Motorway Design Volume Guide

Design volumes for increased safety, reliability and productivity on motorways

December 2017

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2.3.2. Corridors

Figure 10 shows indicative corridor Maximum Sustainable Flow Rates under various lane configurations for standard conditions (i.e. gradient <= 2% and HGV-percentage = 15%). For example, it illustrates that two 2 lane carriageways (Maximum Sustainable Flow Rate = 7,250 veh/h) are more efficient than one 4 lane carriageway (Maximum Sustainable Flow Rate = 6,775 veh/h). The extrapolated trend (for combinations including 6 and 7 lanes) is a reduction of per lane Maximum Sustainable Flow Rate of 4% with every additional lane. This is consistent with measurements on Melbourne’s Managed Motorway network and international research and takes into account the increasing number of lane changes required to fill all lanes to capacity as more lanes are added.
The measurement results presented in Table 17 were normalised to represent ‘standard’ conditions which were defined as a gradient smaller or equal to 2% and a Heavy Goods Vehicle (HGV) percentage of 15%.

No normalisation was done for other ‘non-standard’ static conditions (refer to Part 1, Table 2):

- Lane and shoulder widths – Lane widths at all measurement cross-sections >= 3.25 metres; no shoulder at Cross sections 14779 IB, 14427WB, and 14428 EB (impact of the absence of shoulders on ‘capacity’ assumed to be minor, refer to Henkens and Heikoop (2015), Section 4.1.3);
- Visibility conditions;
- Curvature - narrow curve at Cross-section 14779 IB (regarding the impact of tight curves on ‘capacity’ refer to Section 3.9);
- Sags and crests (particularly relevant to tunnels) – separate values determined for tunnels;
- Location – covered by the scope of this Guide (refer to Section 3.2).

No attempt has been made to standardise measurement results due to dynamic factors as listed in Part 1, Table 3.

3.4. Data and Site Observations

This section outlines objectives for the collation of data used for this Guide. A qualification of the data used and observations from individual measurement sites are also provided.

3.4.1. Data collection principles

It was intended to select cross-sections for the collation of data to estimate ‘capacity’ values and Maximum Sustainable Flow Rates that represent the following conditions:

- Represent all relevant conditions (2-lane, 3-lane, 4-lane, 5-lane cross-sections; different gradients and HGV percentage categories; ‘normal sections’ or bridges/tunnels).
- Collect data in all weather and light conditions (i.e. dry and wet, light and dark).
- Exclude the majority of incident influence.
- It was not considered possible to estimate capacities for all combinations of these factors; e.g. the ‘German HCM’ sets ‘capacity’ values for more than 200 different combinations but is based on only around 50 measurement sites.
- Where there were gaps in the VicRoads data, appropriate information in other highway capacity manuals was used to supplement information, for example data published in the ‘German HCM’ or the ‘Dutch HCM’ was used to interpolate and extrapolate own findings (compare to Section 3.7).

3.4.2. Qualification of the data used

All data used was from the M1 Corridor (Monash and West Gate Freeways). This is because it was the only managed motorway corridor where high quality data was available for the analysis at the time of the analysis.

During the analysis period, not all the requirements for a managed motorway as outlined in Section 1.3 of the Managed Motorway Framework had been fully met. For example, the access from Eastlink to the Monash Freeway in the inbound direction was uncontrolled. Hence, the affected motorway sections have to be considered as ‘partially managed’. It is expected that ‘capacity’ values at selected cross-sections will go up after implementation of the corresponding improvements (e.g. at Detector 14587IB). Realistically, partially managed motorways are the norm since it may never be possible to fully meet all requirements.
3.5. Measurement results

3.5.1. ‘Capacity’

Table 17 shows ‘capacity’ values as determined at a number of locations on Melbourne’s motorway network. The corresponding methodology is explained in Sections 3.3.2 (Approach 1) and 3.3.3.

1) Only considering the three lanes continuing over Warrigal Road Bridge
2) Considering all four lanes at the cross-section
3) Different ‘non-standard’ conditions including gradient, lane-changing restrictions (assumed to increase ‘capacity’ by 5%), higher HGV percentage
4) Domain and Burnley Tunnels
5) Considering gradient, HGV-percentage and lane changing conditions at measurement sites (normalised to $s\leq 2\%$, HGV = 15% based on the factors shown in Section 3.7)

Table 17: ‘Capacity’ values

3.5.2. Maximum productivity

Productivity is defined as the product of traffic flow and traffic speed and it’s achieved if both speed and flow are maintained near maximum values, i.e. near free-flow speed and capacity flow. For each managed motorway cross-section that was used for ‘capacity’ analysis, the traffic flow was determined for which the arithmetic product of these two Key Performance Indicators (KPI’s) can be expected to reach its maximum (refer to Section 3.3.3).

1) Only considering the three lanes continuing over Warrigal Road Bridge
2) Considering all four lanes at the cross-section
3) Different ‘non-standard’ conditions including gradient, lane-changing restrictions (assumed to increase ‘capacity’ by 5%), higher HGV percentage

Table 18: ‘Capacity’ values compared to flows at maximum productivity
3.10. Future Investigation Work

Areas that are either under investigation at present or may be explored further in the future include:

- 'Capacity' values for merging, diverging and weaving including at complex auxiliary lanes;
- More detailed analysis of the differences between unmanaged and managed motorways; this comprises 'capacity', productivity, probability of flow breakdown and the different traffic flows after a flow breakdown ('capacity' loss and recovery path);
- Link between congestion and crash rate (continuation of research based on VicRoads data); and
- The impact of tight curve radii on 'capacity' and productivity.