios and to provide a high level of

comfort at the design speed. As such, the design speed of a highway is not the 'maximum safe speed' along the road.

### Posted speed limit

7.17 The posted speed limits are determined by a combination of factors including the design speed, results of speed surveys, accident rates, and road surface characteristics. They are used as a means to control the speed of traffic to an appropriate level under the general conditions. They are not supposed to be exceeded. Motorists are always required to drive with care and make necessary allowances in respect of their vehicles, driving skill, traffic conditions, climatic conditions, and constraints such as bends and surface characteristics of the road.

7.18 There are suggestions to review the speed limits in Hong Kong. The Panel notes that a Working Group comprising members from relevant departments and related non-government organisations has been conducting regular reviews of speed limits. Approximately 50 sections of roads, including expressways, are covered each year. The review takes into account the results of speed surveys, road configurations, accident rates, traffic conditions and the need to avoid frequent changes of speed limit over a short section of road etc.

7.19 **The Panel recommends that TD continue to conduct regular reviews of speed limits and, if necessary, adjust the speed limit to optimise traffic flow without compromising road safety.**

7.20 The Panel also received suggestions to tighten the speed limit of expressways. Members point out that this would reduce the efficiency of Hong Kong's road network and increase the economic costs in terms of longer travelling time and business foregone by the freight industry. Setting an unrealistically low speed limit for a road, which is capable of accommodating traffic travelling at higher speeds, would also bring about serious enforcement problems.

7.21 As regards the proposal to set different speed limits for different lanes on expressways i.e. designating a slow lane for heavy vehicles and fast lanes for other vehicles, the Panel notes that there is a similar requirement in the Road Traffic (Expressway) Regulations. Under the Regulations, heavy vehicles are prohibited from using the offside lane (i.e. the fast lane) on an expressway with three or more lanes, unless it has to get access to an offside exit (see lane discipline for heavy vehicles in paragraph 7.57).

7.22 On the suggestion to impose different speed limits for heavy and light vehicles, the Panel notes that heavy vehicles, including medium and heavy goods vehicles and buses, are already subject to a maximum speed of 70 km/h (see speed limit for heavy vehicles in paragraph 7.58). Hence, a difference in speed limits between heavy and light vehicles already exists on roads with a speed limit exceeding 70 km/h. The Panel does not recommend a wider differential in speed limits between heavy and light vehicles, as it may increase the risk of traffic accidents.

7.23 For the proposal to limit the speed of passenger services vehicles to 70 km/h, the Panel notes that the maximum speed for buses, including both franchised and non-franchised buses, is already set at 70 km/h, but this limit does not apply to taxis and public light buses (PLBs). The Panel does not see any strong justification on road safety grounds to restrict the maximum speed of taxis and PLBs to 70 km/h. Members also point out that this will affect the efficiency of Hong Kong's public transport system.

7.24 **Instead of limiting the speed of passenger services vehicles (other than buses), the Panel recommends that targetted education programmes and more stringent enforcement be mounted to inculcate a good driving culture. The Panel also recommends that TD evaluate the effectiveness of those speed display units currently in use in green minibuses running overnight routes, and consider the advantages of extending their use to other PLBs.** Please see Chapter 8 for a more detailed discussion about the installation of speed display and control devices in vehicles.

7.25 There is also a suggestion to lower the speed limit for buses under strong wind conditions. The Panel notes that all franchised bus operators have already issued guidelines to their drivers on operating bus services under strong wind conditions. Slowing down the vehicles is one of the requirements. The Panel is satisfied with the existing administrative arrangement.

## TRAFFIC SIGNS AND ROAD MARKINGS

7.26 Traffic signs and road markings are integral parts of the road system. They convey important information to drivers on the directions and the driving rules.

7.27 The Panel notes that the design of traffic signs and road markings in Hong Kong is largely based on the UK Traffic Signs Regulations and General Directions 1975 and 1981. These regulations are in turn developed on the basis of the Convention on Road Traffic and Road Signs and Signals, Vienna 1968, the European Agreement, Geneva 1971, and the Protocol on Road Markings, Geneva 1973. With the adoption of the above conventions, a high degree of uniformity of traffic signing and road marking is achieved throughout the world.

### Traffic signs

7.28 The Panel considers that traffic signs intended for vehicular traffic have to transmit clear messages at the right time to motorists who are travelling at normal speed. It is hence important for traffic signs to have correct legibility distance, simplicity of content and layout and effective illumination or reflectorisation. They need to be appropriately located in relation to the junction, restriction, hazard or other features to which they apply.

7.29 Traffic signs serve regulatory, warning, informative and directional functions as specified by their shapes and colours. Regulatory signs give orders. They are normally circular in shape, and are either mandatory or prohibitive in nature. They are located at the point where the regulatory effect commences (**Figure 7.7**).



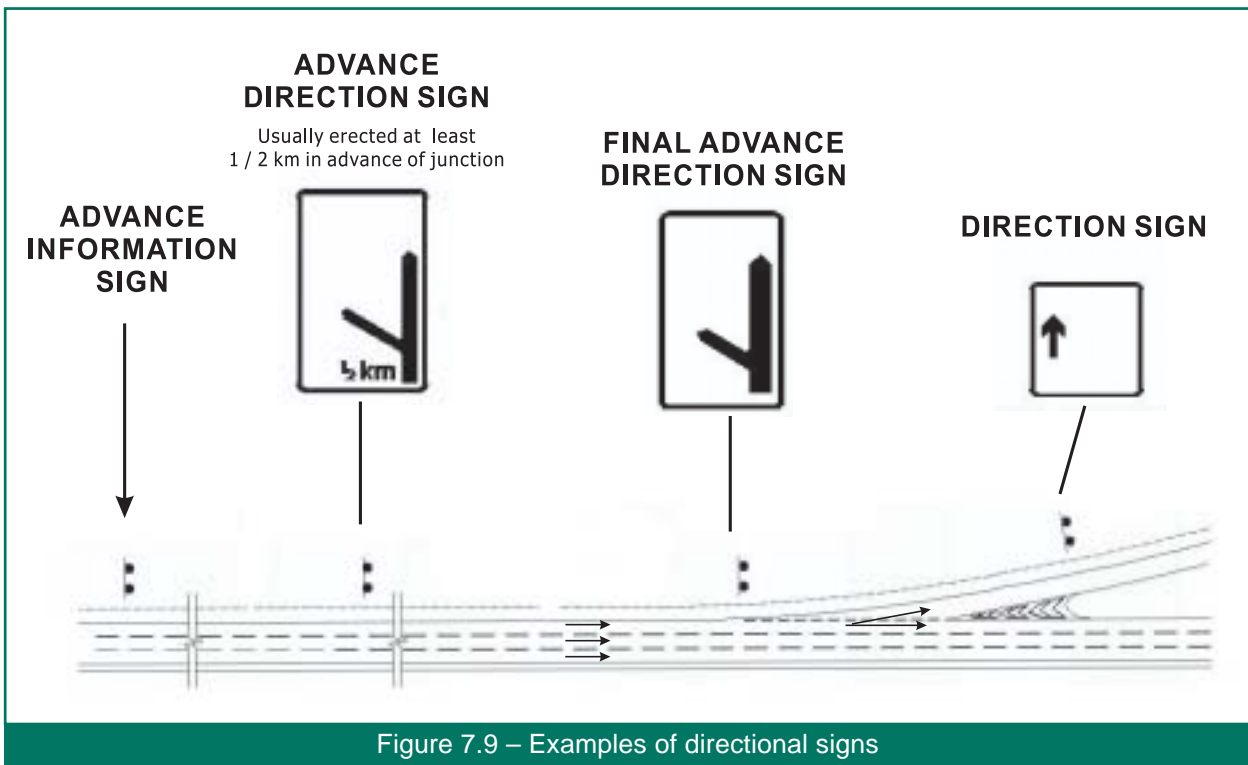
7.30 Warning signs are normally triangular in shape, bearing a black symbol on a white background with a red border while informative signs are usually rectangular in shape (**Figure 7.8**).





7.31 Directional signs enable motorists to find their way to a desired destination. Directional signs can be of different types and in various formats. They can be installed at the roadside or on gantries over the carriageway depending on actual site situations and road conditions.

7.32 For expressways, trunk roads, primary distributor roads and rural roads, a set of three signs, namely, “Advance Direction Sign”, “Final Advance Direction Sign” and “Direction sign” must be provided at all junctions or locations at which there is a slip road branching from the main road. These signs provide drivers with sufficient advance information to choose the correct route (**Figure 7.9**).



7.33 There are suggestions to review the standard of road signage, install more directional and traffic signs to give early warning to motorists and to improve the visibility of the signs. The Panel considers that the signing arrangements in Hong Kong accord with international practices, and notes that TD has recently

completed a study titled 'Comprehensive Review of Directional Signing in Hong Kong', which recommends improvements in signing strategy, sign provision, sign format and sign mounting. A pilot scheme to assess the effectiveness of the recommendations will be carried out in Shatin. More details of the Review are set out in paragraphs 7.43 - 7.46.

7.34 On the other hand, the Panel expresses reservations about the proposal to provide a countdown facility for vehicular signals. According to overseas studies, any advance facility indicating imminent change of traffic signal may increase the risk of traffic accidents, as motorists may have different perceptions and reactions to the advance indication.

### Road markings

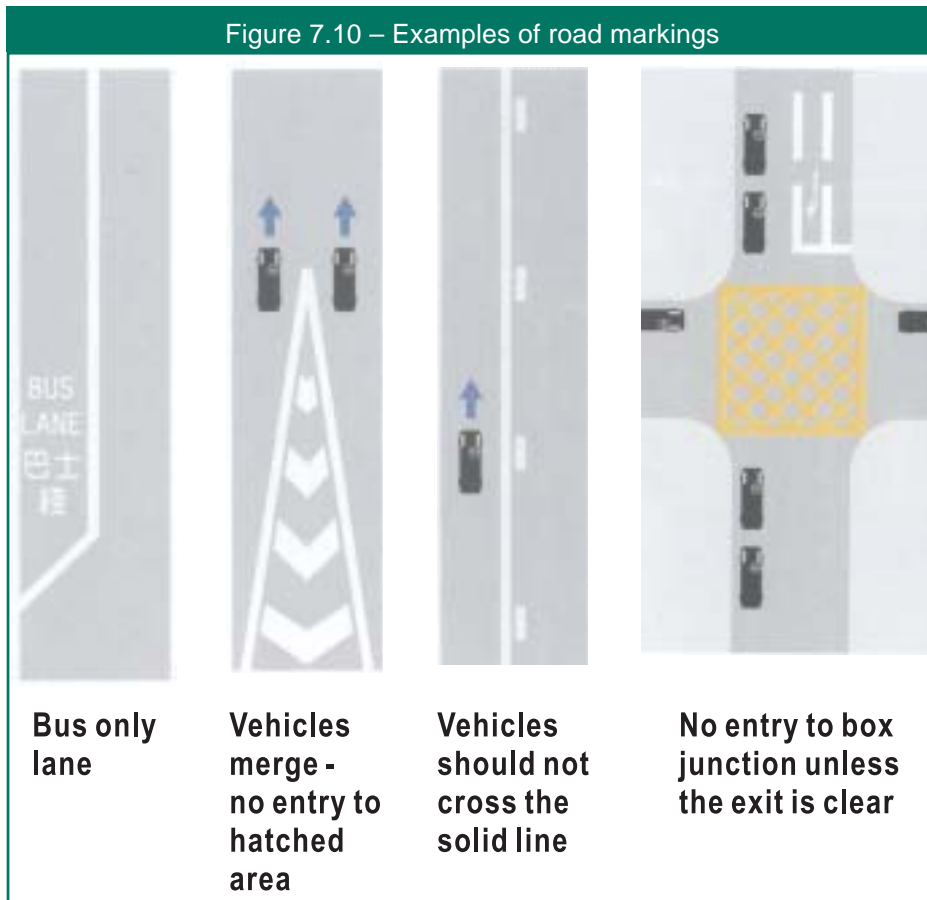
7.35 Road markings are designed to convey regulatory, advisory and warning messages. Regulatory markings are used to –

- prohibit certain actions;
- indicate the direction for vehicles to follow;
- determine the area where certain activities are permitted; and
- direct a driver to take certain actions.

7.36 Warning and advisory markings serve the following functions –

- promote full utilisation of the carriageway;
- warn of a hazard ahead;
- provide carriageway delineation;
- direct traffic around an obstruction or signify a change in traffic lane alignment;
- warn of an action to be taken;
- provide route information; and
- delineate hazardous areas.

7.37 In general, white markings are intended to direct and control moving vehicles, and yellow markings to control stopping of vehicles, e.g. box junction, hatched marking, and yellow lines are stopping restrictions. Road markings should be designed and verified for their compatibility with all traffic signs, directional signs, traffic signals as well as any variable signs and signals. **Figure 7.10** are some examples of road markings.



7.38 Many submissions from the public touch on road markings. There are suggestions to use double white lines to deter lane changing activities at certain road sections (e.g. high-risk locations). The Panel considers that double white lines have already been used at locations where lane changing is considered potentially dangerous, and the suitability of applying double white lines to specific road sections should be assessed on a case-by-case basis. It should be noted that an extensive use of double white lines runs the risk of diluting the respect for such markings, which will not reduce the amount of lane changing but merely shift the act upstream to where the double white lines begin.

7.39 As for suggestions to use double white lines to prevent last-minute attempts to change lanes at diverging points, the Panel considers that, if there is clear visibility ahead of the interchange, coupled with adequate directional signing, it may not be necessary to apply double white lines. Imposing double white lines at diverging points might indeed shorten the time allowed for drivers to observe traffic condition for lane changing and could create an adverse impact on safety.

7.40 There are also suggestions to use double white lines to deter lane changing on roads with speed limit at 70km/h, which are mainly expressways. The Panel appreciates that there are practical and legitimate needs for drivers to change lanes along the way, especially at and near to intersections. The Panel also recognises that when lane changing is not allowed, slower moving vehicles would largely dictate the traffic flow and result in congestion.

7.41 On the suggestion to use road markings to provide motorists travelling on expressways with more information, the Panel notes that this is already in practice. In general, information is best provided through signs mounted on gantries rather than road markings, as the latter could be easily obscured by other travelling vehicles.

### Recent development of traffic signs and road markings in Hong Kong

7.42 The Panel notes that TD commenced in July 1999 a comprehensive review on the traffic signs and road markings. The objectives of the review were to identify problem areas from complaints received, research into the latest practices adopted in major overseas cities, and put forth a set of recommendations with priorities. The Study brought about the following improvements –

- ❑ improve the layout of the no-stopping restriction sign;
- ❑ simplify contents of traffic signs, such as removing the letters 'km/hr' from speed limit signs to enable a larger speed limit numeral to be shown;
- ❑ adjust the orientation of taxi and light bus stand signs to face the traffic to enhance their visibility from a distance; and

- ❑ use distinct wide short dotted markings to delineate exclusive turning lanes and lane drops on expressways/trunk roads and at other suitable locations to facilitate motorists' timely entry into the correct lane.

7.43 In August 2001, TD undertook another study titled 'Comprehensive Review of Directional Signing in Hong Kong'. The objectives were to assess the design standards of directional signing adopted in Hong Kong against those of overseas countries, and to identify areas for continual improvement. The Study was completed in early 2003.

7.44 The Study concludes that the current design standards and provision of directional signs in Hong Kong are generally in line with those of major overseas countries, but a number of problem areas are identified –

- ❑ inadequate directional guidance for access to the strategic road network;
- ❑ discontinuity and inconsistency in destination names;
- ❑ insufficient advance signing;
- ❑ inadequate visibility due to obstruction or improper positioning of some signs; and
- ❑ bulky appearance of gantry structures.

7.45 To address the above problems, the Study recommends that improvements should cover four key areas, viz. signing strategy, sign provision, sign format and sign mounting, along the following lines –

- ❑ develop a four-level destination hierarchy comprising Regions, Sub-regions, Districts and local destinations;
- ❑ adopt new design techniques to address junction importance, speed, lane change and maximise sign visibility;
- ❑ provide an advance information sign (AIS) 1 000 to 2 000 m ahead of strategic road network junctions to provide early alert to motorists;
- ❑ incorporate distance indicators and optimise x-height (size of letters and numbers on the sign) to improve the sign format; and

- use alternative sign mounting techniques to address space constraints, minimise risks of crashes on signs and enhance the aesthetic value.

7.46 To follow up on the recommendations of the Study, TD will rationalise the route numbering system and provide exit numbers on the strategic road network to give clearer directions to inter-district and inter-region traffic. This enhancement measure is scheduled to be completed by early 2004. A pilot scheme, in Shatin, to assess the other recommendations is under planning.

**7.47 The Panel endorses the above improvements and recommends to expedite the implementation of the pilot scheme and the evaluation process so that an implementation programme can be drawn up for the rest of the road network as soon as possible.**

**7.48 The Panel also recommends that a publicity programme be formulated to brief motorists whenever there are changes in signing standards to avoid creating any confusion.**

## USE RESTRICTIONS

7.49 Apart from traffic signs and road markings, there are suggestions on other traffic control measures. For instance, some suggest that the 'keep left' restriction should be strictly imposed on all roads with two or more lanes. The Panel notes that there are already mechanisms to implement the 'keep left unless overtaking' requirement, which is a basic driving principle set out in the Road Users' Code. It is also reinforced by the installation of 'Keep Left Unless Overtaking' signs at selected locations where additional warning is warranted. On expressways, the requirement to keep to the nearside unless for overtaking is stipulated in Regulation 12 of the Road Traffic (Expressway) Regulations, and failure to comply may result in prosecution.

7.50 On the other hand, there are suggestions to remove the 'keep left' restriction on all expressways. The Panel does not support this proposal as the 'keep left' restriction is a basic safety requirement for expressway driving. This

requirement aims to prevent excessive weaving and to help bring about a more orderly traffic flow. Removing the 'keep left' restriction would allow motorists to overtake on the nearside, which is potentially hazardous to other road users.

7.51 There is also a proposal for heavy goods vehicles and buses to use only the middle lane. The Panel has reservations about this proposal as motorists are well accustomed to the 'keep left unless overtaking' practice required under the Road Traffic (Expressway) Regulations. The proposed change may create confusion and increase the risk of accidents. In addition, Members also point to the potential danger arisen from this lane-use restriction to passengers during emergency evacuation, if a bus broke down in the middle of the road.

## TRAFFIC CONTROL IN TUNNELS AND TSING MA CONTROL AREA

7.52 The Panel notes that specific traffic control measures are introduced on safety grounds for certain types of vehicles in tunnels and Tsing Ma Control Area.

### Tunnel Restrictions

7.53 While vehicles conveying dangerous goods are prohibited from using the tunnels, different Tunnel Regulations require some or all of the following vehicles to be confined to the nearside lane of the tunnel –

- ❑ bus;
- ❑ goods vehicle with a permitted Gross Vehicle Weight in excess of 5.5 tonnes;
- ❑ vehicle requiring certain specified permits; and
- ❑ vehicle towing another vehicle.

### Measures taken in Tsing Ma Control Area

7.54 The Tsing Ma Control Area (General) Regulations require that permits have to be obtained for vehicles of excessive weight, height, length and width to travel in the Tsing Ma Control Area, and that the vehicles have to be accompanied by an escort vehicle.

7.55 The Panel notes that during strong wind conditions, High Wind Management is implemented at Lantau Link and Ting Kau Bridge. Under Stage I when the hourly mean wind speed is between 40 km/h - 65 km/h, wind susceptible vehicles (vehicle with an overall height exceeding 1.6 m, motorcycles or motor tricycles) are prohibited from using the Ting Kau Bridge and the upper deck of the Lantau Link. During Stage II when the hourly mean wind speed is between 65 km/h - 165 km/h, only the lower deck of the Lantau Link can be used. At wind speeds in excess of 165 km/h, both road links will be completely closed to traffic.

