Unit 8: Intelligent Transport Systems

Module 8-2

Managed Motorways – Operational Principles, Managed Motorway Toolkit

Traffic Management Training Module

Austroads

Today’s presenter

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Outline of this Module

- Ramp Metering
- Variable Speed Limits (VSL)

Section 8 of Guide to Traffic Management Part 2: Traffic Theory Concepts and
Section 8 of Guide to Traffic Management Part 9: Transport Control Systems – Strategies and Operations
Austroads (2020)

Preliminaries

- Motorways were designed with sufficient capacity for virtually unlimited mobility

Source: Adapted from Transport for NSW (2016).

Preliminaries

Austroads

- Ever increasing demand in reality
- Congestion: recurrent and non-recurrent
- Managed motorways goal: operate motorway networks optimally

Managed Motorways

Austroads

- Inflow Control
  - Ramp metering
- Link Control
  - Variable speed limits
  - Tidal (reversible) lanes
  - Special vehicle lanes and shoulder running
- Driver Information and Guidance
  - VMS information (e.g. congestion warning, route recommendation)

Ramp Metering

Austroads

Preliminaries

Austroads

Ramp metering

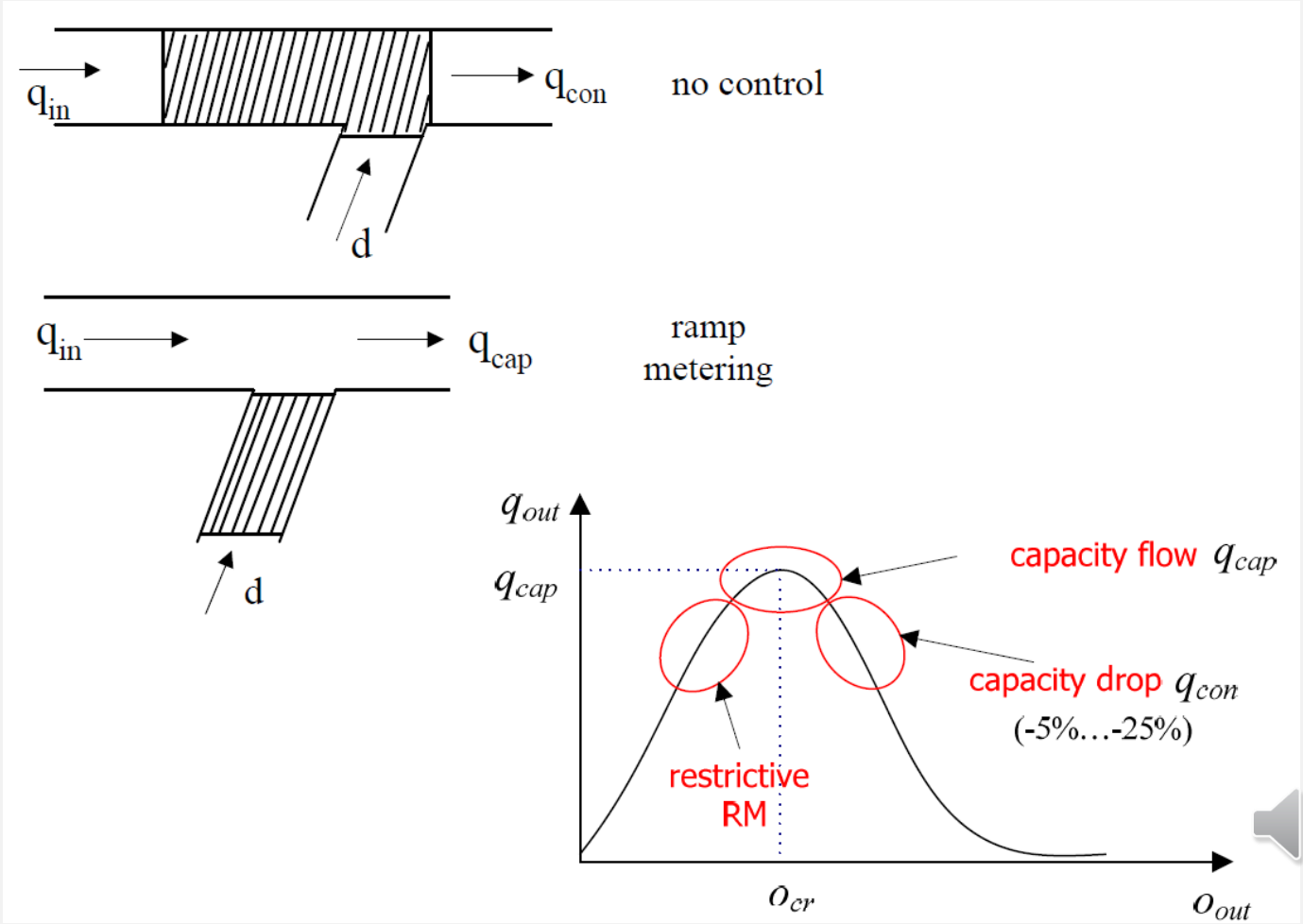
- Control traffic flow into the motorway by means of traffic signals on the entry ramps
- Regulate mainline traffic flow below the operational capacity

