Left **turn treatments at signalised intersections**

A balance between **safety** and **efficiency**

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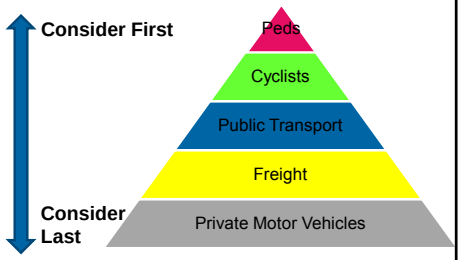
Introduction

- Traditionally, engineering solutions focused on improving safety and efficiency **primarily for vehicles**.
- Recently we are seeing a change in the **road user hierarchy**, in favour of vulnerable road users.
- Concern with the **priority** given to pedestrians.
- No **clear guidelines** when we should be using them.

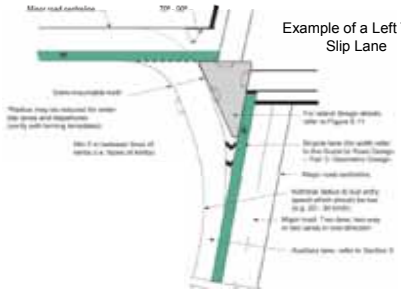


- Although aimed at benefitting pedestrians - **can negate benefits**.
- Implement based on scientific knowledge of the effects rather than **"blanket"** application.

Background

- Summary of a Masters Research Paper undertaken in collaboration with the UoA.
- Effects of:
  - the elimination of left turn slip lanes, and
  - the increased use of left turn red arrow protection

  on **safety** and **efficiency**



Example of a Left Turn Slip Lane

- Nine intersections investigated in the greater Auckland area.
- Case study selected for this paper - intersection of Mayoral Drive / Wakefield Street, Auckland.

Key Literature Review Findings

- **Minimal research** on left turns at signalised intersections.
- Much of the available literature focuses on the safety and operational effects of **channelised turn lanes**.
- Limited research that **quantified the effectiveness** of some of the pedestrian strategies adopted at left turn lanes.
- Direct effect of **long cycle times** – showed a decrease in pedestrian safety (Singh et al., 2011)
- **Safety in numbers** concept – higher pedestrian volumes correlates to an increase in safety

Research Objectives

- Highlight to transport professionals the **quantitative effect** these two treatments have on the overall safety and performance of an intersection **and its users.**

- To develop **preliminary guidelines** for the correct application of the appropriate left turn treatment at signalised intersections. With further research , hoped that the guidelines developed lead to developing an **industry toolbox**.

Research Methodology

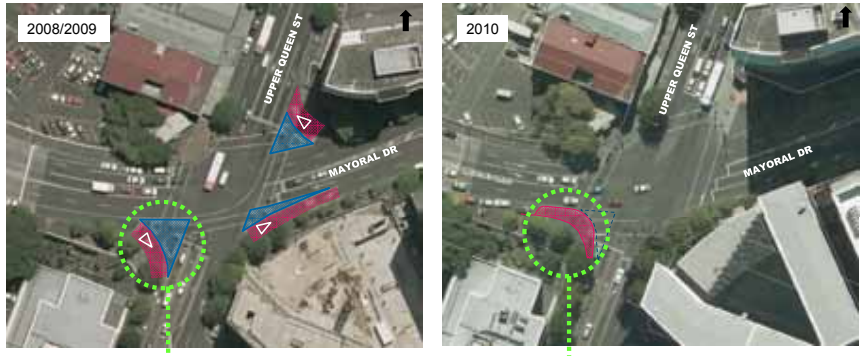
- To achieve the objectives, data analysis was undertaken in three parts:

  1. Theoretical Before / After Analysis – Intersection Performance using SIDRA.

  2. Observational Data Analysis – Vehicle and Pedestrian Compliance from video footage.

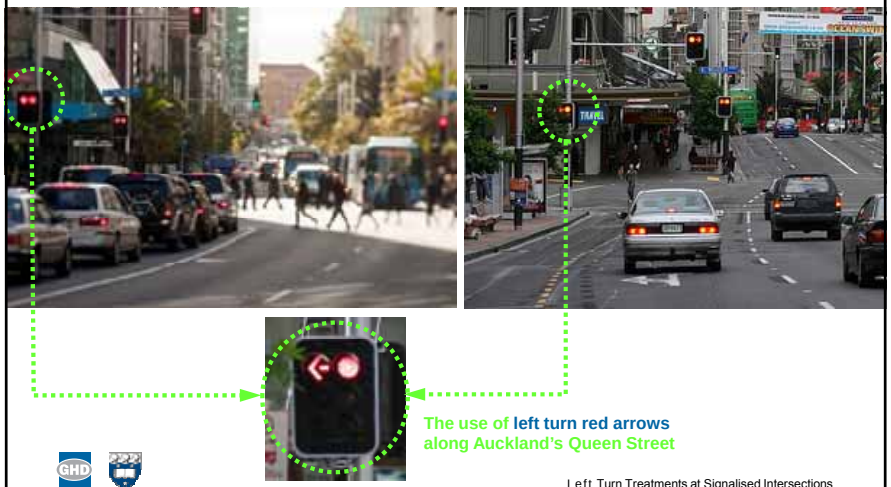
  3. Historic Crash Data Analysis – using NZTA's Crash Analysis System (CAS)