### TRAFFIC MANAGEMENT MEASURES ON HEAVY VEHICLES

7.56 In light of the traffic incident on Tuen Mun Road on 10 July and the recent accidents involving franchised buses, there is heightened public concern about the safety standard of heavy vehicles, especially container trucks and franchised buses. The Panel notes that some safety related controls and restrictions on heavy vehicles are already in place, and some improvement measures will be adopted in light of the traffic accidents.

#### Lane discipline

7.57 Under the Road Traffic (Expressway) Regulations, heavy vehicles including medium and heavy goods vehicles and buses are prohibited from using the offside lane of an expressway with three or more lanes. This regulation helps



segregate the slower heavy vehicles from the faster light vehicles, and hence minimises potentially dangerous lane cutting activities. For other major roads, 'Keep Left Unless Overtaking' traffic signs, climbing lanes on uphill roads and passing bays are provided where appropriate to perform the same function.

### Speed limit

7.58 To enhance road safety, the Road Traffic Ordinance restricts the maximum speed of heavy vehicles to 70 km/h on roads with a posted speed limit over 70 km/h.

### Loading of vehicles

7.59 There are traffic regulations stipulating the maximum weight and size of loads permitted to be carried by goods vehicles. TD has issued a Code of Practice on Loading of Vehicles to advise goods vehicle drivers and operators of the practice and manner for safe conveyance of goods, so that goods vehicles will not pose a danger to other traffic.

### Prohibitions

7.60 The Panel received suggestions for imposing restrictions (full time or time limited) on buses and heavy vehicles from using certain road sections. The Panel notes that heavy vehicles are prohibited from entering around 120 locations throughout the territory due to site constraints, such as steep gradient, substandard width or bends, or insufficient headroom or turning radius.

## SPECIFIC MEASURES FOR FRANCHISED BUSES

7.61 The Panel notes that franchised buses are subject to specific safety measures in terms of route planning, withdrawal of old vehicles from service and

working conditions of bus drivers. The Panel has examined in detail the major accidents involving buses and reviewed the entry requirements and training for bus drivers as well as improvement measures taken/being considered in the wake of the traffic accidents.

### Route planning

7.62 In formulating a bus network, bus routes or route changes, the following factors will be taken into account –

- ❑ transport policy and objectives;
- ❑ volume of passenger demand;
- ❑ suitability of operating bus services with regard to the nature of terrain and conditions of roads and transport termini<sup>2</sup>;
- ❑ deployment of suitable vehicle models on the route;
- ❑ availability of existing services;
- ❑ possibility of meeting the anticipated increase in passenger demand by adjustment of existing services;
- ❑ bus network efficiency and financial viability of the route; and
- ❑ views of the local community including the District Councils.

7.63 Where necessary, there will be additional requirements on specific franchised bus routes. For instance, since 1993 double-decked buses operating on steep roads with a gradient of 10% or more have been required to have integral retarders to improve the breaking efficiency of the vehicles. Double-decked buses running on Route Twisk have been required to be equipped with tachographs since 1988.

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<sup>2</sup> Traffic engineers will advise on the suitability of the roads for bus operation in areas without existing bus route or on roads which have been realigned. Bus trial runs, with the assistance of Traffic Police, will be arranged.

### **Withdrawal of old vehicle from service**

7.64 Under an agreement with franchised bus companies, buses will be withdrawn from service before they reach the age of 18. A younger and more modern fleet will ensure a high level of safety and reliability and generate less pollution.

### **Entry requirements for franchised bus drivers**

7.65 All franchised bus companies, except the Kowloon Motor Bus Co. (1933) Ltd (KMB) and Long Win Bus Co Ltd (LW), recruit new driver trainees who are holders of public bus driving licences. For KMB and LW, their driver trainees have to be holders of private car driving licences for at least three years. Unless the driver trainee has already obtained a public bus driving licence, he must pass the driving tests set by TD upon completion of training.

### **Training, continual education and publicity targetted at bus drivers**

7.66 Franchised bus companies provide new drivers with basic training courses with durations ranging from a few days to about three weeks depending on the driving qualifications of the drivers. The programmes cover classroom and on-the-road training which include the following aspects –

- ❑ driving legislation and code of practice;
- ❑ bus and facilities operation;
- ❑ bus checking procedures;
- ❑ bus driving techniques including manoeuvring, driving responses and manners on the road; and
- ❑ route training and driving practices.

7.67 In addition, one to two-day refresher and enhancement courses are provided for incumbent franchised bus drivers on a regular basis. The main objectives of these courses are to –

- ❑ strengthen drivers' driving skills and manners, including defensive driving;
- ❑ enhance drivers' understanding of the potential risks of the routes they serve and the appropriate reaction; and
- ❑ reinforce concepts of road safety.

7.68 Apart from formal training courses, TD has been conducting Road Safety Seminars for franchised bus drivers since 2002. The Seminars highlight concepts of safe driving and analyse major accident spots and common contributory factors of bus accidents. In addition, franchised bus companies also remind their drivers of the importance of safe driving through regular issue of circulars, notices and in-house publications.

### **Working conditions of bus drivers**

7.69 The issue of fatigue driving was raised in some of the submissions from the public. There are suggestions to introduce legislation on the maximum working hours for professional drivers. The Panel notes that TD has issued guidelines on the working hours of franchised bus drivers, as follows –

- ❑ drivers should take a break of at least 30 minutes after 6 hours of duty and within that 6-hour duty, the drivers should have total service breaks of at least 20 minutes;
- ❑ maximum duty (including all breaks) should not exceed 14 hours and driving duty (i.e. maximum duty minus all breaks of 30 minutes or more) should not exceed 11 hours; and
- ❑ the break between successive working days should not be less than 8 hours.

**To prevent fatigue driving, the Panel considers it important for bus operators and drivers to adhere to the above guidelines.**

## Safety improvement measures

7.70 Apart from reviewing the existing safety measures, the Panel has examined in detail the following major traffic accidents involving franchised buses which occurred from 1998 to 2003 –

- ❑ Tonnochy Road Flyover on 30 January 1998;
- ❑ Lung Mun Road on 2 February 1999;
- ❑ Tate's Cairn Tunnel on 8 September 2001;
- ❑ Tuen Mun Road near So Kwun Wat on 23 January 2003;
- ❑ Lantau Island on 26 January 2003;
- ❑ Tuen Mun Road on 10 July 2003; and
- ❑ Western Kowloon Expressway on 18 October 2003.

7.71 The Panel notes that specific traffic improvement and engineering remedial measures were taken after some of the above traffic accidents when the road environment was found to be a contributory factor. The Panel also notes that TD has requested the franchised bus companies to carry out a comprehensive review of their safety arrangements as a matter of urgency in three months.

7.72 **The Panel recommends that TD continue to implement the following safety improvement measures –**

- ❑ **identify the cause of bus accidents and map out improvement measures to enhance bus safety;**
- ❑ **monitor closely the trend of bus accident rate of different franchised bus companies and take actions, such as that mentioned in paragraph 7.71, to improve the trend; and**
- ❑ **promote bus passenger safety and safe driving through different means of publicity such as Announcements of Public Interest (APIs) on TV and radio.**

### **Safety measures for non-franchised buses (including cross boundary coaches)**

7.73 The Panel notes that apart from franchised buses, specific safety measures are applicable to other buses. Under the Road Traffic Ordinance, all operators of public and private buses must apply for a Passenger Service Licence (PSL) which regulates the operation of the service.

7.74 To cope with the surge of cross boundary vehicular traffic arising from closer economic and social links between Hong Kong and the Mainland, a quota system for cross-boundary traffic was introduced in 1982 to help regulate the volume of cross-boundary traffic. It is jointly administered by the Hong Kong and Guangdong/Shenzhen authorities. The operation of cross-boundary coach service is subject to quota restrictions.

7.75 The Panel notes that the following safety measures for cross boundary coaches have been implemented –

- ❑ non-franchised buses registered on or after 1 June 2002 which are deployed to provide cross-boundary coach service should be installed with seat belts according to the standards set by TD;
- ❑ with effect from 1 February 2002, a PSL condition has been imposed for operators to report to TD on a quarterly basis any accidents involving injury and fatality which occurred in the Mainland or Hong Kong;
- ❑ to facilitate passengers to offer comments or lodge complaints related to the coach service, a PSL condition has been imposed since 1 February 2002 requiring each operator to set up a hotline and to publicise the phone number inside the bus and on the ticket for the coach service; and
- ❑ the traffic accident records of operators have been used as one of the determining factors for quota allocation starting from 2002.

## OBSERVATIONS

7.76 After examining the highway design standards and various traffic management measures, the Panel considers that Hong Kong has a safe highway network and an efficient traffic management system. The Panel also notes that improvement measures arising from systematic reviews are in the pipeline. The Panel urges the Government to expedite the implementation of the improvement measures and to keep track of the best practices in overseas countries.

7.77 The Panel also recommends that the Government keep a close watch of the safety record of specific vehicle types and take proactive steps to enhance their safety standards with participation of the relevant transport trades.

## Chapter 8

# Vehicle Control

### INTRODUCTION

8.1 Technological advancement has made the design of motor vehicles much safer than before. High strength steel offers passengers much better protection without adding undue weight to the vehicle. Antilock braking system improves vehicle performance in case of emergency braking. Padded interiors, special seating design and occupant restraints, such as safety belts and frontal and side airbags, enhance passenger safety during impact situations.

8.2 Despite modern designs that have made vehicles safer, the Panel considers that it is the way in which a vehicle is used and maintained that has the greatest bearing on safety. A proper control on their usage is therefore necessary.

8.3 As shown in Chapter 4, there has been an increase in the number of accidents involving public buses and public light buses in the past two decades. The Panel is of the view that more attention should be paid to these vehicle types. Taking into account suggestions received from the public, the Panel considers that two aspects relating to control of vehicle warrant more detailed examination. They are speed control and vehicle maintenance.

### SPEED CONTROL

8.4 The high performance of vehicles is often subject to abuses, and speeding is a common problem. Apart from roadside enforcement, the Panel considers that in-vehicle equipment can be used to curb this undesirable driving behaviour. The following are some speed control devices.



## Speed display and warning devices

8.5 At present, there is no legal requirement for the installation of speed display or speed warning devices on motor vehicles. A trial scheme on the installation of speed display units (**Figure 8.1**) commenced in August 2002, and by April 2003, speed display units have been installed in 243 green minibuses (GMBs) running overnight routes. The Transport Department (TD) is at present closely monitoring the effectiveness of the device with reference to accident statistics, speeding offences and complaints.



Figure 8.1 – A typical speed display unit on minibus

8.6 **The Panel recommends that, subject to an evaluation of the speed display units installed in GMBs running overnight routes, TD should extend their use to other public light buses.**

8.7 Another type of speed display device is speed display lights at the front top of the driver cab (**Figure 8.2**). The function of these lights is to deter speeding by putting such vehicles under public surveillance.

Figure 8.2 – Typical speed display lights



8.8 The Panel has received suggestions to install speed display devices on top of heavy vehicles. The Panel notes that such a practice used to be adopted in Japan, but was found to be ineffective in view of the large amount of resources required for enforcement by the police. The Japanese authorities have since dropped the use of external speed display and opted for speed limiter instead.

## Speed limiters

8.9 A speed limiter is a device that can limit the speed of a vehicle to a pre-set maximum value under certain operating conditions. There are a variety of products available in the market ranging from mechanical add-on devices to electronic engine management systems<sup>1</sup> (**Figure 8.3**).

8.10 While at present there is no mandatory requirement for speed limiters to be installed in motor vehicles in Hong Kong, it is a common regulatory practice to install speed limiters on heavy goods vehicles in overseas countries, including Australia, European Union, Japan, and Singapore.

8.11 The Panel considers that there are merits in installing speed limiters in passenger services vehicles for better passenger safety. Members note that many new franchised buses have been installed with electronic engine management systems which have incorporated speed limiting functions. **However, consideration should be given to formally requiring newly registered franchised buses to install speed limiters to ensure that the speed limiting device is present and functioning properly.**

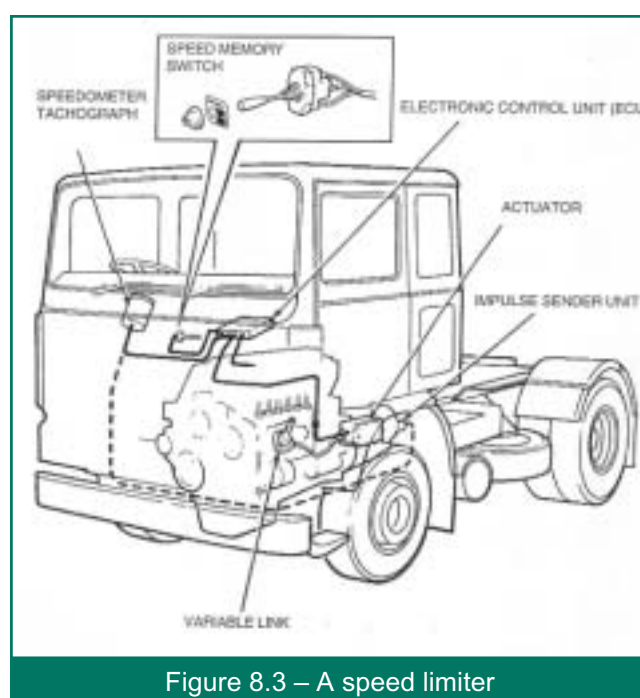


Figure 8.3 – A speed limiter

<sup>1</sup> Electronic engine management systems are used to manage engine operation and performance including engine speed, fuel supply and power.

8.12 **The Panel also recommends that consideration be given for speed limiters to be installed in other heavy vehicles to enhance their safety.** Members recognise that one issue to be addressed is the different speed limits adopted by heavy goods vehicles across the boundary. Medium and heavy goods vehicles are currently restricted to a maximum speed of 70 km/h in Hong Kong. However, the maximum speed limit of heavy goods vehicles on expressways in the Mainland is 90 km/h. While the speed limit differential between the two places can be overcome technically, there will be cost implications. **The Panel recommends that relevant transport trades be consulted on the proposal.**

8.13 The Panel is aware that speed limiters do not offer perfect solutions. They can only prevent speeding on roads with a speed limit equal to or higher than the set speed. They could also be susceptible to abuses and illegal modifications. Besides, almost all types of speed limiters fail to function when the vehicle is running downhill, as they only control the speed of the engine but not the wheels. Nonetheless, they are more effective than speed display units and are less costly than tachographs.

### Tachograph

8.14 Besides controlling the speed of a vehicle by mechanical or electronic means, another option to deter speeding is to keep a full record of the operating conditions of the vehicle including its speed. A ‘tachograph’, often known as ‘black box’, is such a device .

8.15 The word ‘tachograph’ can be broken down into ‘tacho’, from the Greek word ‘takhos’, which means speed, and the word ‘graph’ a record. It is in essence a combination of a clock, a speedometer, an odometer, a tachometer and a recorder (**Figure 8.4**). During a trip, it continuously records vehicle operating information into circular charts inside the unit, depending on the technology used (**Figure 8.5**). This device is commonly used in some countries to control the duty cycle of drivers to prevent fatigue.

Figure 8.4 – A tachograph



Figure 8.5 – Record from a tachograph

8.16 The information recorded in a tachograph is very useful for accident investigation, as it can, depending on the design, tell exactly what state the vehicle was in before the accident by giving information about speed, acceleration, distance travelled, emergency sirens and lights, brake applications, etc.

8.17 The Panel received suggestions to introduce the use of vehicle blackbox (i.e. tachograph) in heavy and passenger services vehicles. In view that a tachograph can serve accident investigation and fleet management purposes, **the Panel recommends that TD explore the fitting of such devices in franchised buses, and, subject to evaluation of effectiveness, extend them to other passenger services vehicles.**

## VEHICLE EXAMINATION

8.18 Another aspect of vehicle safety is to ensure that the vehicles are properly maintained and their mechanical parts are in good operating condition. The Panel has examined the current vehicle examination regime. The Vehicle Safety and Standards Division (VSSD) of TD is responsible for formulating vehicle construction and maintenance standards, and conducting and monitoring statutory vehicle examinations to ensure the safety of vehicles on the road.

## Legal requirements

8.19 Each vehicle is required to be roadworthy and to be registered/licensed before it can be used on the road.

8.20 The relevant laws related to vehicle safety and roadworthiness are summarised below –

<b>Chapter</b>	<b>Title</b>
Cap 374	Road Traffic Ordinance
Cap 374A	Road Traffic (Construction and Maintenance of Vehicles) Regulations (specifies basic technical requirements for all vehicles)
Cap 374F	Road Traffic (Safety Equipment) Regulations (specifies requirements for seat belts, helmets and fire extinguishers)
Cap 374H	Specification of Safety Glass Notice
Cap 230	Public Bus Services Ordinance (regulates the maintenance of franchised buses)

8.21 The law only specifies the minimum requirements. The ultimate responsibility for the detailed design and construction rests with the vehicle manufacturer, while the vehicle owner is responsible for upkeeping the vehicles in good operating condition.

## REQUIREMENTS FOR ALL CLASSES OF VEHICLES

### Vehicle type approval

8.22 New vehicle models of all classes of vehicles have to undergo a type approval process before they can be registered and licensed for use on the road. This process aims to ensure the vehicles' roadworthiness and compliance with the design and construction requirements stipulated in the Road Traffic (Construction and Maintenance of Vehicles) Regulations.

8.23 The type approval process involves checking of technical specifications and associated documentation from vehicle manufacturers as well as an examination of a sample vehicle.

### Annual examination

8.24 Except for motorcycles, and cars not older than six years, all other classes of vehicles are required to undergo an annual examination to ensure their roadworthiness before they can be re-licensed.

### Call up inspections

8.25 Any motor vehicle may be called up for vehicle examination. Call-up inspections are generally initiated by public complaints or referrals by the Hong Kong Police Force (HKPF). Upon receipt of a complaint or referral, a Vehicle Inspection Office of TD would issue a Vehicle Examination Order to the vehicle owner for delivering the vehicle concerned to government vehicle examination centres on a specified date for an examination of the items causing the complaint/referral.

## Roadside enforcement

8.26 Roadside enforcement is a very effective measure to ensure that the vehicle owners or drivers maintain their vehicles in a roadworthy condition and in compliance with relevant regulations. Vehicles can be selected randomly for examination and directed to the check sites by a police officer. Vehicle examiners will inspect and check the mechanical components of the vehicles and condition of the bodywork against applicable construction and maintenance standards.

8.27 The Panel notes that in the UK, roadside checks are held over the country, at roadside as well as permanent sites such as weighbridge stations. **Members recommend that apart from the existing vehicle examination centres, temporary or permanent check sites for roadside enforcement be established in Hong Kong, and preferably be located close to major trunk roads or expressways.**

8.28 **The Panel also recommends that joint roadside spot checks on heavy vehicles by the HKPF and Vehicle Examiners from TD be stepped up.**

## ADDITIONAL REQUIREMENTS FOR COMMERCIAL VEHICLES AND PASSENGER SERVICES VEHICLES

### Pre-registration examination

8.29 Subsequent to the type approval, new commercial vehicles including goods vehicles, buses, light buses, taxis, and trailers are required to undergo a pre-registration examination to confirm their conformity with the type-approved design before their first registration.

8.30 For vehicles carrying large numbers of passengers, such as franchised and non-franchised buses, they are required to undergo a Certificate of Fitness (COF) examination in lieu of a Certificate of Roadworthiness (COR) examination at certain intervals.