Source: www.rms.nsw.gov.au/m4smartmotorway

Ramp Metering

Austroads

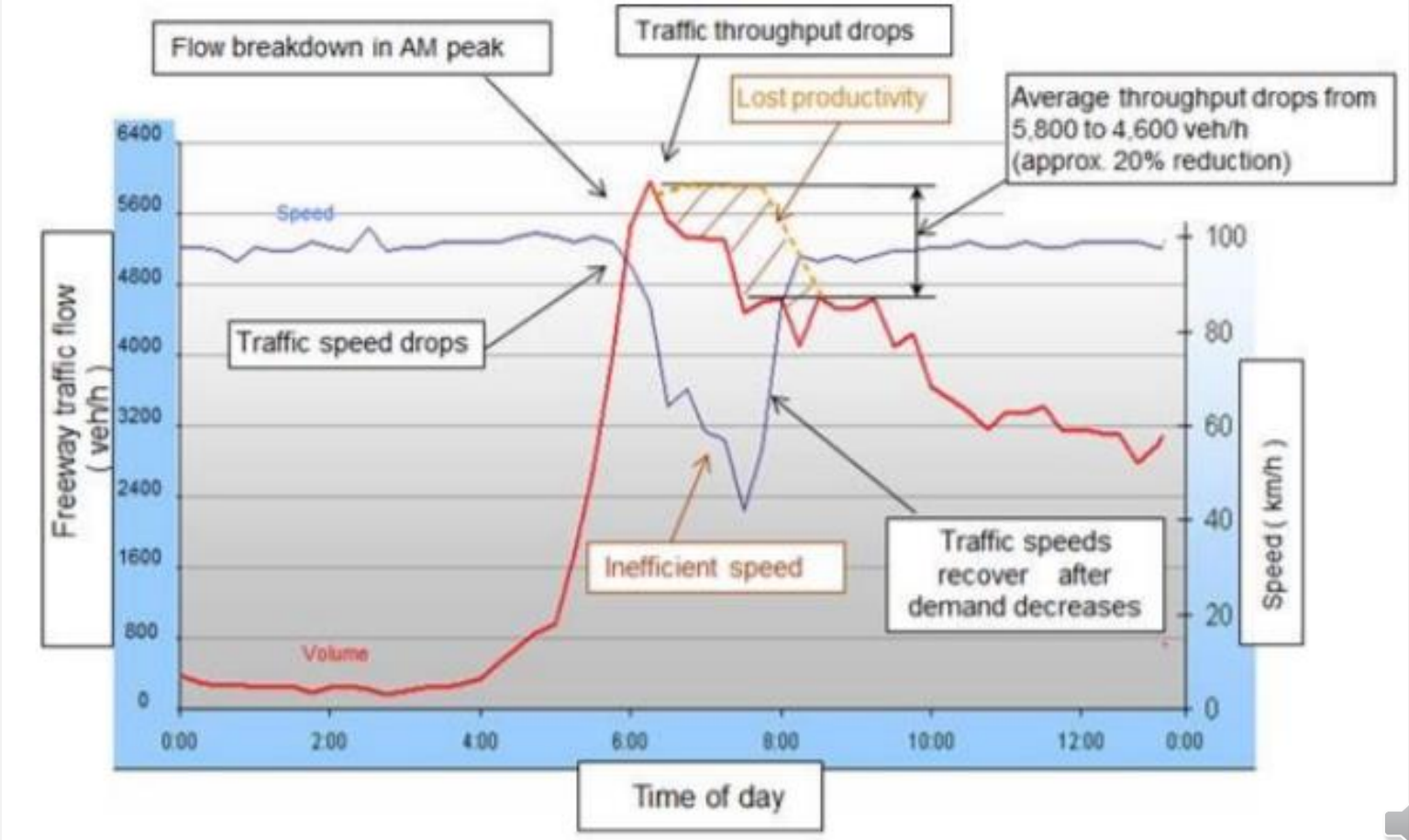
Benefits of ramp metering



Ramp Metering