Elimination of Left Turn Slip Lanes



The removal of **left turn slip lanes** at Upper Queen Street / Mayoral Drive in Auckland's CBD

Use of Increased Left Turn Red Arrows



The use of **left turn red arrows** along Auckland's Queen Street

Issues with these Left Turn Treatments

- Increases the **overall conflict area** within the intersection area
- Increases the **number of potential conflict points** within the intersection area
- Longer **vehicle clearance times**
- Longer **pedestrian crossing clearance times**
- Longer **cycle times**

Case Study: Mayoral Dr / Wakefield St

Site location and description

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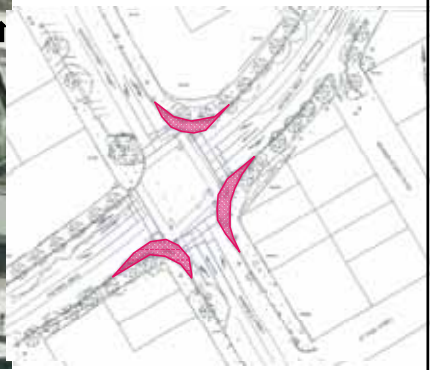


Case Study: Mayoral Dr / Wakefield St

Wakefield Street south approach in 2009 with slip lane

Wakefield Street south approach in 2011 with slip lane removed

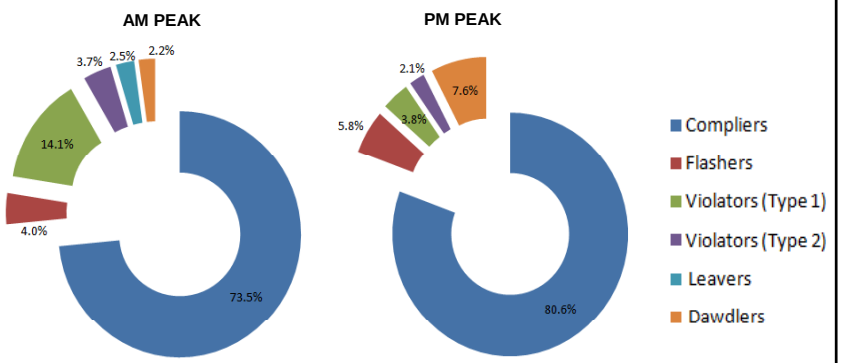
Case Study: Mayoral Dr / Wakefield St

Theoretical Before / After Analysis

Measures of Performance	2008 Conditions PM Peak	
	Base (Slip Lane)	No Slip Lanes
Average Delay (sec)	23.2	40.4 ↑
Level of Service (LoS)	C	D
Degree of Saturation (v/c ratio)	0.520	0.713 ↑
95%tile Queue (m)	50.9 (Mayoral W)	81.2 ↑ (Mayoral E)
Total CO_2 Emitted (kg/h)	447.9	481.5 ↑
Cycle Time (sec)	70	100 ↑

Case Study: Mayoral Dr / Wakefield St

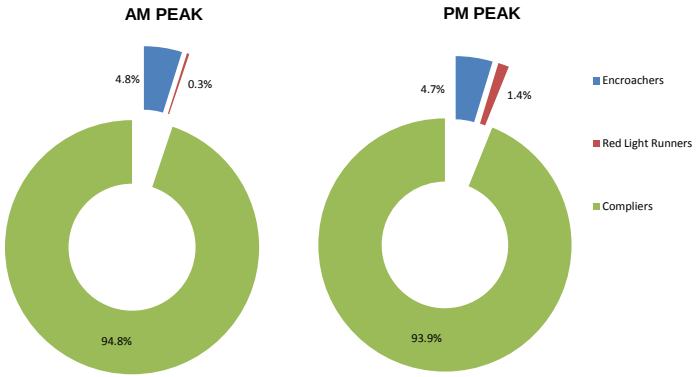
Observational Data Analysis – Pedestrian Compliance (Typical)



Issues with these Left Turn Treatments

Case Study: Mayoral Dr / Wakefield St

Observational Data Analysis – Vehicle Compliance



Case Study: Mayoral Dr / Wakefield St

Crash Data Analysis

- 10 year crash history from 2001 to 2010 was analysed.
- Total of 53 crashes, predominantly crossing / turning type crashes
- 6 (11.3%) involved pedestrians.
- 1 pedestrian crash involved a pedestrian crossing on the slip lane however due to negligence of pedestrian.
- All others involved **pedestrians crossing against the signal**.
- Insufficient crash information available to determine if removal of slips have resulted in a safer pedestrian environment.

Preliminary Design Guide for Pedestrians at Left Turns

	High Ped Volume	Low Ped Volume
High Traffic Volume	Consider use of Partial Pedestrian Protection for the Walk interval . A late start can also be considered.	
Low Traffic Volume	Consider use of Partial Pedestrian Protection with Walk + ½ Clearance	Consider use of Partial Pedestrian Protection.

Conclusions and Recommendations

- Both left turn treatments result in:
  - Increased clearance times for pedestrians and vehicles
  - Increased cycle times
- The nine intersection study showed a relationship between increased cycle times and pedestrian non-compliance
- More research needed to quantify the effects of urban design elected treatments on safety and efficiency
- Better informed implementation of left turn treatments on a case by case basis rather than “blanket” application

Acknowledgments

- Peter Evans – NZ Transport Agency
- Tim Booth – GHD Ltd and Doug Wilson – UoA
- Auckland Transport (Mitch Tse)

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