### Additional requirements for franchised buses

8.31 The Panel notes that franchised buses are subject to additional requirements under the Public Bus Services Ordinance (Cap 230). Franchised bus companies are required to carry out maintenance and repair as the Commissioner for Transport may specify, and TD's examiners are empowered to inspect the buses and maintenance facilities at any reasonable time.

8.32 Franchised bus companies are required to inspect the overall condition of their buses at least once per month. Each bus company has its own additional programmes, e.g. checking wheel, tyres or brakes at specified intervals, and requiring their bus drivers and depot staff to report any observable defects. TD closely monitors the maintenance programme of franchised bus companies and holds regular meetings with their engineering departments to discuss ways to enhance bus design and maintenance.

8.33 In addition, TD also conducts annual COR examinations and COF examinations at certain intervals as well as spot checks on in-service franchised buses to ensure their safety and roadworthiness. Any defects found will need to be rectified before the bus can resume service. Prosecution may be instituted if particularly serious defects are found.

### Stability test

8.34 An additional stability test (tilt test) is applicable to both franchised and non-franchised buses and light buses. The stability of a double-decked bus is checked by loading weights in relative positions to represent the driver and a full complement of passengers on the upper deck. If the surface on which the vehicle stands were tilted to either side at an angle of 28 degrees from the horizontal, at which point overturning occurs, the vehicle fails the test (**Figure 8.6**).

Figure 8.6 – A bus undergoing stability test





8.35 At the moment, the stability test requirement is only applicable to buses and light buses under the existing regulations. **The Panel recommends that the feasibility of extending the stability test to heavy goods vehicles be explored.**

### **Qualification of vehicle mechanics**

8.36 The Panel received a suggestion to improve the quality of mechanics for vehicle maintenance. The Panel agrees that the quality and experience of vehicle mechanics and the facilities of the servicing and repair workshops are essential to ensure the maintenance standard and thus roadworthiness of vehicles. To this end, the Environment, Transport and Works Bureau commissioned a consultancy study on devising a regulatory scheme for the vehicle maintenance trade in 2003. The results are expected to be available at the end of 2003. **The Panel supports measures to enhance the quality and service of vehicle mechanics.**

## Chapter 9

# Vehicular Parapet Design

## INTRODUCTION

9.1 After the incident on 10 July, concern was expressed about the design of the vehicular parapet at the incident spot and other locations with similar characteristics. For this reason, the Panel has devoted much effort in reviewing the issue of parapet design and will set out its findings in detail in this chapter.

9.2 Although this chapter is not intended to be a technical report, the Panel considers it essential and beneficial for the fundamental concepts behind parapet design to be explained and understood. The engineering principles involved are complex and technical. Therefore, an attempt has been made to put these principles in layman terms to help the public better understand the matter.

9.3 Parapets are protective devices that are designed to reduce the severity of an accident when an errant vehicle leaves the roadway. They provide a passive line of defence. As such, they cannot be the cause of, or a contributory factor in, an accident. Properly designed, they can reduce the severity of the consequence of an accident. At the same time, these vehicle parapets are also obstacles which means that a vehicle hitting a parapet can result in injury to the occupants as well as vehicle damage.

## BASIC DESIGN PRINCIPLES

### What happens when a vehicle collides with a parapet

9.4 To aid understanding, some of the physical principles involved in a collision between a vehicle and a parapet are explained below.

9.5 When a vehicle collides with a parapet, there are several possible outcomes that depend on a number of factors, including the strength and rigidity of the parapet,

the speed of the collision, the angle of incidence, vehicle weight and the centre of gravity of the vehicle relative to parapet's height. The result is that –

- ❑ the vehicle is retained and may either be stopped by, or rebound from, the parapet; or
- ❑ the vehicle may penetrate the barrier if it is not strong enough to withstand the impact; or
- ❑ the vehicle may roll over the parapet if the parapet is not high enough.

9.6 Where parapet retains the vehicle, the collision process may be broken down into four phases, as shown in **Figure 9.1** –

- ❑ collision of vehicle's front corner;
- ❑ lateral scrapping against the parapet;
- ❑ collision of vehicle's rear corner; and
- ❑ re-entry of vehicle onto the carriageway.

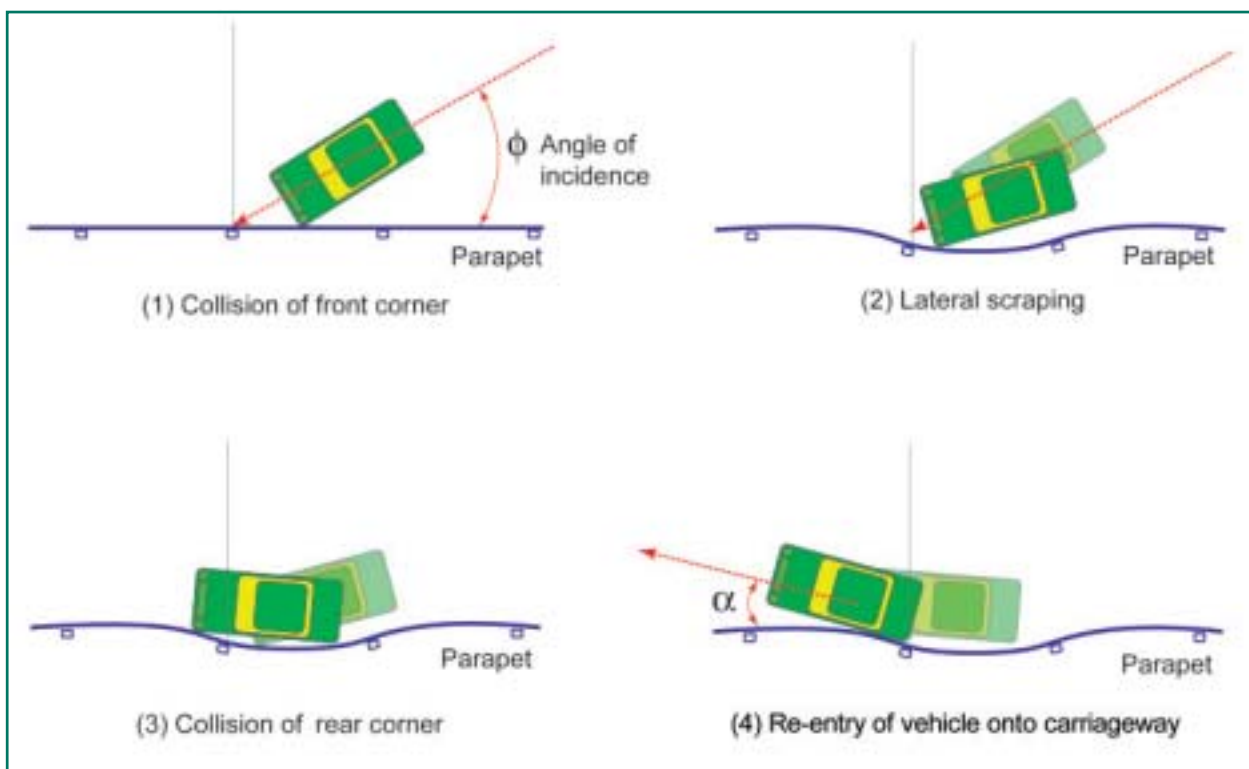


Figure 9.1 – The four phases of collision against a parapet

9.7 The angle of incidence ' $\phi$ ' can be influenced by many factors such as site geometry, vehicle speed and friction on the road surface. The larger the angle of incidence, the more severe the collision. The likelihood of a vehicle penetrating the parapet will also be correspondingly higher.

9.8 The degree of the exit angle ' $\alpha$ ' depends on the amount of energy released in the collision. The more energy released (by deforming the parapet and/or the vehicle) the smaller the exit angle. The less energy released, the larger the exit angle. This will also increase the likelihood of secondary collisions by the errant vehicle running onto other vehicles on the roadway.

9.9 To analyse whether a vehicle will roll over a parapet is a complex process. It depends on the centre of gravity (CG) of the vehicle relative to the contact point with the parapet, the weight and speed of the errant vehicle, and the magnitude and duration of the reaction force the parapet exerts on the vehicle. If the vehicle's CG is above the point of contact between the vehicle and the parapet, the more flexible the parapet and the vehicle are, then the less likely will the vehicle roll over the parapet.

### Containment levels

9.10 It is international practice that safety features are developed and tested for selected normalised situations that are intended to encompass a large majority, but not all, of the possible in-service collisions. The Panel notes that lighter vehicles account for a much higher proportion of vehicle numbers, and are therefore more likely to be involved in a collision than other types of vehicles. Past accident records confirm that most crashes on vehicular parapets involved light vehicles.

9.11 Containment capacity refers to the ability of the parapet to contain the impact of an errant vehicle and to deflect it away in a controlled manner. A containment level is normally expressed in terms of the angle of incidence, the weight and speed of the vehicle which represent the magnitude of the impact that the parapet is designed to sustain.

9.12 Parapets are designed to satisfy a selected containment level. For any particular containment level, there can be a variety of designs.

9.13 A strong parapet designed to a higher containment level may stop a heavy vehicle in the desired manner, but may cause considerable damage to a smaller vehicle. Occupants of a small vehicle may also be subject to severe acceleration force and injury. Conversely, a parapet with a lower containment level designed for light vehicles would not perform as equally well for larger vehicles which, in case of a severe impact, may even penetrate the parapet. It is therefore important to seek a balance between risk and the level of containment.

### Crash testing

9.14 Because crash dynamics are complex, the most effective means to verify the performance of a parapet design is to conduct a full scale crash test. These tests can be very expensive especially when heavy vehicles are involved. Testing facilities are not available in Hong Kong.

### Testing standards

9.15 To ensure that parapet designs meet balanced requirements across all vehicle types and numbers, and to provide a unified standard for verifying parapet design, 'test levels' have been defined in more recent international standards. A 'test level' may include more than one containment level. In other words, for a particular 'test level' to be satisfied, parapet designs could be subject to multiple tests each representing a different containment level. Different international standards have slightly different 'test levels' defined. The range of 'test levels' also varies. Acceptance criteria for the tests are also different, but are normally expressed in terms of structural adequacy, vehicle occupant risk, vehicle damage and exit path requirements.

### Computer simulation

9.16 Given that physical tests are expensive, and that it is not feasible to duplicate every possible impact scenario and have it tested, computer simulation provides a viable and more economical alternative. Once a computer model of a particular combination of vehicle and parapet type is developed and calibrated, the model can be used to simulate different collision scenarios.

### Design objectives

9.17 The design objectives of all vehicular parapets are similar. The three main requirements are structural adequacy, reduction of occupant risk, and controlled post-impact vehicular response to avoid secondary accidents and to minimize undue risk to the errant vehicle and other road users.

9.18 Structural adequacy is a measure of the ability of the parapet being able to stop an errant vehicle from penetrating, under-riding or overriding the parapet, or to redirect the vehicle in a controlled manner. The parapet may undergo an acceptable sideways deflection.

9.19 Risk to occupant is based on the acceleration and deceleration experienced by the occupant during impact, and the hazard posed by detached elements. Consideration should be given to the risks posed to other road users by the detached fragments of the parapet after impact.

9.20 The third design objective is to control the exit angle and the post-impact vehicle direction to reduce the likelihood of subsequent multi-vehicle accidents involving the crash vehicle re-entering traffic after 'bouncing' off the parapet.

## PARAPET DEVELOPMENT IN HONG KONG

9.21 The Panel has examined the history of parapet design in Hong Kong. The Panel notes that constant review and improvement on protection requirements are carried out by the Highways Department (HyD) having regard to the latest international practices and local experience. Reference is made in particular to the requirements of British standards. Parapets are generally designed to prevailing standards at the time when new projects or major renovations are implemented. It is the opinion of the Panel that, since parapets only reduce the severity of an accident, and do not contribute directly to accidents, old designs should not be viewed as 'unsafe'. It is also not a recognised international engineering practice to replace all existing parapets whenever a new standard emerges. A risk assessment and cost benefit analysis, taking into account the likely hazard, type and volume of vehicles, speed, road geometry, accident statistics and the surrounding environment etc, should be carried out before any enhancement programme is implemented.

9.22 Guidelines for the design of parapets are given in Chapter 15 of the Structures Design Manual (SDM) published by HyD. Parapets are classified for design purposes into five groups, namely P1 to P5. Only P1, P2 and P4 are designed for vehicle impact at different containment levels, viz. 'normal', 'low' and 'high' respectively. P3 and P5 are pedestrian and bicycle parapets not designed for vehicle impact. The section of parapet involved in the incident belongs to the P1 group.

9.23 The following summarises the history of parapet design development in Hong Kong and highlights the special features and properties of each type adopted. The design requirements on P1, P2 and P4 are reproduced from the SDM in the following table. As P2 only applies to low speed roads, the following discussion only focuses on P1 and P4. There are about 248.5 km of P1 parapet and 1.2 km of P4 parapet installed in the territory.

Group	Containment level	Usage
P1	To restrain vehicles up to 1.5 tonnes travelling at 113 kph and a 20° angle of incidence	On expressways and limited access roads
P2	To restrain vehicles up to 1.5 tonnes travelling at 80 kph and a 20° angle of incidence	On low speed roads
P4	To restrain vehicles up to 24 tonnes travelling at 50 kph and a 20° angle of incidence	At bridges over railways and other high risk locations

9.24 In the 1970s, parapets in Hong Kong were designed to meet the P1 standard following the requirements of the document 'BE5' published by the Department of Transport, United Kingdom (UK). A three-rail steel parapet (called the 1<sup>st</sup> generation) was adopted as the design (**Figure 9.2**). This type of parapet is light and attracts less wind load. It is designed to absorb part of the impact energy through deflection of the parapet components so that vehicles rebound back at a smaller angle and a relatively lower speed.



Figure 9.2 – First generation P1 three-rail steel parapet



9.25 In 1975, a three-rail aluminium P1 parapet was introduced (**Figure 9.3**). The performance of this type of parapet is basically the same as its steel counterpart. However, the maintenance cost of aluminium is lower as it does not rust. The material is also lighter and can be moulded into more aesthetically pleasing designs.



Figure 9.3 – First generation P1 3-rail aluminium parapet

9.26 In 1981, HyD developed a concrete P1 parapet with a metal top rail (**Figure 9.4**). The ultimate containment capability is slightly higher, but the operation mode is different. An errant vehicle is lifted up by the profile of the parapet to dissipate a portion of the impact energy before being redirected back to the carriageway.



Figure 9.4 – Concrete P1 parapet with a metal railing

9.27 This type of parapet suffers less damage on impact, is easy to maintain, and has the advantage of preventing debris and splash from reaching the area beneath the elevated structure. However, this type of parapet absorbs less impact energy. Vehicles tend to rebound at a larger angle and a higher speed. There is also the risk of a vehicle overturning or overriding the parapet.

9.28 In 1979, Hong Kong considered it necessary to introduce a higher containment level for railway overpass parapets. The parapets were designed to contain a 24 tonne concrete mixer truck at 50 kph with an impact angle of no less than 20°. A fully loaded concrete mixer truck was the most common heavy vehicle at the time. This containment level was subsequently included in the SDM as the design requirement for the P4 Group parapet. A standard concrete design has been developed as shown in **Figure 9.5**.



Figure 9.5 – High containment P4 concrete parapet

9.29 Apart from the standard parapet designs, the Panel notes new parapet designs have been developed to meet special needs for individual projects. These designs may each offer a slightly different containment level.

9.30 For example, a special type of P4 was developed for the Tsing Ma Bridge, Kap Shui Mun Bridge and Ting Kau Bridge. This type of parapet consists of five high tension steel strands anchored on strong metal posts (**Figure 9.6**). It has the advantage of attracting minimal wind loads, is light, and is particularly suitable for long span bridges. However, they can only be applied on straight spans and cannot be applied over bridge expansion joints.



Figure 9.6 – Tensioned Steel-strand P4 parapet of the Tsing Ma Bridge

9.31 For the Ting Kau Bridge approaches, due to the relatively tight radius involved, and to maintain a gradual transition with the P4 parapet on the bridge, another special design was adopted (**Figure 9.7**). Two top rails instead of one on a concrete base have been used.



Figure 9.7 – Ting Kau viaduct

9.32 Between 1999 and 2000, HyD continued to refine the design of the P1 parapet. A new generation of the three-rail P1 parapet was developed. Major modifications consisted of re-orienting the top rail, strengthening the post-to-rail and post-to-base plate connections, and bolting the splicing between the rails. Example of a modified P1 steel parapet is shown in **Figure 9.8**, and an aluminium one in **Figure 9.9**.



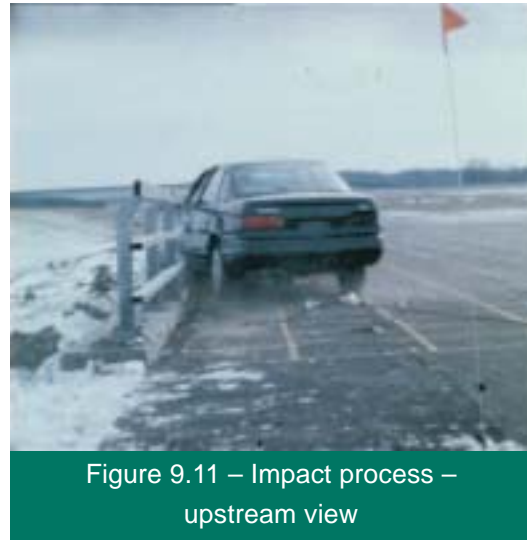
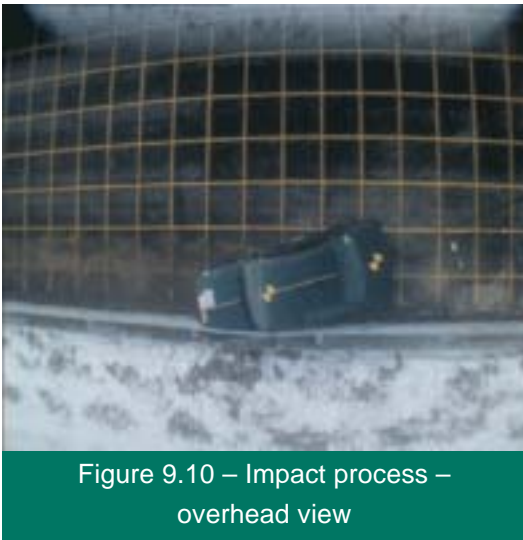
Figure 9.8 – Modified P1 steel parapet

Figure 9.9 – Modified P1 aluminium parapet



### Computer simulations for P1 parapet

9.33 To verify the field performance of the parapet designs adopted in Hong Kong, HyD commissioned a consultancy in August 2000 to assess the performance of the two generations of P1 parapet using computer simulation technique. The computer model was calibrated using full-scale field tests conducted in a testing laboratory in the USA (**Figures 9.10 and 9.11**).



9.34 The study covered the following five types of P1 vehicular parapets –

- ❑ three-rail steel vehicular parapet (1<sup>st</sup> generation);
- ❑ three-rail aluminium vehicular parapet (1<sup>st</sup> generation);
- ❑ concrete vehicular parapet with aluminium top rail;
- ❑ three-rail steel vehicular parapet (2<sup>nd</sup> generation); and
- ❑ three-rail aluminium vehicular parapet (2<sup>nd</sup> generation).

9.35 The test found that all five types of P1 vehicle parapet met the designed level of containment as required by the SDM. The computer simulation showed that the 2<sup>nd</sup> generation three-rail P1 parapet had a higher containment capability than the 1<sup>st</sup> generation. The 2<sup>nd</sup> generation three-rail P1 was capable of arresting a 1.5 tonne errant vehicle at 113 kph but at a higher impact angle of 40°.