Austroads

Benefits of ramp metering

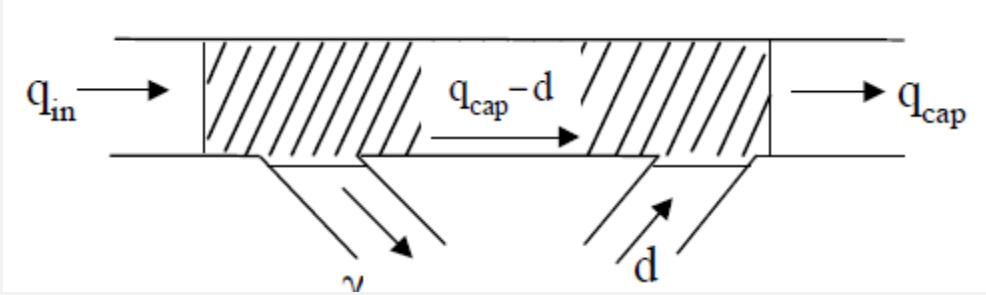


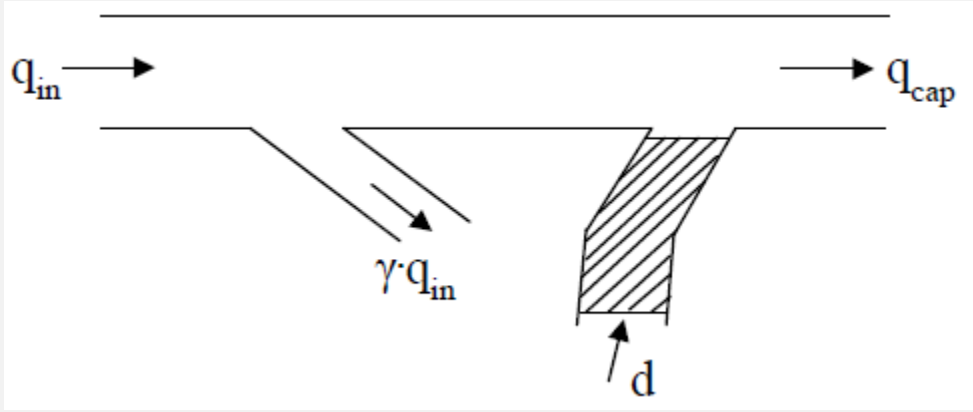
Source: VicRoads (2013).