9.36 HyD then proceeded to schedule replacement of all 1<sup>st</sup> generation three-rail P1 parapet in Hong Kong. Of 90 km of the 1<sup>st</sup> generation three-rail P1 parapet in Hong Kong, about 42 km have been replaced.

9.37 **The Panel recommends that the replacement programme be expedited, taking into account other recommendations in this report.**

### Computer simulation for bus collision

9.38 As a double-decked bus was involved in the incident, the Panel has made some effort, but was unable to obtain any documented technical information in Hong Kong or abroad, on the containment capability of common parapet types in respect of a double-decked bus collision. On request of the Panel, HyD conducted computer simulations during the period of this review to determine the crashing capacities of P1 parapets for different scenarios of bus impact. The preliminary results show that the P1 parapets are capable of retaining a double-decked bus striking at a low angle of incidence.

Parapet	Angle of Impact	Speed	Simulation Case Result
1 <sup>st</sup> Generation P1 Steel Parapet	10°	50 kph	double-decked bus retained
2 <sup>nd</sup> Generation P1 Steel Parapet	10°	60 kph	double-decked bus retained
Concrete P1 Parapet with Top Rail	20°	50 kph	double-decked bus retained

9.39 **The Panel recommends HyD to conduct further computer simulations to establish the ultimate capacity of all P1 vehicle parapets relating to an impact by a double-decked bus. In view of the particular situation in Hong Kong where double-decked buses are used on almost every part of the road network, the Panel further recommends that when new parapet designs are developed, double-decked bus should be included as one type of heavy vehicle for design consideration.**

## INTERNATIONAL STANDARDS

9.40 Owing to limited research activities in Hong Kong, and the lack of testing facilities, the Panel notes that HyD’s work in parapet design relied heavily on international standards, in particular the British Standard BS6779 (Highway Parapets for Bridges and Other Structures), based on which the current SDM was developed. The Panel notes that the European Standard – EN1317 (Road Restraint Systems), which is being developed, would ultimately replace BS6779. The design approach adopted in Report 350 of the National Cooperative Highway Research Programme (Recommended Procedures for the Safety Performance Evaluation of Highway Features) of the USA is very similar to EN1317. The Panel has therefore made a detailed examination of these standards to identify rooms for improvement in the design process in Hong Kong.

### British Standard BS 6779

9.41 Three levels of containment are specified for metal parapets in BS6779 with the following minimum parapet height and vehicle impact characteristics –

Level of containment	Minimum height of parapet (m)	Vehicle Mass (kg)	Height of CG (mm)	Angle of impact	Speed (kph)
Normal	1.0	1 500	480 to 580	20°	113
Low	1.0	1 500	480 to 580	20°	80
High	1.5	30 000	1 650	20°	64

9.42 The standard sets out guidance on the choice of level of containment. For instance, the ‘low’ level of containment is used in urban situations where speed restrictions up to 80 kph apply.

9.43 The 'high' level containment was introduced in the early 1980s, largely as a requirement of British Rail for certain railway lines, where a vehicle falling onto a track would almost certainly result in multi-casualty accident. However, high containment parapets are necessarily strong and hence less yielding. This means they are likely to cause additional damage to light vehicles that strike them and may result in vehicles being deflected at a greater angle than desirable, thereby increasing the risk of injury and secondary accident. It is therefore stated in the standard that the use of 'high' level containment should be largely restricted to cases such as bridges over railways.

### European Standard EN 1317

9.44 EN 1317 contains five parts altogether and is still being developed. Currently, only three parts are available. This standard is set to replace the corresponding British Standard.

9.45 EN1317 is more sophisticated and comprehensive than BS6779. For vehicular parapets, in addition to containment capacity, the standard also includes requirements on vehicle deformation, parapet deflection and occupant risk. Occupant risk is expressed in terms of impact severity level, which is determined by the total acceleration and deceleration experienced by vehicle occupants during impact with the parapet.

9.46 For parapet design, the major differences between BS6779 and EN1317 are that –

- ❑ the containment level specification is more refined in EN1317;
- ❑ impact tests are required for both heavy and light vehicles in most cases for any particular design in EN1317; and
- ❑ the coverage of the impact test report in EN1317 is more comprehensive than BS6779, in particular on impact severity.

9.47 EN 1317 has taken a slightly different approach in defining containment level. Four containment levels are defined. Each containment level consists of a number of sub-levels. Each sub-level represents an impact scenario equivalent to a test level.

9.48 Instead of the two types of vehicle specified in BS 6779, eight types of vehicles of mass ranging from 900 kg to 38 000 kg (that is, car, rigid heavy goods vehicle, bus and articulated heavy goods vehicles of different sizes) are specified for acceptance testing. A set of 11 different tests is specified. The tests differ in terms of the impact speed (65 kph to 110 kph), impact angle ( $8^\circ$  to  $20^\circ$ ), weight and type of vehicles.

9.49 The extent to which a parapet is deformed on impact is characterised by the dynamic deflection and the working width. The working width is the distance between the parapet face on the traffic side before impact and the maximum dynamic lateral position of any major part of the parapet (Figure 9.12). The dynamic deflection and the working width can be used to define the conditions under which the parapet can be installed and the distance to be provided in front of obstacles.

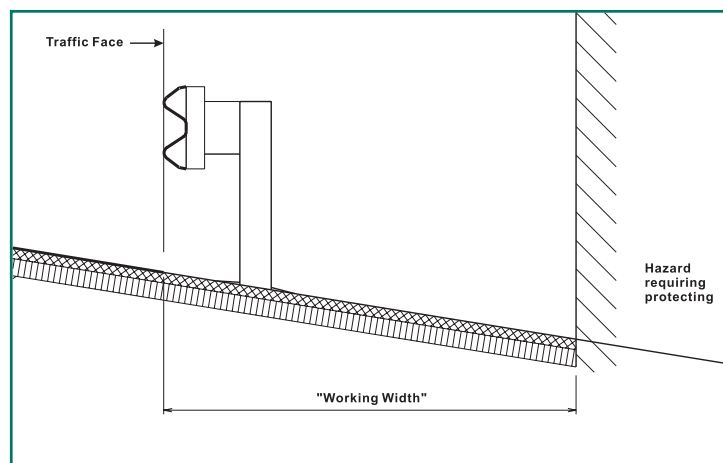


Figure 9.12 – Illustration of the concept of working width

9.50 Except for parapets specifically designed to contain light vehicles, the evaluation of containment levels will require the carrying out of two tests, one based on a heavier vehicle, and another using a lighter vehicle. This will ensure that while the heavy vehicle is contained (without excessively deforming the parapet), the light vehicle is not excessively damaged (or causes injury to the occupant).



### Report 350

9.51 In Report 350, six test levels for different applications are specified. Test level '1' is the lowest and '6' the highest. The higher the test level, the more it applies to a road carrying a larger number of heavy vehicles.

9.52 For these tests, six types of vehicles ranging from 700 kg to 36 000 kg are specified for impact testing (the vehicle types range from car, pickup truck, van truck, tractor with van trailer or tanker trailer). For each test level, three to four tests are specified. Each test is based on a different size of a particular test vehicle impacting on the parapet at a certain speed (50 kph to 100 kph), and a certain angle (15° to 25°). The test criteria include the three major aspects of structural adequacy, occupant risk, and vehicle trajectory. The objective of all tests is generally to ensure that heavy vehicles are contained and damages to light vehicles are acceptable. In other words, the parapet design is expected to perform for both heavy and light vehicles.

9.53 Parapet design is evaluated using the dynamic performance criteria on the basis of real impact tests.

### Application of international standards to Hong Kong

9.54 The Panel notes that, when compared with EN1317 and Report 350, the current SDM, which is based on BS 6779, is more restrictive in terms of the coverage of containment levels specified in the standard.

9.55 The Panel accepts that design standards are never static, but are constantly evolving based on local experience and sentiment, tradition, practice, technological level and economy of a particular country, or by borrowing from experience from other countries. What may be suitable for one country may not be entirely suitable for another. **The Panel considers that adoption of standards from other countries should be done judiciously.**

9.56 The Panel notes that HyD has constantly kept abreast of the latest international design standards, particularly in advanced countries and regions. **The Panel accepts that the British Standard is still the mainstay for historical reasons, but expects HyD to adopt new unified standards where possible, besides evolving its own standards in new works and major renovations.**

9.57 The Panel recommends that as the UK is also transiting from BS6779 to EN1317, HyD should follow closely the development of EN1317 and other international standards, and bring the SDM in line with the new internationally recognised standards in due course.

### Development of new designs

9.58 Having examined the local and international standards, the Panel notes that there are very limited design choices for vehicular parapets in particular for the P4 high containment level. The standard P4 concrete wall configuration, though capable of containing double-decked buses, is not suitable for many forms of bridge design.

9.59 The Panel also notes that foreign standards do not make reference to double-decked bus. The extensive use of double-decked buses is a distinct feature of Hong Kong's transport system, but the containment capacity of the various types of parapets for this type of vehicle has not been fully evaluated.

9.60 The maximum legislated weight for a vehicle in Hong Kong is 44 tonnes. **The Panel considers that there is a need to review whether a higher containment level than P4 should be introduced for a certain combination of topographic and traffic conditions.**

9.61 There is at present a technical dilemma in preparing a parapet design that can satisfy different containment levels at the same time. However, as technology develops, provisions have been made in more recent international standards, in particular in EN1317, for parapets to be designed to meet more than one containment level. This is to ensure that parapet designs will perform within acceptable limits for selected categories of heavy and light vehicles.

9.62 The Panel recommends that HyD expand the range of containment levels, in particular at the high end, having due regard to the extensive use of double-decked buses in Hong Kong, and the maximum legislated vehicle weight permitted on the road system. The Panel also recommends that HyD continue to monitor the development of multiple containment parapet in the international scene, and develop workable parapet designs for the Hong Kong situation.

9.63 The Panel is pleased to note that HyD has already taken forward this recommendation at the time of preparing this report. In line with the Panel's recommendation, a comprehensive review of the design requirements for vehicular parapets will be carried out jointly with the Transport Department.

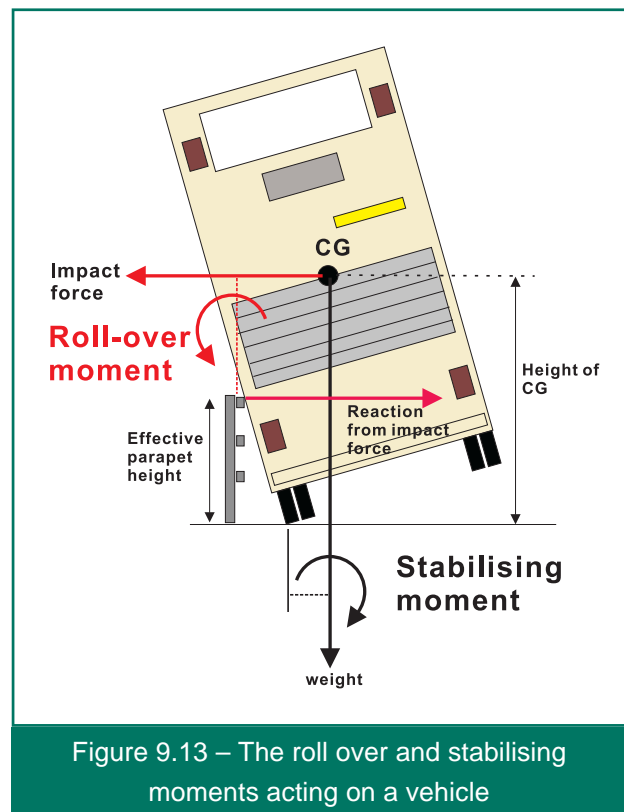
## PARAPET HEIGHT

9.64 After the incident, there was public concern that parapets in Hong Kong are not high enough. A parapet may be strong enough to prevent penetration by a vehicle, but unless it is also high enough, an impacting vehicle or its cargo hitting a parapet may roll over the railing. The Panel has therefore examined the mechanism behind roll-over scenarios using a simple static approach.

9.65 The following table shows the parapet height currently specified in the HyD Standard Drawings for parapet group P1, P2 and P4 –

Group	Application	Height (mm)
P1	Normal vehicular parapets	1 100
P2	Normal vehicular parapets	1 100
P4	High containment vehicular parapets for railway overpasses and other high risk situations	1 500

9.66 The likelihood of a vehicle rolling over a parapet of a given height may be estimated using a simple static method by balancing the roll-over moment against the stabilising moment (**Figure 9.13**). The roll-over moment is the product of the 'lateral impact force exerted by the vehicle onto the parapet' and the 'difference in height between the vehicle CG and the effective parapet height'. The balancing moment is the product of the 'vehicle weight' and 'half the width of the vehicle'.



9.67 A double-decked bus has a large stabilising moment due to its typical weight, passenger loading and vehicle width. To roll over the parapet, the roll-over moment must be larger than this stabilising moment.

9.68 In a study conducted by HyD on a 1.1 m high post and rail type parapet, the roll-over moment during impact is envisaged to be much smaller than the stabilising moment. This is because the deflection of the parapet components and the deformation of the bus will lessen the impact force, and the corresponding roll-over moment.

9.69 Computer simulations on existing P1 parapets so far show that a 1.1 m parapet would be adequate to prevent a double-decked bus travelling at 50 km/h from rolling over if the impact angle is small.

9.70 Based on this analysis, the Panel does not at this stage consider a 2 m high parapet, as suggested by some members of the public, is necessary for the safety of double-decked buses.

9.71 **The Panel recommends that HyD generate more simulation results involving other impact scenarios in order to fully evaluate the adequacy of the standard height adopted for the P1 parapets.**

## SELECTION CRITERIA

9.72 International standards do not normally provide guidelines to determine where a safety feature, satisfying a given test level and with specific performance characteristics, would have applications. That decision rests with the highway agency responsible for the implementation of the safety feature.

9.73 The Panel agrees with Report 350 on its recommendation that highway agencies should develop objective guidelines for the choice of safety features and the appropriate test levels, taking into account factors such as traffic conditions, traffic volume and heavy vehicle composition, site characteristics, the consequence of vehicle penetration and the cost effectiveness of other safety alternatives.

9.74 The current guidance provided in the SDM is relatively crude. A P1 parapet is suitable for general application, while a P4 parapet is used for bridges over railways and high risk locations. There is limited guidance as to what constitutes high risk. Professional experience is relied upon when deciding whether a new design has to be developed for certain site specific conditions.

9.75 **The Panel recommends that, in anticipation of an expansion of the parapet hierarchy, and the possibility of introducing more height variations, detailed guidelines and analysis procedures be given to designers on the choice of containment level and parapet height with particular attention to the congested environment in Hong Kong and the unique situation of having a large fleet of double-decked buses operating on the road network.**

## DESIGN REQUIREMENTS FOR PARAPET COMPONENTS AND CONNECTION DETAILS

9.76 Chapter 15 of the SDM specifies the design requirements of metal parapets. It incorporates by reference the requirements from BS 6779, and qualifies by stating that ‘where Hong Kong specifications or conditions differ from the requirements or conditions described in the British Standards, adjustments appropriate to Hong Kong shall be made’.

9.77 For reinforced concrete parapets, a separate standard in the form of a table is set out in the SDM specifying the required strength.

## MATERIALS AND WORKMANSHIP

9.78 BS 6779 specified in great detail quality control requirements. It contains strict specifications on workmanship control particularly on metals. Reference is made to other relevant British Standards for quality control on steel and aluminium alloys. Welding and testing requirements including non-destructive testing are also clearly specified.

9.79 Part 3, Section 20 of the General Specification for Civil Engineering Works (GS) published by the then Hong Kong Government in 1992 covers the material standard for ‘Vehicular Parapets’.

9.80 The GS specifically provides that steel for vehicular parapets, including welding, should comply with the requirements of Section 18 on structural steelwork, but testing requirements are exempted.

9.81 The Panel understands that such an exemption does not mean the steelwork will not be tested. Particular specification on testing requirements may be included by the designer of individual construction contracts.

9.82 **Taking into account the structural significance of the parapet, the Panel recommends that the GS be revised to include suitable testing requirements for fabricating the steel components used in vehicular parapets.**

9.83 For aluminium, reference is made in the GS to other British Standards for welding and testing requirements.

## NEW MATERIALS AND RESEARCH OPPORTUNITIES

9.84 The Panel has received public suggestions on new parapet designs and materials. A design by the University of Wisconsin involves a parapet made of reinforced glass fibre shaped into multiple rectangular sections in different sizes. Research work has indicated that the design is suitable for restraining both large and small vehicles. Other designs suggested include the use of rubber tubes containing rice husks and wood bran. A student has also made an innovative suggestion of using magnetic parapets.

9.85 The Panel does not rule out the potential of any particular design but notes that research work to properly evaluate the feasibility and effectiveness will be required. The Panel understands that HyD is also following closely the technological developments in the international scene, and is prepared to introduce new designs into Hong Kong for trial if they can be adapted to local conditions.

9.86 **The Panel recommends that HyD could carry out some research work in collaboration with local tertiary institutions.**

9.87 There is a suggestion to enclose a section of Tuen Mun Road with steel nets. The Panel has reservations about the technical viability of such a proposal, in particular the feasibility of such a retrofitting programme.

### IN-SERVICE EVALUATION

9.88 The Panel notes that vehicular parapets are designed and tested to selected containment levels. However, testing cannot duplicate every roadside condition or vehicle impact situation. The evaluation process should not therefore stop with successful completion of crash tests.

9.89 **The Panel recommends that HyD carry out in-service evaluation of the parapet designs on the basis of the damage information collected after traffic accidents so that various types of parapet design can be refined and improved on an on-going basis.**

### HIGH PRIORITY LOCATIONS FOR IMPROVEMENT

#### Collision statistics

9.90 In conjunction with the HyD, the Panel conducted a desk-top study on traffic accident records in the past five years in which a vehicle ran into a vehicular parapet or a roadside safety barrier. Of the 2 000 cases identified, it was found that 94.3% involved light vehicles, 4.4% involved medium and heavy goods vehicles and 1.3% involved buses.

9.91 The records indicated that most of the errant vehicles were successfully retained by the vehicular parapets. Of all the recorded accidents, only four involved vehicles penetrating or rolling over a vehicular parapet.



9.92 Having examined the issues relating to parapet designs in great details and past collision statistics, the Panel considers that the existing standards adopted by the HyD for parapet design are generally in line with international practices. Taking into account the standards adopted for road design, and the measures in place to control various types of vehicles and drivers, the Panel is of the view that the various types of P1 parapet are suitable for general application and on elevated structures in terms of containment capacity and height protection. However, in view of the July incident, and the limited knowledge about bus collisions, **the Panel considers that there is room for enhancement at critical locations where penetration of the vehicular parapet would result in catastrophic consequences. A proper risk assessment procedure should be developed for such situations.**

### Priority locations for road safety enhancement

9.93 Before a systematic procedure is fully developed for the selection of containment level and the assessment of parapet height, the Panel worked closely with HyD to identify a list of high priority locations having similar characteristics as the incident site where road safety enhancement, including where appropriate higher containment parapets, would have a significant effect in reducing the severity of an accident.

9.94 The July incident spot is identified as having the following characteristics –

- ❑ high posted speed limit;
- ❑ high traffic volume;
- ❑ high bus usage;
- ❑ high percentage of commercial vehicles;
- ❑ located near expressway entrance with weaving traffic;
- ❑ high level above ground; and
- ❑ having residents underneath the road structure.

9.95 A scoring system was then developed to rank bridges and elevated road sections against the above characteristics. Based on results made in the analysis, a preliminary list of road sections has been drawn up for which consideration should be given to providing some road safety enhancement work.

Item No.	District	Location
1	NT	Tuen Mun Road (7 locations)
2	NT	Tolo Highway (4 locations)
3	NT	Tsuen Wan Road (3 locations)
4	NT	Sha Tin Road (3 locations)
5	NT	Shing Mun Tunnel Road (3 locations)
6	NT	Tseung Kwan O Tunnel Road (2 locations)
7	NT	Yuen Long Highway (3 locations)
8	NT	Cheung Tsing Highway (3 locations)
9	NT	Lion Rock Tunnel Road, section between Kak Tin and Fung Shing Court
10	NT	North Lantau Highway (2 locations)
11	K	Ching Cheung Road (2 locations)
12	K	Kwun Tong Bypass, slip road connecting Lei Yue Mun Road
13	K	Kwai Chung Road, section fronting Mei Foo Shun Chuen
14	K	Lung Cheung Road near Tai Wo Ping Interchange
15	HK	Shek Pai Wan Road (2 locations)
16	HK	Island Eastern Corridor, section between Victoria Park Road and Healthy Street West

9.96 The Panel considers that the incident on 10 July was a rare occurrence, the cause of which has yet to be established. Neither the incident site nor the list of road sections identified in paragraph 9.97 above are accident black spots. In considering measures that could enhance safety, expert world-wide will ask : does it make economic sense or is it appropriate to spend large sums to prevent accidents of very low probability (albeit entailing severe consequences), or is it better to spend resources on a package of known measures by which more lives could be saved and injuries prevented in general?

9.97 The Panel advocates a total safety management approach. A risk assessment should be conducted when road safety enhancement schemes are formulated. Strengthening the parapets is but one enhancement measure. It would not be the only measure and may not be the most cost effective option. In certain cases, a good traffic management scheme to accommodate driver behaviour may be more effective.

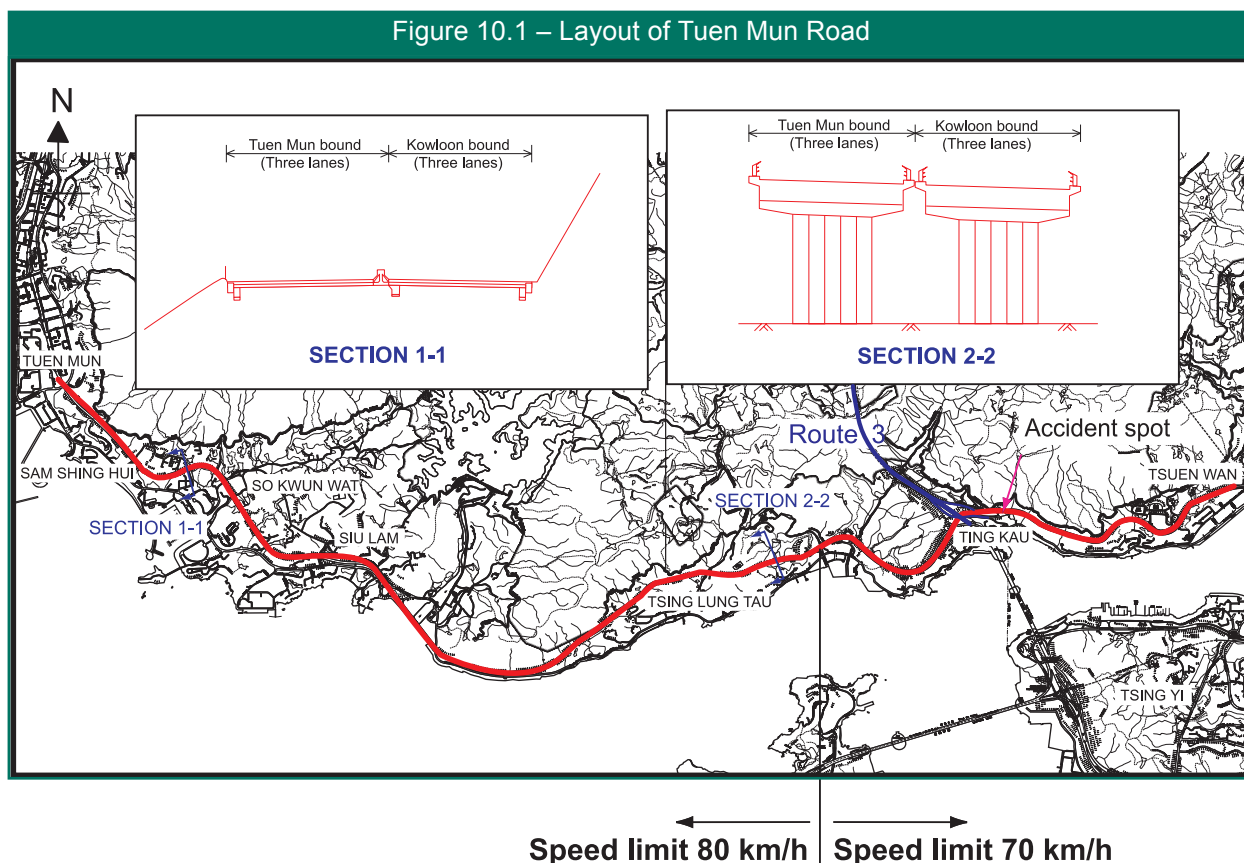
9.98 **The Panel recommends that a detailed study be conducted immediately to formulate a package of road safety enhancement measures for these road sections.**

## Chapter 10

# Tuen Mun Road

### INTRODUCTION

10.1 Tuen Mun Road was designed during the period between the late 1960's and the early 1970's as a high capacity dual three-lane carriageway connecting Tsuen Wan with Tuen Mun. Construction of the 15 km long carriageway commenced in 1974 and was completed in 1983. Since completion, a number of improvement works have been carried out to enhance the road to meet the growing needs. A general layout of the Tuen Mun Road, from south of Tuen Mun Town (Wong Chu Road) to Tsuen Wan Road, is shown in **Figure 10.1**.



10.2 The section of Tuen Mun Road where the July incident occurred was widened in the mid 1990's to accommodate the slip road leading to the Tai Lam Tunnel approach road of the Tsing Long Highway. The Panel notes that the location of the July incident is not an accident blackspot. Prior to the July incident, there was no history of any fatal or major traffic accident at this location.

10.3 In order to assess the safety performance of Tuen Mun Road, the Panel has reviewed the accident statistics of the road for the past ten years (1993 - 2002). The Panel then examined in depth the traffic engineering standards adopted and management measures implemented along Tuen Mun Road. The Panel has also studied carefully public suggestions to enhance the safety of Tuen Mun Road. Where appropriate, the Panel has made recommendations for further improvements on the basis of these suggestions. Parapet design and the Tuen Mun Road reconstruction and improvement project are two other important subjects covered in this chapter.

### ACCIDENT STATISTICS

10.4 Accident statistics provide a direct measure of the safety performance of a road transport system. The Panel has studied in detail the accident rates of Tuen Mun Road in the past ten years (1993 - 2002) and compared the rates with those of other roads in Hong Kong.

10.5 The traffic accident trends on Tuen Mun Road by severity in the past ten years have been analysed. During this period, accident rates in terms of *accidents per million vehicle-kilometre* were on a downward trend with rates dropping about 26%, from 0.53 to 0.39. The number of fatal accidents has also been falling over the past ten years.

## Comparison of accident rates with other expressways and all roads

10.6 In order to assess the relative safety performance of Tuen Mun Road, the Panel has compared the *number of accidents* and the accident rate *per million vehicle-kilometre* of Tuen Mun Road and other expressways in Hong Kong. The Panel notes that Tuen Mun Road had the highest number of traffic accidents in the past ten years. However, using a more encompassing rate measured in terms of *number of accidents per million vehicle-kilometre*, the performance of Tuen Mun Road is better than the overall average<sup>1</sup>, and is on par with other expressways including those more recently built to the current standards (e.g. Western Kowloon Expressway, Cheung Tsing Highway etc).

## Comparison of vehicle involvement rates

10.7 The Panel analysed the vehicle types involved in the traffic accidents and their severity in the past three years (2000 - 2003) in order to ascertain whether a particular vehicle type was more prone to an accident on Tuen Mun Road.

10.8 The Panel examined the accident involvements and involvement rates per million vehicle-kilometre of major vehicle types for Tuen Mun Road, for all expressways and for all roads. In general, the involvement rates of heavy vehicles such as public buses and medium and heavy goods vehicles were lower than those of light vehicles such as private cars, taxis and motorcycles. This was also the case on Tuen Mun Road.

10.9 The Panel reviewed the trends of fatal accidents involving different vehicle types along Tuen Mun Road and other expressways in the past three years. For Tuen Mun Road and all expressways, the majority of fatal accidents involved private cars and light goods vehicles. Also, the fatal accident involvement rates for heavy vehicles on Tuen Mun Road were generally lower than those on all roads.

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<sup>1</sup> In 2002, Tuen Mun Road had a rate of 0.39 accidents per million vehicle-kilometre, whereas the range for all expressways was between 0.18 and 0.70. For all roads, the average accident rate was 1.35.

### Tuen Mun Road on par with other expressways

10.10 Having examined the past accident statistics, the Panel considers that Tuen Mun Road is intrinsically safe as is evidenced by its accident rates, which are about average for all expressways, including those more recently built to current design standards. Notwithstanding the high proportion of heavy vehicles using Tuen Mun Road, there is no evidence to indicate that heavy vehicles are more prone to accidents along Tuen Mun Road. The Panel notes that the overall number of traffic accidents on Tuen Mun Road remains at around 250 per year despite increases in the annual traffic throughput. **Nonetheless, the Panel considers that there is always room for improvement.**

### Major contributory factors of traffic accidents

10.11 The Panel has analysed the contributory factors of traffic accidents along Tuen Mun Road with respect to other roads in Hong Kong. The following major factors have been identified –

- ❑ driving too close to vehicle in front;
- ❑ careless lane changing; and
- ❑ loss of vehicle control.

10.12 All of the above factors are driver related. This finding is consistent with the general observation of major factors contributing to traffic accidents in Hong Kong, as discussed in Chapter 5. The Panel considers that to achieve a noticeable reduction in the number of accidents on Tuen Mun Road, enforcement action against these specific behaviours should be strengthened.

10.13 Loss of vehicle control is often associated with driving at an inappropriate speed. The Panel notes that 16 speed enforcement cameras (SEC) sites had been earmarked for installation at different locations along Tuen Mun Road. 14 have already been installed, with installation work on the remaining two scheduled for completion by the end of 2003.

10.14 The Panel recommends that the Transport Department (TD) and the Hong Kong Police Force (HKPF) expedite all necessary preparatory work so that the SEC system on Tuen Mun Road can be fully operational as soon as possible. The Panel further recommends that once the SEC system is operating, HKPF deploy more resources to patrolling, with particular emphasis on tailgating and careless lane changing.

## DESIGN STANDARDS

### Speed

10.15 The Panel has reviewed the appropriateness of the present speed limits along Tuen Mun Road, with focus given to the section of Tuen Mun Road where the July incident occurred. The current speed limit posted for this section of the Tuen Mun Road is 70 km/h.

10.16 The Panel notes that in 1991 and 1998, TD conducted two comprehensive reviews of the speed limits for Tuen Mun Road with a view to rationalising the speed limit for the whole expressway. The review in 1991 initially suggested raising the speed limit for the eastern half of Tuen Mun Road (between Tsuen Wan and west of Sham Tseng) from 70 km/h to 80 km/h. However, it was decided that the speed limit of 70 km/h was appropriate and should be maintained for this part of Tuen Mun Road. The decision was based on observed vehicle speed under free-flow conditions. Furthermore, there was concern that raising the speed limit might potentially increase the number of accidents. The subsequent review in 1998 recommended retaining the speed limit of 70 km/h for this part of Tuen Mun Road for the same reasons while increasing the speed limit for the western half from 70 km/h to 80 km/h.

10.17 In light of the July incident, the Panel has requested TD to carry out a check on whether the horizontal curves are adequate for the posted speed limits along the whole length of Tuen Mun Road. The Panel is satisfied that there is an adequate safety margin under the present speed limit.



10.18 There has been a suggestion from the public to reduce the speed limit for Tuen Mun Road to 50 km/h for heavy vehicles and 60 km/h for other vehicles to deter speeding. The Panel notes that the speed limit for Tuen Mun Road is subject to regular review and understands that setting an unrealistically low speed limit for a road, which is capable of accommodating higher vehicle speeds, would only result in serious and frequent violations by motorists and cause unmanageable enforcement problems.

### Geometric standards of Tuen Mun Road

10.19 As the speed limits posted for the eastern and western halves of Tuen Mun Road are 70 km/h and 80 km/h respectively, the Panel has focused on the highway design standards applicable to this range of speed and compared them with the current standards in Hong Kong.

10.20 Fundamental design principles and a comparison of design standards adopted by Hong Kong and overseas countries are discussed in Chapter 7. Key highway design elements of the current Hong Kong standards and Tuen Mun Road are tabulated in **Figure 10.2** on the next page for comparison.

10.21 The Panel notes that a small proportion of the total length of Tuen Mun Road falls outside the desirable values of the current standards as a result of the topography of the route. Those sections are not accident black spots.

10.22 The Panel recognises that the standards of highway design throughout the world, including Hong Kong, are gradually being raised beyond required safety margins to provide a higher level of comfort in addition to safety. Non-compliance with certain aspects of the latest design standard does not automatically infer a safety problem. The Panel considers that the marginally lower standards of Tuen Mun Road at a few locations, due to changes in standards over time, mainly affect the comfort of motorists but not their safety. The issue of designing for safety and comfort is discussed in greater depth in Chapter 7.

**Figure 10.2 – Comparison of key highway design elements between current standards and Tuen Mun Road**

	Major design elements	Current Hong Kong standard (desirable values) for design speeds		Tuen Mun Road <sup>2</sup>	Tuen Mun Road at the accident location
		70 km/h	80 km/h		
(a)	Minimum sight distance	120 m	145 m	90 m	250 m
(b)	Maximum gradient	4%	4%	8.8% <sup>3</sup>	1%
(c)	Minimum horizontal curve radius	250 m	320 m	150 m <sup>4</sup>	300 m
(d)	Maximum superelevation	7%	7%	10%	3.8%
(e)	Minimum carriageway width (for three-lane carriageway)	11 m	11 m	10.05 - 11 m <sup>5</sup>	10.4 m
(f)	Width of hard shoulder	3.3 m		1.5 - 3.3 m <sup>5</sup>	3.2 - 3.4 m
(g)	Taper gradient of diverging lane	1:15		1:10.5 to 1:110	1:22.5

<sup>2</sup> The speed limit is 70 km/h for the section of Tuen Mun Road between Tsuen Wan and Sham Tseng and 80 km/h for the section between Sham Tseng and Tuen Mun.

<sup>3</sup> The maximum gradient of 8.8% occurs at a descending section of about 200 m long near Tsuen Wan; the other section with a gradient of 8.5% occurs at a descending section of about 500 m long near Tsing Lung Tau; the rest of the road meets current standards.

<sup>4</sup> The minimum radius of curvature of 150 m occurs only at an approximately 200 m long section of the highway near Yau Kom Tau; the rest of the mainline meets the current standards.

<sup>5</sup> Part of the Kowloon-bound 3-lane carriageway was widened to 11.0 m between 1994 and 2001. The hard shoulder was also widened to 3.3 m.

10.23 The Panel also notes that the section of Tuen Mun Road at the accident location generally satisfies the current Hong Kong standards, with the exception of the 10.4 m carriageway width which is less than the required 11 m. However, the overall width of the road at the location of the incident spot is considerably more than 10.4 m due to the presence of a diverging lane.

10.24 The diverging lane where the accident occurred has a taper gradient of 1:22.5, which is better than the standard of 1:15.

## TRAFFIC MANAGEMENT MEASURES

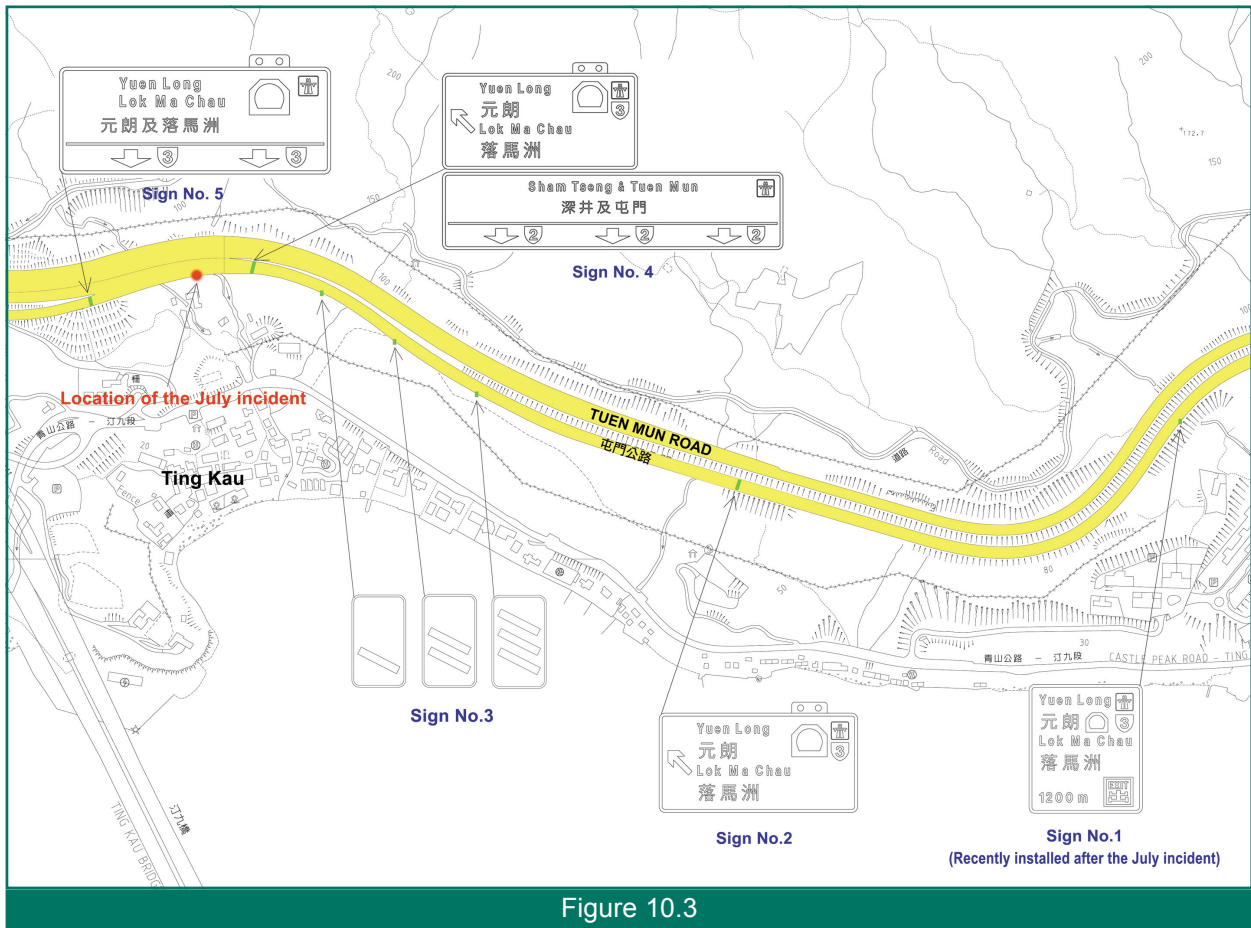
### Traffic signs

10.25 The Panel has examined the traffic signage along Tuen Mun Road. The Panel notes that a number of improvement works have been carried out along the road in the past decades. For example, TD implemented several traffic management improvement measures at nine individual sections/locations (near Sham Tseng, Pun Shan Tsuen, So Kwun Wat, Sham Tseng Interchange and Siu Lam) and lowered the past record of relatively high accident frequencies at these locations.