Ramp Metering

Austroads

Benefits of ramp metering





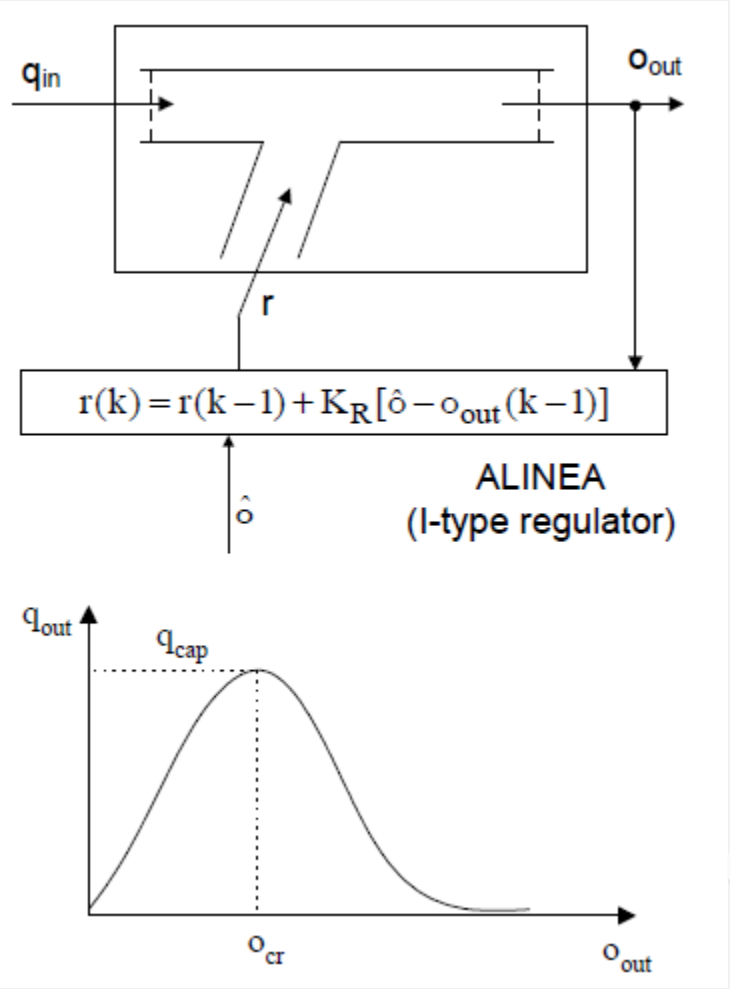
Ramp Metering

- Implementation with traffic lights
  - one car at a time (control via red phase duration)
  - fixed traffic cycles
- Intermediate possibilities:
  - n cars at a time (n = 2, 3,…)
  - variable traffic cycles (short when possible, long when necessary)

See Section 10.6 of Guide to Traffic Management Part 10: Transport Control – Types of Devices Austroads (2020)