10.26 The Panel considers that the traffic signage along Tuen Mun Road is effective in general. Regulatory, warning and informative traffic signs along Tuen Mun Road are generally located correctly in relation to restrictions, hazards and other features to which they apply. The sizes of the signs are generally appropriate to the speed of vehicles using the road. The signs are clear of visual obstruction. Roadside directional signs and gantry signs are posted at an appropriate height.

10.27 At the accident location, typical direction signs, comprising an advance direction sign, a final advance direction sign and a direction sign, are provided to alert motorists of the diverging lane, which leads to the slip road connecting to the Tai Lam

Tunnel approach road. These signs are illustrated in **Figure 10.3** as **Sign Nos. 2, 4 and 5**. They are supplemented by a set of typical count-down markers (Sign No. 3). Photographs of these signs and markers are provided in **Figures 10.4 to 10.8** on next page correspondingly.



## Road markings

10.28 The Panel has also reviewed existing road markings along Tuen Mun Road and observed that lane lines, warning lines and bus lane lines in delineating traffic lanes are generally in order. Double white lines and hatched markings are provided at appropriate locations where special vehicle control is required and lane changing is prohibited. The warning chevrons, arrows, merging/diverging lane markings used in lane drops and merging/diverging points are also in order.



Figure 10.4 – Sign No. 1



Figure 10.5 – Sign No. 2



Figure 10.6 – Sign No. 3



Figure 10.7 – Sign No. 4



Figure 10.8 – Sign No. 5

## Enhancement measures

10.29 Although there is no intrinsic deficiency in the design of the section of Tuen Mun Road at the incident spot, there is always room for improvement. In line with the total safety management approach, the Panel considers it prudent to work closely with TD to draw up a package of enhancement measures specifically for this section of road, taking into account the recommendations made in those two studies on traffic signage and road markings outlined in Chapter 7.

10.30 **The Panel recommends the following package of enhancement measures be implemented –**

- ❑ **install a new advance information sign (AIS) 1 200 m before the final advance direction sign. The sign provides additional information to motorists of the exit at a distance of 1 200 m ahead;**
- ❑ **convert a 100 m section of lane line markings to warning line markings before the start of the diverging point to enhance the awareness that a diverging point is approaching;**
- ❑ **widen the edge line marking from 200 mm to 300 mm at the diverging point to enhance definition at that spot;**
- ❑ **align the advance direction sign (ADS) immediately over the inside lane to further alert motorists to keep left for the exit ahead to Yuen Long and Lok Ma Chau;**
- ❑ **install a ‘Get In Lane’ sign between the AIS and ADS to provide additional warning to motorists to change lanes where necessary; and**
- ❑ **install a crash cushion at the nosing between the main road and the slip road as a safety precaution.**

10.31 The Panel notes that the first recommendation to install an AIS has already been completed (see Sign No.1 of **Figure 10.3**). **Action is in hand to implement the other enhancement measures.**

## Use restrictions

10.32 Many submissions have been received from the public on traffic management measures for improving the safety of Tuen Mun Road. There are suggestions to restrict buses and heavy vehicles from using the slow lane along Tuen Mun Road. The Panel does not support the proposal because motorists, including drivers of heavy vehicles, are already accustomed to the well-established practice of driving on the nearside lane unless overtaking. It would be hard to translate this proposal into a workable and enforceable scheme. Its potential effect on the overall risk to bus users is also unclear. In addition, it would affect the operation of the existing bus lane designated on the nearside lane of the Kowloon-bound carriageway of Tuen Mun Road.

10.33 There have also been suggestions to ban buses and heavy vehicles, including container trucks, from Tuen Mun Road. The Panel does not support the proposal, as there is no evidence to show that these categories of vehicles are more prone to traffic accidents on Tuen Mun Road. In addition, banning these vehicles from Tuen Mun Road would have serious economic and social impacts on the northwest New Territories (NWNT). Tuen Mun Road, as part of Route 2, is a vital route linking urban areas to the NWNT as well as the Lok Ma Chau Crossing. Furthermore, any buses and heavy vehicles banned from using Tuen Mun Road would have to use other alternative routes. This would overload some of the road sections in the region, resulting in widespread traffic congestion and unnecessarily long travelling time, particularly during peak hours.

10.34 A suggestion has been received to divert heavy vehicles from Tuen Mun Road to Route 3 by renting some lanes from Route 3, or subsidising heavy vehicles to use them, or diverting buses to Castle Peak Road. The Panel considers that there is no need to divert heavy vehicles and buses from Tuen Mun Road to Route 3 on road safety grounds. Diversion measures should only be made for traffic management purposes. In this regard, Members note that TD has recently completed the Northwest New Territories Traffic and Infrastructure Review (the Review) which, as a first step, identifies the long-term transport needs of the NWNT and North Lantau areas. As part of the Review, TD is also looking into possible traffic

management measures and minor road improvements to improve the through traffic capacity of Tuen Mun Road in Tuen Mun Town Centre. The Panel also notes that the implementation timeframe and relative priorities of the various road proposals will need to be established in the next stage of the Review.

10.35 Another suggestion is to build an elevated by-pass along Castle Peak Road (i.e. double decking) to take buses running along Tuen Mun Road. The Panel does not support the proposal which is not a practical way to provide additional capacity for the Tuen Mun Road corridor. Moreover, there are serious physical and environmental constraints to building an elevated by-pass along Castle Peak Road.

10.36 There is a suggestion to prohibit lane changing along Tuen Mun Road to improve safety. The Panel considers the proposal not practical. Apart from the obvious need to change lanes at and near to intersections, Tuen Mun Road would be greatly under-utilised, resulting in widespread traffic congestion, especially during peak hours.

### PARAPET DESIGN

10.37 The Panel notes that the section of parapet (175 m long) at the incident spot has already been strengthened with additional posts. An additional line of safety barriers (164 m) has also been installed alongside the parapet. All other vehicular parapets along Tuen Mun Road have already been replaced with the 2<sup>nd</sup> generation P1 parapet.

10.38 The Panel is also advised by the Highways Department (HyD) that the department is reviewing all bridge sections along Tuen Mun Road, and is drawing up a priority list of locations with characteristics similar to those of the incident spot.

10.39 **The Panel recommends that the containment level of the parapet at the identified locations be reviewed and upgraded where necessary. Other enhancement measures including provision of additional traffic signs and road markings should be considered as a total package.**



## ROAD SAFETY REVIEW

10.40 The Panel notes that Tuen Mun Road has already been in service for more than twenty years. A number of major improvement works have been carried out on the road in the past years in accordance with prevailing design standards and guidelines. Small scale improvements have also been implemented as a result of previous accident investigations.

**10.41 The Panel recommends that a comprehensive road safety review be conducted for Tuen Mun Road, particularly from the drivers' perspective, to identify any possible safety enhancement measures. Improvement schemes which can be implemented within a short period should be drawn up as interim enhancement, while structural improvements will be covered by the Tuen Mun Road reconstruction and improvement project.**

10.42 The Panel considers that this recommendation will serve the same purpose as a road safety audit as suggested by individual professional institutes.

## RECONSTRUCTION AND IMPROVEMENT

### Construction programme

10.43 The Panel notes that the public is keen to see an early completion of the Tuen Mun Road reconstruction and improvement project. However, the project cannot start before the completion of the Castle Peak Road improvement project, which is required to provide a diversion route with adequate capacity in case of traffic accidents on Tuen Mun Road.

10.44 The Panel has worked closely with TD and HyD to identify opportunities for advancing the Tuen Mun Road reconstruction and improvement project. The Panel is pleased to note that through streamlining planning and design processes, work on the project can begin six months earlier in mid-2005 for completion in phases between mid-2009 and mid-2011 on the basis that three lanes in both

directions will have to be maintained during peak hours throughout the whole construction period.

10.45 As requested by the Panel, TD has reviewed the time window for lane closure and devised preliminary proposals to implement lane closures on Tuen Mun Road during daytime off-peak hours to facilitate reconstruction works. **The Panel has requested HyD to conduct another traffic impact assessment, taking into account relaxations on lane closure arrangements and the projected traffic condition of Tuen Mun Road, and to review the construction programme with a view to further shortening the construction period.**

### Highway design

10.46 In view of the July incident, the Panel recommends that the opportunity be taken to conduct a comprehensive review of the alignment design of the Tuen Mun Road reconstruction and improvement project to identify areas for further improvement to bring the entire length of Tuen Mun Road up to current expressway standards.

## Chapter 11

# Miscellaneous Issues

### Introduction

11.1 The Panel has addressed most of the improvement proposals suggested by the public in the previous chapters. Other proposed improvements which fall outside the scope of subjects discussed earlier or the Panel's scope of work are examined in the following paragraphs.

### Driver's health

11.2 In order to ensure that a driver is physically fit to drive, one suggestion is to impose regular check-ups on drivers. The Panel notes that illness only contributed to less than 1% of the traffic accidents over the past ten years and that motorists aged 70 or over are required to undergo annual medical checks before they are allowed to renew their driving licences. In addition, all franchised bus operators require their bus-drivers to undergo annual medical examination after they reach a certain age. Kowloon Motor Bus and Long Win Bus require their drivers of age 60 or above to undergo annual medical examination, while Citybus, New Lantao Bus and New World First Bus require their drivers to undergo annual medical examination after they reach the age of 50.

11.3 The Panel considers that the current requirements are working well, as reflected by the small number of traffic accidents caused by illness. There seems no strong grounds to extend the mandatory requirement of health examination to motorists below the age of 70.

11.4 Another suggestion is to stop issuing driving licences to drivers of age 60 or above to minimise the risk of traffic accidents. The Panel has reviewed the accident statistics in the past ten years and found that only about 4% of the traffic accidents involved drivers aged 60 or above. As there is no evidence indicating that drivers of age 60 or above are more prone to traffic accidents, Members do not support this proposal. The Panel also notes that the requirement of mandatory

medical checks for drivers of age 70 or above in Hong Kong is comparable with requirements in other developed countries. For instance, Singapore has recently raised the age at which drivers need to undergo medical examination from 60 to 65.

### **Safety of parapets and railings**

11.5 After the July incident, some members of the public have expressed concerns about the safety of parapets and railings along elevated road structures at certain locations such as Castle Peak Road, Island Eastern Corridor, Aldrich Bay Road (near Chun Fung Garden), an elevated road at Sham Shui Po and a flyover in Lam Tin etc. The Panel has relayed those public concerns to the Highways Department (HyD).

### **Road maintenance**

11.6 There are suggestions for more frequent road maintenance to ensure that road surface and road markings are in good condition, obstructions to sightline are cleared and anti-skid materials are applied on the road surface where required. The Panel welcomes those suggestions and has referred them to HyD for follow-up action.

### **Communication with the transport trade and driver associations**

11.7 There is a suggestion to improve the Government's communication with transport trade associations and to extend the membership of the Road Safety Council (RSC) to these associations. The Panel understands that the RSC's key function is to examine territory-wide road safety issues, and individuals from different sectors are appointed to the RSC. The Panel considers it appropriate to maintain the flexibility in the RSC's appointments, as the RSC's work does not focus on matters relating to a specific trade. The Panel also notes that there are at present regular conferences between TD and different transport trades (taxi, public light bus, public bus, goods vehicle) to facilitate communication.

### **‘Two-second’ rule**

11.8 A member of the public commented that it was difficult to comply with the ‘two-second’ rule during rush hours on Tuen Mun Road and Tolo Highway, especially under wet weather. The Panel notes that the ‘two-second’ rule is aimed to keep an adequate distance between travelling vehicles to minimise the risk of collision. In case of bad weather, the Road User’s Code recommends that the count should be doubled to four seconds or more.

### **Other suggestions**

11.9 There are a number of suggestions which are not related to highway safety nor fall within the Panel’s terms of reference, as follows –

- ❑ install noise barriers along Ching Cheung Road as part of the road widening works to minimise noise created by traffic;
- ❑ provide more toilets and relaxation areas along Tuen Mun Road;
- ❑ identify an alternative route for transportation of containers to reduce the number of container trucks using Tuen Mun Road;
- ❑ rectify the inappropriate use of land at So Kwun Wat where agricultural land is used for storage of containers; and
- ❑ provide better paramedic and ambulance services as well as trauma units in hospitals for victims of serious road accidents.

The Panel has referred the above suggestions to relevant departments.

## Chapter 12

# Summary of Recommendations

### INTRODUCTION

12.1 Road safety is determined by a dynamic interplay between road users, vehicles and the road environment. With the benefit of public views and inputs from relevant departments, the Panel has examined in considerable detail factors that affect these three elements, including design of parapets that serve as protective devices to reduce the consequences of accidents. The following is a summary of recommendations by the Panel on various aspects of road safety.

### DRIVING BEHAVIOUR

12.2 While road users, vehicles and road environment all have a bearing on road safety, the human factor is the most complex and dynamic. Accident trends and public views point to inappropriate driving behaviour as a major contributory factor of road accidents. The Panel considers that priority should be given to improving driving behaviour and attitude through public education and formal training.

#### **Sustainable publicity programme to improve driving behaviour**

12.3 The Panel considers it important to publicise the road safety messages widely in the transport trade. Members recognise that some forms of publicity, such as road safety seminars and meetings are mainly targetted at companies with large vehicle fleets and transport trade associations. They may not be able to reach self-employed or individual drivers with no affiliation to such associations. In light of this, the Transport Department (TD) should identify additional avenues to extend the coverage of publicity efforts to individual drivers. (*paragraph 5.19*)

12.4 Regarding the approach to publicity programmes, apart from condemning aggressive driving behaviour, consideration should be given to promoting good driving practices and fostering a considerate driving culture. (*paragraph 5.20*)

12.5 To ensure the continuity and sustainability of promotional efforts, the Hong Kong Police Force (HKPF), TD and the Road Safety Council (RSC) should consider formulating a longer term programme that extends beyond the normal annual cycle. In addition, collaboration with District Councils should be actively pursued to extend the reach of road safety campaigns. (*paragraph 5.14*)

12.6 An effective feedback mechanism is vital for devising appropriate promotional strategies for different target groups. In addition to measuring public awareness of its publicity programmes, the RSC should devise an evaluation methodology, which involves targetted surveys on the driving population, to assess the effectiveness of the programmes. Research in this area can be conducted in conjunction with local tertiary institutions. (*paragraph 5.16*)

### **Mandatory driving courses for repeat traffic offenders**

12.7 Except when directed by the court, motorists only take part in the Driver Improvement Scheme (DIS) on a voluntary basis. To improve the driving behaviour and attitude of repeat traffic offenders, the Government should explore the feasibility of requiring drivers who have accumulated a certain number of 'Driving Offence Points' to attend DIS on a mandatory basis. (*paragraph 5.24*)

### **Pre-service training for drivers of passenger services and commercial vehicles**

12.8 TD has recently proposed that all applicants for a taxi driving licence attend a mandatory pre-service training programme, which includes training on driving behaviour and attitude, before they can qualify for a taxi driving licence. TD should, in due course, review the effectiveness of this programme, and, in light of experience, consider extending the programme to drivers of public light buses and other professional drivers. (*paragraph 5.26*)

### **Skills Upgrading Scheme for passenger services transport trades**

12.9 The Vocational Training Council is developing a Skills Upgrading Scheme to provide comprehensive training for the drivers of taxis, public light buses and non-franchised buses. The Scheme will help improve driving attitude, knowledge of traffic rules and regulations as well as road safety concepts and skills for handling accidents and emergencies on the roads. TD should review the course content of the Skills Upgrading Scheme to ensure that sufficient emphasis is placed on promoting good driving practices, and recognition should be given to drivers who have completed the course to increase the incentive for enrolment. The Government should also explore, with relevant organisations, the development and introduction of a similar skills upgrading programme for drivers in the trucking industry. (*paragraph 5.28*)

### **Probationary driving licence for new private car and light goods vehicle drivers**

12.10 The rapid expansion of Hong Kong's expressway network has increased the need for field training on expressways. However, in view of the practical difficulties to include expressways as part of training and testing requirements, the Government should explore the feasibility of expanding the existing 'probationary driving licence' arrangement for motorcyclists to cover new private car and light goods vehicle drivers. The proposed arrangement would allow new drivers to obtain on-the-road practical experience, including expressway driving experience, during the 'probationary' period before being issued with a full driving licence. (*paragraph 5.30*)

### **Quality Driving Instructor Course**

12.11 There is a need to upgrade the skill level of driving instructors to match enhanced road safety measures in Hong Kong. TD should explore the feasibility of introducing a 'Quality Driving Instructor Course' to ensure that driving instructors have the proper knowledge and teaching skills to pass on good driving practices to their students. Recognition should also be given to driving instructors who have completed the course. (*paragraph 5.33*)



## LEGISLATION AND ENFORCEMENT

12.12 Comprehensive legislation and effective enforcement are essential to combat undesirable driving behaviour. The Panel has reviewed road safety related legislation and enforcement measures to identify areas for further improvement.

### Legislation

12.13 The Government has kept road safety related legislation under constant review. Legislative amendments concerning the imposition of fixed penalties for some common traffic offences and the creation of a new offence against tailgating are under deliberation. The Government should expedite preparations for these legislative changes. (*paragraphs 6.16 and 6.17*)

### Enforcement

12.14 Members consider that public education should be supplemented by enforcement as a deterrent. To maximise the impact on road users, HKPF should continue to devise enforcement programmes in tandem with the publicity plan mounted by the RSC. (*paragraph 6.23*)

12.15 The Speed Enforcement Camera (SEC) system is a proven effective tool to deter speeding and enhance road safety. Installation works for 75 locations for SECs are now underway. TD should work closely with HKPF, the Highways Department (HyD) and other relevant parties to put the SECs into operation by early 2004. Apart from the 75 locations on the existing road network, feasibility study should be conducted for expanding the SEC coverage to new strategic road network (SRN) routes, existing SRN routes which do not have such systems, as well as other routes with speeding problems. (*paragraphs 6.25 and 6.26*)

12.16 After the SECs have been put into operation, HKPF should deploy more resources for mobile enforcement and patrolling to monitor other undesirable driving behaviour that cannot be captured by SEC, e.g. abrupt lane changing and tailgating. (*paragraph 6.27*)

12.17 HKPF should continue to make good use of advanced technology and acquire additional equipment to facilitate traffic enforcement. (*paragraph 6.29*)

### **TRAFFIC ENGINEERING AND MANAGEMENT**

12.18 The Panel has examined in depth issues concerning traffic engineering and management that define the road environment and shape the behaviour of road users. As the July incident occurred on an expressway section of the Tuen Mun Road, Members have focused more on the design and traffic management issues concerning high speed roads.

#### **Highway design**

12.19 After examining local and international design standards, the Panel concludes that local standards are in line with international practices while taking into consideration topographical constraints in Hong Kong. Members point out that there is a need to differentiate between safety and comfort requirements in highway design standards. (*paragraph 7.2*)

#### **Speed management**

12.20 TD should continue to conduct regular reviews of speed limits and, if necessary, adjust the speed limits to optimise traffic flow without compromising road safety. (*paragraph 7.19*)

#### **Recent development of traffic signs and road markings in Hong Kong**

12.21 The Panel fully endorses the recommendations made in the 'Comprehensive Review of Directional Signing in Hong Kong' commissioned by TD in 2001 to improve the signing strategy and the provision, format and mounting of signs in Hong Kong. Rationalisation of the route numbering system and introduction

of exit numbers on the SRN is already underway and will be completed in early 2004. Other recommendations will be assessed in a pilot scheme being planned for Sha Tin. TD should work closely with HyD for an early completion of the pilot scheme. Subsequent evaluation should be expedited, so that an implementation programme can be drawn up for the rest of the road network as soon as possible. (*paragraphs 7.46 and 7.47*)

12.22 TD should formulate a publicity programme to brief motorists whenever there are changes in signing standards to avoid creating any confusion. (*paragraph 7.48*)

### **Safety measures for franchised buses**

12.23 The safety records and performance of franchised bus operators have been closely monitored by TD. In order to enhance the safety of franchised buses, TD should continue to implement the following improvement measures –

- ❑ conduct careful route planning;
- ❑ remove old vehicles from the fleet;
- ❑ issue guidelines on working conditions of bus drivers;
- ❑ identify and study bus accidents and map out improvement measures to enhance bus safety;
- ❑ closely monitor the trend of bus accident rates of different franchised bus companies and take actions, such as urging bus companies to carry out a comprehensive review of their existing safety arrangements, to ensure these trends are improved; and
- ❑ promote bus passenger safety and safe driving through different publicity means such as Announcements of Public Interest (API) on TV and radio. (*paragraphs 7.62, 7.64, 7.69 and 7.72*)

### **Continuous safety enhancement**

12.24 The Government should expedite the implementation of improvement measures arising from systematic reviews such as the 'Comprehensive Review of

Directional Signing in Hong Kong' and keep track of best practices adopted in overseas countries. (*paragraph 7.76*)

12.25 The Government should keep a close watch on the safety record of specific types of vehicles and take proactive steps to enhance their safety standards with participation of the relevant transport trades. (*paragraph 7.77*)

## VEHICLE CONTROL

12.26 Technological advances have made motor vehicles much safer than before. But regardless of improved vehicle safety, the manner in which they are used and maintained has a major bearing on road safety. The increase in the number of accidents involving public buses and public light buses warrants special attention. Control over their speed and maintenance is important.

### Speed control

12.27 As a trial scheme, speed display units (SDUs) have been installed in 243 green minibuses running overnight routes. TD should, subject to evaluation of effectiveness, extend the use of SDUs to all other public light buses. (*paragraph 8.6*)

12.28 There are merits in installing speed limiters in passenger services vehicles to enhance safety. Although many new franchised buses have installed electronic engine management systems with speed limiting functions, the Government should consider formally requiring all newly-registered franchised buses to be installed with speed limiters. Consideration should also be given to require other heavy vehicles to be installed with speed limiters, subject to consultation with the transport trades. (*paragraphs 8.11 and 8.12*)

12.29 Tachographs (vehicle blackboxes) are useful devices that can perform accident investigation and fleet management functions. TD should explore with franchised bus companies the fitting of such devices and, subject to evaluation of effectiveness, extend their use to other passenger services vehicles. (*paragraph 8.17*)

## Vehicle examination

12.30 Roadside enforcement is an effective measure to ensure that vehicle owners and drivers maintain their vehicles in a roadworthy condition. Apart from the existing vehicle examination centres, temporary or permanent check sites for roadside enforcement should be established, preferably close to major trunk roads or expressways. Joint roadside spot checks on heavy vehicles by HKPF and TD should also be stepped up. (*paragraphs 8.27 and 8.28*)

12.31 Under existing regulations, the stability test (tilt test) only applies to buses and light buses. TD should explore the feasibility of extending the stability tests to heavy goods vehicles. (*paragraph 8.35*)

## VEHICULAR PARAPET DESIGN

12.32 Parapets are protective devices designed to reduce the severity of an accident when a vehicle leaves the roadway. They are a passive line of defence, and do not contribute to the cause of an accident.

### Parapet development in Hong Kong

12.33 Field tests and computer simulations have demonstrated that the 2<sup>nd</sup> generation P1 parapet is superior to its 1<sup>st</sup> generation design. HyD should expedite and prioritise the replacement of all 1<sup>st</sup> generation P1 parapets in Hong Kong, taking into account other recommendations in the report. (*paragraph 9.37*)

12.34 Because of limited knowledge worldwide about parapet behaviour during a bus impact, HyD should expedite the computer simulations commissioned during the period of this review to establish the ultimate capacity of all P1 vehicular parapets relating to an impact by a double-decked bus. In view of the particular situation in Hong

Kong where double-decked buses are used on almost every part of the road network, when new parapet designs are developed, double-decked buses should be included as one type of heavy vehicle for design consideration. (*paragraph 9.39*)

### International standards

12.35 For historical reasons, HyD has been using the British Standard BS6779 as the basis for developing local standards for parapet design. However, BS6779 will gradually be replaced by the more sophisticated European Standard EN1317 now being developed. HyD should follow closely the development of the European Standard and other relevant international standards, and align the Structures Design Manual with the new internationally recognised standards in phases. (*paragraph 9.57*)

### Development of new designs

12.36 HyD should expand the range of containment levels, in particular at the high end, with regard to the extensive use of double-decked buses in Hong Kong, and the maximum legislated vehicle weight permitted on the road system. HyD should continue to monitor the development of multiple containment parapets in the international scene, and develop workable parapet designs for the Hong Kong situation. (*paragraph 9.62*)

### Parapet height

12.37 Computer simulations commissioned during the period of this review on existing P1 parapet designs showed that a 1.1 m parapet would be adequate to prevent a double-decked bus from rolling over if the impact angle was small. HyD should generate more simulation results involving other impact scenarios to fully evaluate the adequacy of the standard height (1.1 m) adopted for the P1 parapets. (*paragraph 9.71*)

### **Selection criteria**

12.38 In anticipation of an expanded parapet hierarchy and the possibility of more height variations, HyD should give detailed guidelines and analysis procedures on the choice of containment level and parapet height, with particular attention to the congested environment in Hong Kong and the unique situation of a large fleet of double-decked buses using the road network. (*paragraph 9.75*)

### **Materials and workmanship**

12.39 To ensure a good workmanship control on vehicular parapets, HyD should revise the General Specification for Civil Engineering Works to include suitable testing requirements for fabricating the steel components used in vehicular parapets. (*paragraph 9.82*)

### **New materials and research opportunities**

12.40 Apart from following international developments, HyD should carry out research work on parapet design in collaboration with local tertiary institutions. (*paragraph 9.86*)

### **In-service evaluation**

12.41 Crash tests cannot duplicate every roadside condition or vehicle impact situation, hence, HyD should carry out in-service evaluation of the parapet designs on the basis of the damage information collected after traffic accidents so that various types of parapet design can be refined and improved on an on-going basis. (*paragraph 9.89*)

### **High priority locations for improvement**

12.42 The Panel and HyD have jointly identified a preliminary list of locations with similar characteristics as the site of the Tuen Mun Road incident. Although none of the

locations is an accident blacksite, HyD and TD should immediately conduct a detailed study to formulate a package of road safety enhancement measures for the road sections, where penetration of the vehicular parapet may result in catastrophic consequence, as identified during the preparation of this report. (*paragraph 9.98*)

### TUEN MUN ROAD

12.43 The Panel has assessed the safety performance of Tuen Mun Road from a traffic engineering and management point of view, and concludes that Tuen Mun Road is intrinsically safe. The Panel has also carefully considered suggestions from the public on measures to enhance the safety of the road.

12.44 In view of the fact that traffic accidents along Tuen Mun Road are mainly driver related, and that speeding is one of the common problems, TD and HKPF should expedite the necessary preparatory work for the SEC system on Tuen Mun Road, so that it can be fully operational as soon as possible. Once the SEC system is operating, HKPF should deploy more resources to patrolling, with particular emphasis on tailgating and careless lane changing. (*paragraph 10.14*)

12.45 Although there is no intrinsic design deficiency at the site of the Tuen Mun Road incident, the Panel considers it prudent to work closely with TD to draw up a package of enhancement measures as detailed below, taking into account public views and the recommendations made in recent studies on traffic signs and road markings –

- ❑ install a new advance information sign (AIS) 1 200 m before the final advance direction sign. The sign provides additional information to motorists of the approaching exit 1 200 m ahead (already implemented);
- ❑ convert a 100 m section of lane line markings to warning line markings before the start of the diverging point to enhance awareness that a diverging point is approaching;
- ❑ widen the edge line marking from 200 mm to 300 mm at the diverging point to enhance definition at that spot;



- ❑ align the advance direction sign (ADS) immediately over the inside lane to further alert motorists to keep left for the exit ahead to Yuen Long and Lok Ma Chau;
- ❑ install a 'Get In Lane' sign between the AIS and the ADS to provide additional warning to motorists to change lanes where necessary; and
- ❑ install a crash cushion at the nosing between the main road and the slip road as a safety precaution. (*paragraph 10.30*)

12.46 HyD should review and upgrade the containment level of the parapet, where necessary, at identified locations with characteristics similar to those of the incident site. Other enhancement measures, including the provision of additional traffic signs and road markings, should be considered as a total package. (*paragraph 10.39*)

12.47 Tuen Mun Road has already been in service for more than 20 years. Over the years, a number of major improvement works have been carried out in accordance with prevailing design standards and guidelines. Standards and guidelines are evolving and have been subject to constant review and enhancement. TD should conduct a comprehensive road safety review of Tuen Mun Road, particularly from the drivers' perspective, to identify any possible safety enhancement measures. Improvement schemes that can be completed in the immediate term should be drawn up as interim enhancement, while structural improvements will be covered by the Tuen Mun Road reconstruction and improvement project. (*paragraph 10.41*)

12.48 The public is keen to see an early completion of the Tuen Mun Road reconstruction and improvement project. HyD has advanced the work on the project by six months to mid-2005 for completion in phases between mid-2009 and mid-2011. As requested by the Panel, TD has devised preliminary proposals to implement lane closures during daytime off-peak hours. HyD should review the construction programme with a view to further shortening the construction period. (*paragraph 10.45*)

12.49 In view of the July incident, the opportunity should be taken to conduct a comprehensive review of the alignment design of the Tuen Mun Road reconstruction and improvement project to identify areas for further improvement to bring the entire length of Tuen Mun Road up to current expressway standards. (*paragraph 10.46*)

# Acknowledgements

The Panel would like to express its gratitude to all those who have contributed to this Report. They include professional bodies, tertiary institutions, transport trade associations and other organisations that have rendered their valuable suggestions, and members of the public who have shared their views in written submissions and through other channels. The Panel is particularly indebted to Professor Richard Allsop for his expert advice on traffic safety and management issues.

The Panel is grateful to the Environment, Transport and Works Bureau, the Highways Department, the Hong Kong Police Force and the Transport Department for providing detailed information on various road safety issues and conducting extensive and timely researches into different subjects of interest. We would also like to thank the Official Languages Division of the Civil Service Bureau for their Chinese translation service, the Efficiency Unit for their assistance in page and layout design, and the Information Services Department for the cover design.

The Panel wishes to record its appreciation to Ir Wai Chi-sing, the Secretary to the Panel, for his efficient and dedicated support to the Panel, and to other staff of the Secretariat for their assistance.

## Appendix I – Biographical Notes on Members

### CHAIRMAN

#### **Dr Cheng Hon-kwan, GBS, JP**

Dr Cheng Hon-kwan is a civil and structural engineer by profession with over 50 years of experience in the field. Dr Cheng is a Past President and Honorary Fellow of the Hong Kong Institution of Engineers and was awarded the Gold Medal by the Institution of Structural Engineers (UK) in 2002 in recognition of his contribution and achievement in the structural engineering field. Dr Cheng is currently the Chairman of the Transport Advisory Committee and is fully conversant with road safety legislation and the local transport scene. Dr Cheng has extensive experience in public services and has taken up the chairmanship of many advisory boards and committees.

### MEMBERS

#### **Ir Edmund Leung Kwong-ho, JP**

Ir Edmund Leung is a mechanical engineer by profession with over 35 years of experience. Ir Leung has been involved in many major highway design projects and has considerable experience in motor vehicles. Ir Leung is a Past President of the Hong Kong Institution of Engineers and the Past Chairman of the Hong Kong Branch of the Institution of Mechanical Engineers (UK). Ir Leung is active in public services, which cover areas of engineering, environment and education.

#### **Dr Wong Sze-chun**

Dr Wong Sze-chun is an Associate Professor in the Department of Civil Engineering of the University of Hong Kong. Dr Wong specialises in transportation and traffic engineering and is a Fellow of the Chartered Institute of Logistics and Transport in Hong Kong and the Vice President and Founding Member of the Hong Kong Society for Transportation Studies. He is also on the Editorial Advisory Board of a number of transportation and urban planning journals.

# Appendix II – Public Consultation

## INVITATION FOR WRITTEN SUBMISSIONS

### (1) Professional Bodies

- £ Construction Industry Training Authority
- £ Hong Kong Institution of Engineers
- £ Hong Kong Institution of Highways & Transportation
- £ The Association of Consulting Engineers of Hong Kong
- £ The Chartered Institute of Logistics & Transport in Hong Kong
- £ The Hong Kong Construction Association
- £ The Institute of Highways & Transportation (UK) – Hong Kong Branch
- £ The American Society of Civil Engineers – Hong Kong Section
- £ Hong Kong Academy of Engineering Sciences
- £ Hong Kong Society for Transportation Studies
- £ Institution of Civil Engineers (UK) Hong Kong Association
- £ Joint Structural Division of the Hong Kong Institution of Engineers and the Institution of Structural Engineers (UK)

### (2) Academic Institutions

- £ City University of Hong Kong – Department of Building and Construction
- £ Hong Kong University of Science and Technology
  - › Department of Civil Engineering
  - › Department of Mechanical Engineering

- £ University of Hong Kong
  - › Department of Civil Engineering
  - › Department of Mechanical Engineering
  - › Institute of Transport Studies
- £ Hong Kong Polytechnic University
  - › Department of Civil and Structural Engineering
  - › Department of Mechanical Engineering

### (3) Transport Trade

#### ***Franchised Bus Companies***

- £ Citybus Limited
- £ Long Win Bus Co. Ltd
- £ New Lantao Bus Co. (1973) Ltd
- £ New World First Bus Services Ltd
- £ The Kowloon Motor Bus Co. (1933) Ltd

#### ***Driving Instructors Associations***

- £ Articulated & Commercial Vehicle's Instructors Union
- £ Driving Instructors Association
- £ Driving Instructors Merchant Association Limited
- £ Hong Kong Commercial Vehicle Driving Instructors Association Ltd
- £ Hong Kong Driving Instruction Club Limited
- £ Hong Kong & Kowloon Goods Vehicle Omnibuses and Minibuses Instructors' Association Ltd
- £ Hong Kong Motor Car Driving Instructors Association Limited

- £ Hong Kong Society of Articulated Vehicle Driving Instructors Ltd
- £ Kowloon Motor Driving Instructor's Association Limited
- £ Motor Transport Workers' General Union (Driving Instructors' Party)
- £ Public & Private Commercial Driving Instructors' Society

#### ***Designated Driving Schools***

- £ Hong Kong School of Motoring Ltd (Wong Chuk Hang)
- £ Hong Kong School of Motoring Ltd (Shatin)
- £ Hong Kong School of Motoring Ltd (Yuen Long)
- £ Tsuen Wan Driving School

#### ***Designated Driving Improvement Schools***

- £ The Hong Kong Federation of Trade Union Occupational Retraining Centre Ltd (Hong Kong Island)
- £ Hong Kong School of Motoring Ltd (Kowloon West)
- £ Hong Kong Driving Improvement School Ltd (Kowloon East)
- £ Hong Kong Driving Improvement School Ltd (NT)

#### ***Transport Trade Associations***

- £ Institute of Advanced Motorists Hong Kong
- £ Hong Kong Automobile Association
- £ Hong Kong Logistics Association
- £ Hong Kong Road Safety Association

Other transport trade associations invited to attend the consultation sessions have also been invited to submit their views in writing.

#### **(4) Other Organisations**

- £ Road Safety Council

## INVITATION TO CONSULTATION SESSIONS

### (1) Taxis

#### *Urban Taxi Associations*

- £ Chuen Lee Radio Taxis Association Ltd
- £ CTOD Association Company Limited
- £ Fraternity Taxi Owners Association
- £ Happy Taxi Operator's Association Ltd
- £ Hong Kong & Kowloon Radio Car Owners Association Ltd
- £ Hong Kong and Kowloon Rich Radio Car Service Centre Association Ltd
- £ Hong Kong Kowloon Taxi & Lorry Owners Association Ltd \*
- £ Motor Transport Workers General Union
- £ Pak Kai Taxi Owners Association Ltd
- £ Quadripartite Taxi Service Association Ltd
- £ Rambo Taxi Owners' Association Ltd
- £ Rights of Taxi Owners & Drivers Association Ltd \*
- £ Royal Best Quality Taxi Association Ltd
- £ Tai Wo Motors Ltd
- £ Taxi Drivers & Operators Association Ltd
- £ Taxicom Vehicle Owners Association Ltd
- £ The Hong Kong Taxi and Public Light Bus Association Ltd
- £ The Kowloon Taxi Owners Association Ltd \*
- £ The Taxi Operators Association Ltd \*
- £ Traffic Services Employees Association
- £ United Friendship Taxi Owners & Drivers Association Ltd \*
- £ Urban Taxi Drivers Association Joint Committee Co. Ltd

- £ Wai Fat Taxi Owners Association Ltd
- £ Wai Yik Hong Kong & Kowloon & NT Taxi Owners Association
- £ Wing Lee Radio Car Traders Association Ltd
- £ Wing Tai Car Owners & Drivers Association Ltd

***NT Taxi Associations***

- £ Hong Kong Tele-call Taxi Association
- £ North District Taxi Merchants Association
- £ NT Taxi Merchants Association Ltd \*
- £ NT Taxi Owners & Drivers Fraternal Association
- £ NT Taxi-call Service Centre
- £ Public Vehicle Merchants Fraternity Association
- £ Sai Kung Taxi Operators Association Ltd
- £ Sun Hing Taxi Radio Association
- £ Tang's Taxi Companies Association Ltd
- £ Taxi Dealers & Owners Association Ltd \*
- £ The Association of NT Radio Taxicabs Ltd
- £ The Fraternity Association of NT Taxi Merchants

***Lantau Taxi Association***

- £ Lantau Taxi Association

**(2) Public Light Buses**

- £ G.M.B. Maxicab Operators General Association Ltd
- £ Hong Kong Kowloon & NT Public & Maxicab Light Bus Merchants' United Association
- £ Hong Kong Public Light Bus Owner & Driver Association
- £ Hon Wah Public Light Bus Association Ltd
- £ Hong Kong Public & Maxicab Light Bus United Association



- £ Kowloon Fung Wong Public Light Bus Merchants & Workers' Association Ltd
- £ Lam Tin Wai Hoi Public Light Bus Association
- £ Lei Yue Mun Ko Chiu Road Public Light Bus Merchants Association Ltd
- £ Lung Cheung Public Light Bus Welfare Advancement Association Ltd
- £ Motor Transport Workers General Union (Public Light Bus Branch)
- £ NT PLB Owners Association
- £ NT San Tin PLB (17) Owners Association
- £ PLB General Association \*
- £ Sai Kung PLB Drivers and Owners Association
- £ The Kowloon PLB Chiu Chow Traders & Workers Friendly Association
- £ Tsuen Wan PLB Commercial Association Ltd
- £ Tuen Mun PLB Association
- £ Yuen Long Tai Po PLB Merchants Association Ltd
- £ Hong Kong Scheduled (GMB) Licensee Association \*

**(3) Light Goods Vehicles**

- £ Organisation of Hong Kong Drivers
- £ The Hong Kong Union of Light Van Employees
- £ Transport and Delivery Workers Union

**(4) Heavy Vehicles Other Than Buses**

- £ Container Transportation Employee General Union \*
- £ Container Truck Drivers Union
- £ Federation of Hong Kong Industries

- £ Hong Kong Container Drayage Services Association Ltd \*
- £ Hong Kong Container Tractor Owner Association Ltd \*
- £ Hong Kong Dumper Truck Drivers Association \*
- £ Hong Kong Transportation Association Ltd \*
- £ Ken On Concrete Co. Ltd Lorry Owner-Drivers Association
- £ Kowloon Truck Merchants Association Ltd
- £ Lok Ma Chau China - Hong Kong Freight Association \*
- £ Mixer Truck Drivers' Association
- £ Motor Transport Workers General Union
- £ Pioneer Concrete Owners Drivers Association
- £ The Concrete Producers Association of Hong Kong Ltd
- £ The Goods Vehicle Fleet Owners Association Ltd

**(5) Buses**

***Franchised Bus Drivers Unions***

- £ Citybus Limited Employees Union
- £ KMB Workers General Union \*
- £ Kowloon Motor Bus Staff Union L.W.B. Branch \*
- £ Motor Transport Workers General Union City Bus Branch
- £ Motor Transport Workers General Union New World Bus Branch \*
- £ Motor Transport Workers General Union, KMB Branch
- £ Motor Transport Workers General Union, L.W.B. Branch
- £ New World First Bus Company Staff Union

***Non-franchised Bus Associations***

- £ Hong Kong Guangdong Boundary Crossing Bus Association
- £ New Hong Kong Bus Company Limited
- £ Private Hire Car for Young Children Association Ltd
- £ Public Omnibus Operators Association Ltd \*
- £ School Buses Operators Association Ltd
- £ School Children Vehicle Section, Motor Transport Workers General Union

\* denotes associations which have sent representatives to attend the consultation sessions on 19 September 2003.