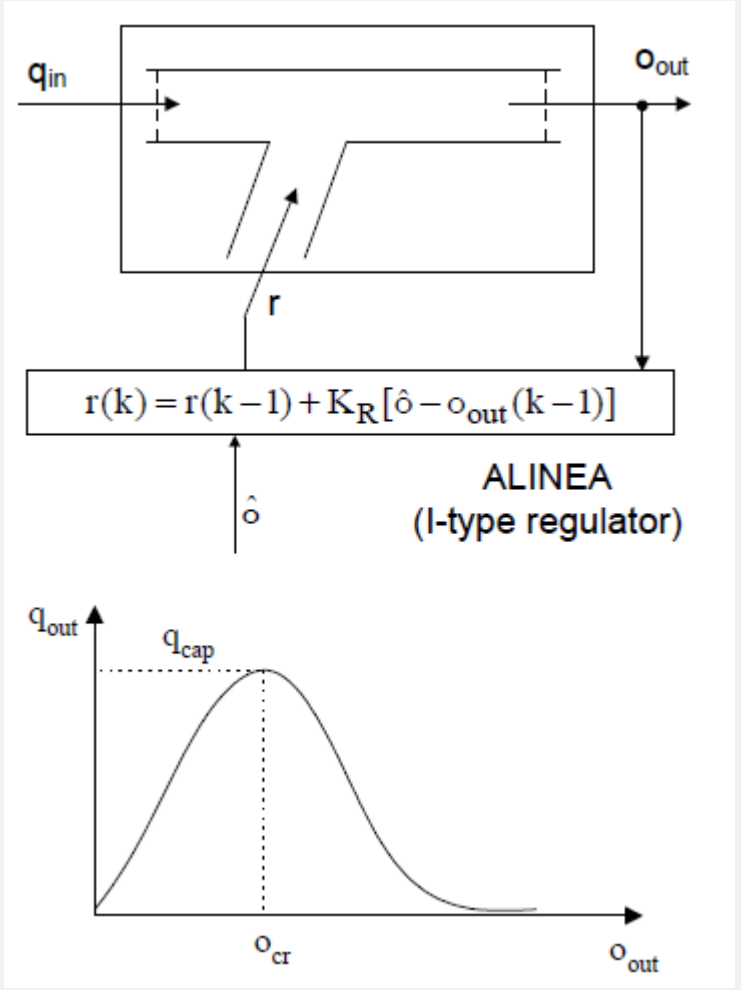
ALINEA

- real-time operation (traffic-responsive)
- keep traffic conditions close to pre-specified set values
- smooth stabilisation around $\hat{o}$
- simple: no switching, only $\hat{o}$ (and K_R) prespecified
- Note: o_{cr} less sensitive than q_{cap}



ALINEA

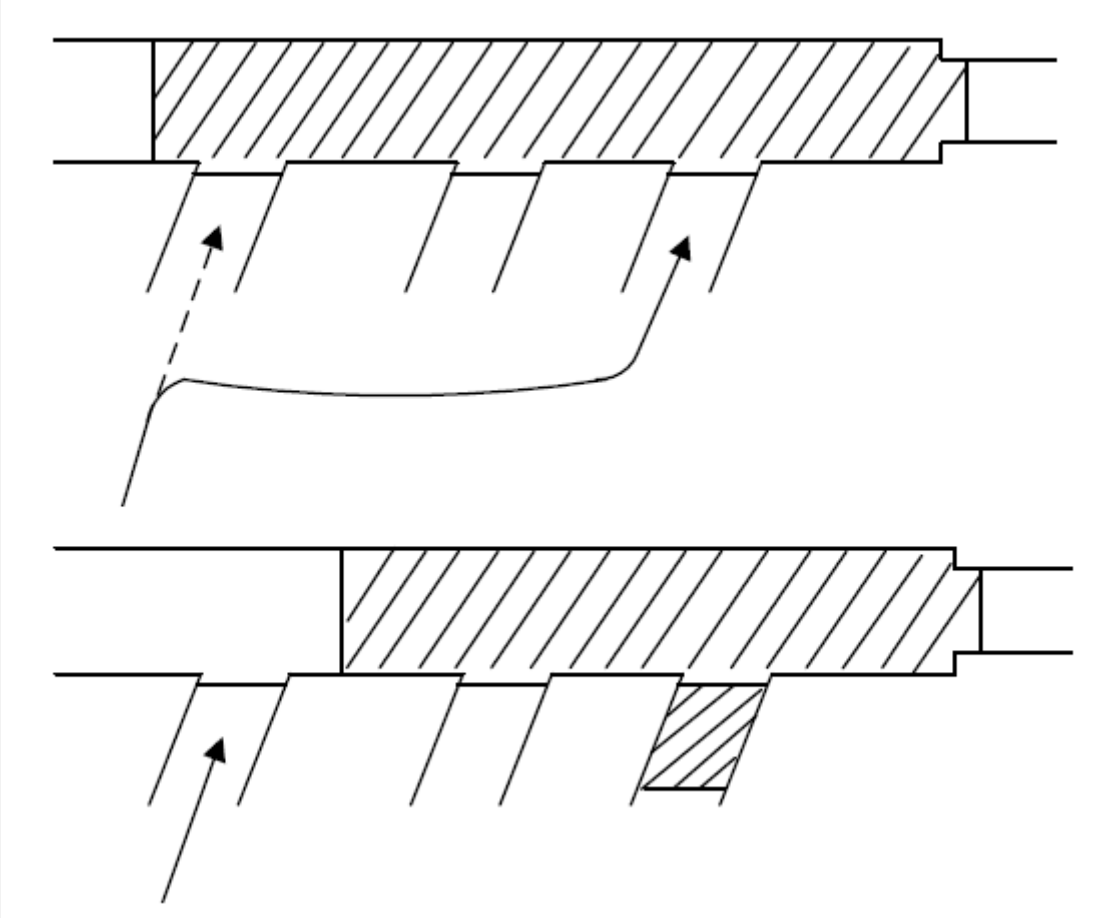
- Issues
  - Real-time estimation of critical occupancy o_{cr}
  - Ramp queue length estimation
  - Ramp queue control
  - Random-location bottleneck



ALINEA

- Boulevard Périphérique (Paris)
  - cycle time implementation (C = 40s)
  - $o_{cr} \approx 31\%$; $\hat{o} = 29\%$
- A10 West Motorway (Amsterdam)
  - one-car-per green
  - $o_{cr} \approx 20\%$; $\hat{o} = 18\%$
- M8 East Motorway (Glasgow)
  - very short cycles (C = 20s)
  - $\hat{o} = 26\%$

Coordinated Ramp Metering

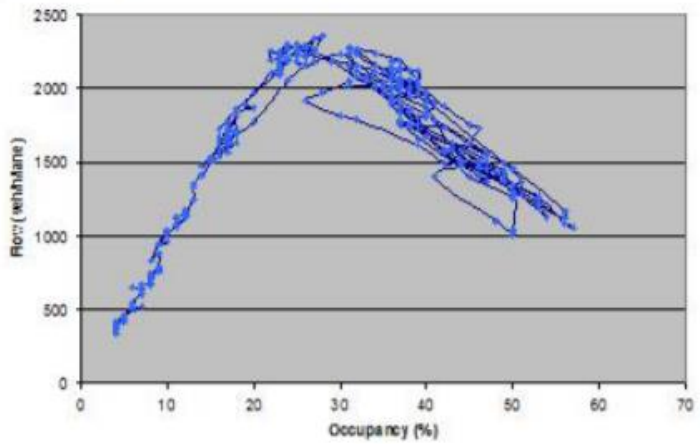


Coordinated Ramp Metering

- Example:

  Melbourne's M1 Monash freeway with 64 ramps using HERO

Unmanaged motorway

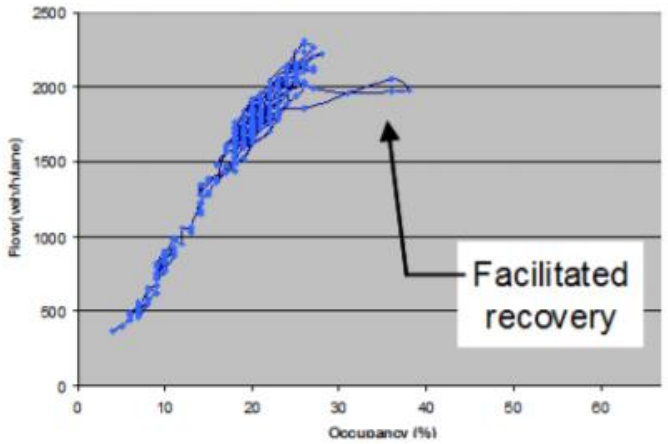


Flow breakdown occurs

Note:

- reduced throughput
- reduced speed
- congestion
- lost productivity.