## Appendix III – Summary of Public Views

SUGGESTIONS	RESPONSES (relevant para. no.)
<b>(1) Driving Behaviour</b>	
<p>£ Improve training by –</p> <ul style="list-style-type: none"> <li>› requiring drivers who have accumulated 12 Driving Offence Points to attend a mandatory refresher course;</li> <li>› imposing mandatory driving courses for drivers of high-risk vehicles, e.g. passenger services and commercial vehicles;</li> <li>› requiring learners to attend improvement/advanced driving courses including driving on expressways;</li> <li>› upgrading the training of vehicle drivers including drivers of buses and heavy vehicles;</li> <li>› reviewing the driving training/test requirements to include elements of driving attitude; and</li> <li>› upgrading the training/standard of driving instructors.</li> </ul>	<p>5.23, 5.24</p> <p>5.23 - 5.28</p> <p>5.30</p> <p>5.25 - 5.28</p> <p>5.21 - 5.30</p> <p>5.33</p>
<p>£ Step up public education by –</p> <ul style="list-style-type: none"> <li>› launching education and publicity campaigns to improve driving behaviour and general attitude of road users;</li> <li>› promoting good driving practices; and</li> <li>› reviewing traffic accident blackspots and educate drivers.</li> </ul>	<p>5.6 - 5.20</p>
<p>£ There is a suggestion that most traffic accidents are related to inappropriate driving behaviours, which are common along Tuen Mun Road; and</p>	<p>5.1 - 5.3, 10.11, 10.12</p>

SUGGESTIONS	RESPONSES (relevant para. no.)
<p>£ Other suggested adopting the driving practices in Australia where drivers are required to give way to buses.</p>	Figure 5.1 (E)(iv)
<b>(2) Enforcement/Sanction</b>	
<p>£ Require passengers of all public transport vehicles to wear seat belts; and ban passengers from standing.</p>	6.6
<p>£ Impose higher sanction for traffic offences (e.g. increase fine by 250%; and deduct 5 points for every breach up to 15 points and thereafter temporary or permanent suspension of the driving license for further breach).</p>	6.15, 6.18
<p>£ Step up enforcement action against traffic offences, such as driving at inappropriate speed, tailgating, drink driving, abrupt lane changing, abuse the use of fast lane, careless and dangerous driving, overloading, poor maintenance and wrong tyre pressure.</p>	6.22, 6.23
<p>£ Strengthen enforcement and sanction by installing more speed enforcement cameras; increasing frequency of patrolling; using dummy police vehicles where necessary.</p>	6.25 - 6.27 Note 1
<p>£ Reduce the number of police officers deployed to enforcement against speeding, and deploy more manpower to patrolling, particularly for Tuen Mun Road.</p>	6.27, 10.14
<p>£ Make full use of new technologies, e.g. automatic speed checking equipment, in-vehicle video, and aerial surveillance etc.</p>	6.29

Note 1 The Panel does not recommend the use of dummy police vehicles due to space constraints.

## SUGGESTIONS

## RESPONSES

(relevant  
para. no.)

- |   |  |        |
|---|--|--------|
| £ | Adopting a “third party reporting” system as in New Zealand to encourage the public to report undesirable driving behaviour via electronic means or a specific form. | 6.30   |
| £ | Installation of the traffic control and surveillance system.   | Note 2 |

### (3) Traffic Engineering and Management

#### *Highway Design Standards*

- |   |   |              |
|---|---|--------------|
| £ | Enhance existing highway design standard including extending the length of merging lanes, improving superelevation for downhill bends.  | 7.8 - 7.14   |
| £ | Upgrade Tuen Mun Road to current highway design standards by – <ul style="list-style-type: none"> <li>› improving the road alignment, removing sharp bends;</li> <li>› using bridges and tunnels to achieve a straight alignment and if necessary converting three-lanes to two-lanes to overcome spatial constraints; and</li> <li>› improving the layout of exit and slip roads to avoid the need for special manoeuvre.</li> </ul> | 10.41, 10.46 |

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Note 2 Traffic Control and Surveillance (TCS) facilities, in the form of variable message signs, lane control signals, closed circuit television (CCTV), variable speed limit signs, speed enforcement cameras and incident detectors are installed in all tunnel areas and the Tsing Ma Control Area.

The Panel notes that for expressways under construction or being improved, namely Shenzhen Western Corridor, Deep Bay Link, Yuen Long Highway and Route 8 between Tsing Yi and Sha Tin, TCS facilities will also be provided. This may be provided in other future new highways, and retrofitted to existing highways where possible.

SUGGESTIONS	RESPONSES (relevant para. no.)
<p>£ Improve the cross-section of Tuen Mun Road by upgrading the carriageway lane to the standard width of 3.65 m, and provision of –</p> <ul style="list-style-type: none"> <li>› hard shoulder with adequate width;</li> <li>› buffer area and more lay-bys; and</li> <li>› a 3.65 m wide emergency lane and an extra-lane for slow traffic.</li> </ul>	10.41, 10.46
<p>£ Reviewing current traffic condition of Tuen Mun Road and incorporating the finding in the road upgrading works.</p>	10.46
<p>£ Road surface materials should be appropriate for the types of travelling vehicles.</p>	Note 3
<b>Traffic Signing</b>	
<p>£ Review the standards of traffic signs with a view to improving their visibility, positioning, size, content, and incorporating overseas practices/standards from USA, Korea and Europe.</p>	7.42 - 7.48
<p>£ Erect more directional and traffic signs (or provide a screen) to give early warning to motorists.</p>	7.45 - 7.48
<p>£ Implement findings of TD's study on signage conducted a few years ago.</p>	7.42 - 7.48
<p>£ Provide a countdown facility for vehicular signal, e.g. by indicating the time for changing colour or by flashing the green light before it changes to amber.</p>	7.34

Note 3 The use of appropriate road surfacing materials is always part of road design considerations.

## SUGGESTIONS

## RESPONSES

(relevant para. no.)

- |   |  |        |
|---|--|--------|
| £ | Install remote control speed limit signs to facilitate adjusting the speed limits in response to sudden changes in traffic flow due to a traffic accident. | Note 4 |
| £ | Erect warning signs at locations of substandard road sections prior to undertaking the road upgrading works.   | Note 5 |
| £ | Road bends should be colour-coded according to their risk level.   | Note 6 |

### Road Markings

- |   |   |            |
|---|---|------------|
| £ | Use double white lines to restrict lane changing and over-taking at high-risk locations, and at diverging points to stop last-minute attempt to change lanes. | 7.38, 7.39 |
| £ | Use of double white lines for roads with speed limit of 70 km/h and for three-lane carriageways (mainly expressways).   | 7.40       |
| £ | Use road markings to give more information e.g. paint traffic signs on the road.  | 7.41       |

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Note 4 This is also called Variable Speed Limit Signs (VSLS). Such have been installed in the Tsing Ma Control Area and in the tunnels completed in the late 90s and are being retrofitted in some older tunnels. For some expressways under construction, namely Shenzhen Western Corridor and Route 8 between Tsing Yi and Sha Tin, VSLS will be provided. TD will consider the same for existing busy highways as part of TCS facilities.

Note 5 Rather than erecting warning signs to identify substandard road sections, the Panel considers it more appropriate, and is indeed the current practice of TD, to erect signs to warn drivers about the actual hazards such as sharp bends, the need to reduce speed etc.

Note 6 A sign about the direction of the bend, if it is a double bend, the need to reduce speed, etc. is more useful to drivers than information about risk level. There is no objective measure of risk level of road bends.



SUGGESTIONS	RESPONSES (relevant para. no.)
£ Wider use of “cat-eye” stones for road markings; and use “textured” lanes to differentiate emergency lane from traffic lanes.	Note 7
<b><i>Use Restriction</i></b>	
£ Remove “keep left” restriction on all expressways, but other suggested imposing “keep left” restriction on all roads with two or more lanes.	7.49, 7.50
£ Buses and heavy vehicles to use middle lane only.	7.51
£ Prohibit buses/heavy vehicles in occupying the middle lane for too long except for overtaking; container trucks should use slow lane only.	7.57
£ Heavy goods vehicles should be prohibited from overtaking.	7.51, 7.57
£ Ban red minibus from using the Castle Peak Road.	Note 8
£ Restrict heavy vehicles from using certain roads during certain time and under conditions (e.g. use middle lane under bad weather conditions).	7.60
£ Use single-decked buses (in lieu of double-decked buses) for Tuen Mun Road and other elevated expressways at hilly locations.	7.62, 7.63
£ Prohibit lane changing at the accident spot at Tuen Mun Road by using double white lines.	10.36

Note 7 Current design guidelines for expressways and trunk roads require the provision of cat-eye stones. Lighting level in most urban environment renders cat-eye stones unnecessary. The Panel considers there is no need to use textured lanes to differentiate hard shoulders.

Note 8 Red minibuses are currently prohibited from using Tuen Mun Road, Route 3 and Tai Lam Tunnel. Banning them from using Castle Peak Road would cause them to make a long detour for reaching northwest New Territories, and reduce the choices for passengers along Castle Peak Road. The Panel considers this is not in the interest of passengers.

<b>SUGGESTIONS</b>		<b>RESPONSES</b> (relevant para. no.)
£	Restrict buses/heavy vehicles from using the slow lane of Tuen Mun Road.	10.32
£	Ban heavy vehicles (i.e. buses, container trucks and other heavy vehicles) from using Tuen Mun Road. One suggestion noted the adverse effects of banning buses from using the road.	10.33
£	Use ‘tunnel mode’ operation (i.e. prohibiting lane changing) throughout Tuen Mun Road.	10.36
£	Remove bus only lanes; and allow buses and coaches to use hardshoulders during rush hours.	Note 9

### ***Speed Management***

£	Review current speed limits in Hong Kong.	7.18, 7.19
£	Improve speed management by –	
	<ul style="list-style-type: none"> <li>› lowering speed limits for expressways from 80 to 70 km/h;</li> </ul>	7.20
	<ul style="list-style-type: none"> <li>› using a consistent speed limit throughout a road;</li> </ul>	7.18, 7.19
	<ul style="list-style-type: none"> <li>› adopting different speed limits for heavy and light vehicles e.g. impose a lower speed limit for heavy vehicles on expressways especially along high risk roads;</li> </ul>	7.22
	<ul style="list-style-type: none"> <li>› limiting the speed for passenger vehicles and good vehicles to 70 km/h;</li> </ul>	7.23, 7.24
	<ul style="list-style-type: none"> <li>› imposing a speed limit of 50 km/h for buses and lorries (like Singapore) and install external speed display devices (e.g. an amber flashing light) on heavy vehicles along Tuen Mun Road;</li> </ul>	8.8, 10.18

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Note 9 Allow buses or coaches to use hard shoulders would jeopardize their function and would obstruct the passage of emergency vehicles.

**SUGGESTIONS**

**RESPONSES**

(relevant para. no.)

	<ul style="list-style-type: none"> <li>› adopt different speed limits for different lanes on expressways as in Mainland; and</li> <li>› lower the speed limit especially for buses/ coaches under strong wind condition whilst one suggested increasing it to 90 km/h.</li> </ul>	<p>7.21</p> <p>7.25</p>
£	<p>Tighten the speed control of Tuen Mun Road by –</p> <ul style="list-style-type: none"> <li>› lowering the speed limit for the western stretch to 60 km/h;</li> <li>› imposing a speed limit of 50 km/h for heavy vehicles along the whole length of the road; and</li> <li>› limit the speed to 30 km/h for the Sham Tseng section at the incident spot.</li> </ul>	<p>10.16, 10.18</p> <p>10.18</p> <p>10.15 - 10.17</p>

£

**Vehicle Control**

£	<p>Install in-vehicle speed display devices for passenger service vehicles and heavy vehicles to facilitate speed control.</p>	<p>8.6, 8.8</p>
£	<p>Enhance speed control by using new technologies e.g. in-vehicle black box, GPS-based speed adaptation system and speed limiters.</p>	<p>8.5 - 8.17</p>
£	<p>Impose more stringent vehicle examination including checks on the tyre conditions.</p>	<p>8.27, 8.32, 8.33</p>
£	<p>Review the stability design of buses taking into account loading weights due to passenger’s preference to sit at the upper deck. To improve stability of buses, passengers should not be allowed to sit at the upper deck until the lower deck seats have been filled.</p>	<p>8.34</p>

## SUGGESTIONS

## RESPONSES

(relevant  
para. no.)

£ Improve quality of mechanics for vehicle maintenance. 8.36

### (4) Parapet Design

£ Carry out full-scale impact tests and computer simulation for parapet design; and conduct studies on the dynamic instability problem upon collision. 9.14, 9.16, 9.39, 9.71

£ Review the current design standard for parapets in Hong Kong, taking into account overseas practices e.g. US standards. 9.56, 9.57, 9.62

£ There is concern that P4 type parapets cannot stop a 38 tonne heavy goods vehicle traveling at 70 km/h. 9.62

£ Provide more choices of parapet types and detailed guidelines in their selection. 9.62, 9.75

£ Explore the use of new parapet materials and designs (e.g. magnetic parapets, parapets made of rubber tubes filled with rice husks and wood bran etc.). 9.84 - 9.86

£ Enclose Tuen Mun Road with a steel net. 9.87

£ Workmanship and quality control are important, especially at the welding joints between the parapet posts and the base plate; and parapets should be securely anchored. 9.80, 9.82

£ Strengthen the design of parapets by – 9.12, 9.29  
 > adopting ‘composite’ barrier design in which outer barrier can be used to protect light vehicles and the inner barrier for heavy vehicles; 9.61, 9.62

SUGGESTIONS	RESPONSES (relevant para. no.)
<ul style="list-style-type: none"> <li>› adding steel beams to strengthen the open space between railings; and</li> <li>› wider use of concrete barrier walls with additional railings on top to increase the containment level.</li> </ul>	
<p>£ Increase the containment level of parapets by –</p> <ul style="list-style-type: none"> <li>› raising the parapet containment height to 2 m or above for double-decked buses; and</li> <li>› using P4 type (i.e. high containment parapets) instead of lower level type parapets at high risk locations.</li> </ul>	<p>9.69, 9.70</p> <p>9.23, 9.74, 9.75</p>
<p>£ Review existing parapets at high risk locations for improvement (e.g. along bridges, elevated road structures and central barriers of highways) and conduct an regular inspection once every five years.</p>	<p>9.93 - 9.98</p>
<p>£ Use tensioned steel strand type parapets, or tensioned wire in conjunction with steel rails to reduce the direct impact force.</p>	<p>9.12, 9.30</p>
<p>£ Others</p> <ul style="list-style-type: none"> <li>› wider use of crash cushions at high risk locations; and</li> <li>› using hard materials for parapets may cause considerable injury and damage while high parapets may adversely affect sight-line.</li> </ul>	<p>Note 10</p> <p>9.13</p>

Note 10 The Panel notes crash cushions have been installed at high-risk locations. The Panel notes TD's undertaking to install such at other high-risk locations in future.

<b>SUGGESTIONS</b>		<b>RESPONSES</b> (relevant para. no.)
<b>(5) Miscellaneous</b>		
£	Examine the problem of fatigue driving and improve conditions of professional drivers by introduction of legislation to limit their working hours; and limit the working hours of bus drivers to 12 hours.	7.69
£	Conduct road safety audit for Tuen Mun Road, and establish a road safety audit system for Hong Kong (like Australia and Singapore).	10.41
£	Divert buses and heavy vehicles from Tuen Mun Road to Route 3 (by providing incentives to use this route) or to Castle Peak Road to relieve the traffic on Tuen Mun Road.	10.33
£	Build an elevated by-pass along Castle Peak Road (i.e. double-decking) to take buses running along Tuen Mun Road.	10.35
£	Improve the blackspot areas along Tuen Mun Road as soon as possible.	10.29, 10.41
£	Review the long-term transport needs of the northwest New Territories, and advance the Tuen Mun Road reconstruction project;	10.33, 10.44, 10.45
£	Explore the feasibility of prohibiting drivers aged 60 or above to drive heavy vehicles and requiring motorists to undergo mandatory medical checks.	11.2, 11.4
£	Assess the adverse effect of “infotainment” (i.e. in-vehicle TV) on bus drivers.	Note 11

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Note 11 The only one speaker of 'Infotainment' on the lower deck of buses is separated from the driver and the volume is set to no more than 2 dBA above the ambient noise level. It should not distract the driver.

SUGGESTIONS	RESPONSES
	(relevant para. no.)
£ Impact of strong wind (e.g. Typhoon Signal 3 or above) on stability of buses should be examined.	7.25 Note 12
£ Review the parapet/railings and road safety of elevated road structures at the following locations – <ul style="list-style-type: none"> <li>› Castle Peak Road;</li> <li>› Island Eastern Corridor;</li> <li>› Aldrich Bay Road (near Chun Fung Garden);</li> <li>› a flyover in Lam Tin; and</li> <li>› an elevated road at Sham Shui Po.</li> </ul>	11.5
£ Carry out more frequent road maintenance (e.g. ensure road surface and road markings are in good condition; remove obstruction to sightline; and apply anti-skid materials where required etc.).	11.6
£ Install noise barriers along Ching Cheung Road as part of the road widening (for the Route 9 Project) to minimise traffic noise.	11.9
£ Provide more toilets and resting places along Tuen Mun Road.	11.9
£ Improve communication with the transport trade and driver associations and extend membership of the Road Safety Council to trade associations.	11.7
£ Difficult to comply with the “2-second” rule during rush hours at Tuen Mun Road and Tolo Highway, especially under wet weather.	11.8

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Note 12 The Panel notes that there is no evidence of accidents involving buses overturning due to strong wind. Most bus services would be suspended after typhoon signal No. 8 is in force. All franchised bus operators have issued guidelines to their drivers about operation in strong wind, which include driving at a slower speed.

SUGGESTIONS	RESPONSES (relevant para. no.)
£ Examine the freight route of containers in order to find ways to ease the traffic congestion problem due to container trucks, e.g. identify alternative freight routes, restrict the container trucks from travelling during rush hours etc.	11.9
£ Rectify inappropriate use of land at So Kwun Wat where agricultural land is used for storage, in order to reduce the number of container trucks using Castle Peak Road.	11.9
£ Provide better paramedic and road-side ambulance services as well as trauma units in hospitals for victims of serious road accidents.	11.9