Managed motorway



Flow breakdown avoided

Ramp signals with HERO control:

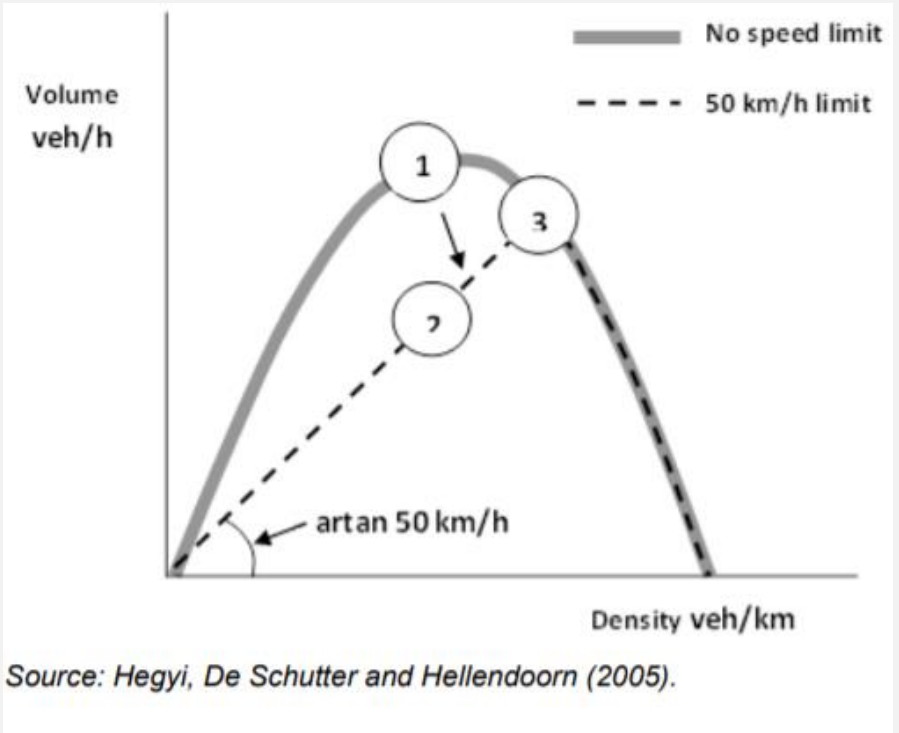
- prevent flow breakdown
- maintain optimum throughput
- maintain optimum speed
- facilitate flow recovery.

Source: VicRoads (2013).

Variable Speed Limits

Austroads

Variable Speed Limits



Source: Hegyi, De Schutter and Hellendoorn (2005).

Source: Austroads (2020)

Variable Speed Limits

- When VSL is activated at under-critical densities, it can have an adverse impact on traffic efficiency (i.e. increased travel times).
- When VSL activated at critical and over-critical densities, it can help delay the onset of flow breakdown, but generally has limited ability to prevent flow breakdown.
- VSL at critical levels of operation provides a reduction in the speed differentiation of vehicles (e.g. homogenisation of speeds), which can result in improved flow stability.

Time to Reflect

Q1. True/False: Variable speed limit can improve safety and traffic flow performance simultaneously.

A. True

B. False

Q2. True/False: ALINEA is a coordinated ramp metering method.

A. True

B. False

Time to Reflect

Q1. True/False: Variable speed limit can improve safety and traffic flow performance simultaneously.

True

Q2. True/False: ALINEA is a coordinated ramp metering method.

False

References

Austroads (2020). Guide to Traffic Management Part 2: Traffic Theory Concepts. AGTM02-20, Austroads, Sydney, NSW. https://austroads.com.au/publications/traffic-management/agtm02/media/AGTM02-20-Part-2-Traffic-Theory-Concepts.pdf

Austroads (2020). Guide to Traffic Management Part 9: Transport Control Systems – Strategies and Operations. AGTM09-20, Austroads, Sydney, NSW. https://austroads.com.au/publications/traffic-management/agtm09/media/AGTM09-20_Part_9_Transport_Control_Systems_Strategies_and_Operations.pdf

Thank you for participating

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