TECHNICAL NOTE

SHARED SPACE:
TOWARDS A PEOPLE FOCUSED MODELLING STRATEGY

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ABSTRACT:

Pedestrians represent a highly significant element of total road users in urban areas, however most planning and modelling is focused solely on the movement of vehicles. This paper seeks to demonstrate the value of incorporating pedestrians in traffic modelling.

Three case studies are presented to demonstrate where combined traffic and vehicle modelling delivers real benefit, not only to engineers and modellers, but also to policy makers, urban designers and planners.

The three case studies have helped to identify the following benefits:

- The interaction between vehicles and pedestrians at crossings can be modelled and the signal timings adjusted to optimise performance for all road users;
- The models can be used to improve the urban environment for pedestrians through enhanced safety and improved efficiency at crossing points;
- Informal crossing, red-man crossing and gap acceptance can be modelled more accurately to gain a better understanding of the crossing capacity of road sections;
- Pedestrian queuing at crossings can be dynamically modelled and incorporated into venue/event strategy plans;
- Bus stops and vehicle drop off and pick up can be modelled with a greater degree of precision; and
- More realistic visualisations can be produced providing more confidence in the output.

INTRODUCTION

Traditionally planners, modellers and engineers all too often focus solely on the movement of vehicles in urban areas. Although efficient vehicle movement is of vital importance, the efficient movement of pedestrians should be an integral part of everyday engineering solutions, particularly when pedestrians represent the dominant road users in many areas. As traffic engineers and urban designers strive to create a more pedestrian friendly environment, the need to understand people behaviour and their interaction with other modes of transport becomes more critical.

Analysis of pedestrian movement and the use of pedestrian simulation software are important tools for predicting pedestrian movement in environments with significant vehicle and pedestrian interaction. This is becoming increasingly important as policy makers and transportation planners seek to remove the distinctions between vehicle space and pedestrian space through shared space environments. These environments help to enhance the vibrancy of the urban realm but have been criticised as being chaotic, dynamic and within them travel patterns change according to the surroundings. It is essential, therefore, to incorporate this complex behaviour into any planning and design to achieve effective and sustainable engineering solutions.

This technical note will cover how such vehicle / pedestrian / crowd modelling tools and software can be used to provide advice on pedestrian movement at CBD intersections and event crowd planning for major international sporting events.

PEDESTRIAN MOVEMENT IN CBD ENVIRONMENTS

Two case studies are presented here to demonstrate the value of combining pedestrians and vehicles in single models for studies of busy urban areas.

Case Study 1 - Methodology

Pedestrian behaviour at crossings has always been a concern in an urban environment. While controlled pedestrian crossing facilities are provided at most signalised intersections in a typical CBD, little consideration has been given to how pedestrian desire lines coincide with such existing facilities. The relationship between pedestrian crossing and safety is complicated with some research indicating that pedestrian safety increases where pedestrian compliance with signals decreases. This is because pedestrians tend to be more careful and aware of traffic when they are not reliant on signals.

Intersection design has traditionally been focused on providing an optimum environment for vehicles. Multiple lanes or slip lanes are often introduced to minimise delays and queues. However, this can create a very pedestrian unfriendly environment, in particular the challenge for pedestrians to cross over a fast-moving stream of traffic on a slip lane without any form of guidance.

We have attempted to demonstrate how elements of intersection geometry can be reflected using transportation modelling, to better understand the interaction between vehicles and pedestrians and the likely effects of any proposed improvement scheme on the performance of all modes which share the same road space.

The studied intersection is a signalised intersection located on Mayoral Drive in the Auckland CBD. The existing layout of the intersection raises a few issues on pedestrian safety as the number of pedestrians grows over the years. The high speed left-turn slip lanes compounded with pedestrians' lack of awareness of crossing the slip lanes have caused a few near-miss accidents. Significant numbers of pedestrians were also observed to cross just south of the intersection as this path is considered a more direct access to major facilities. Figure 1 highlights the current issues at the studied intersection.

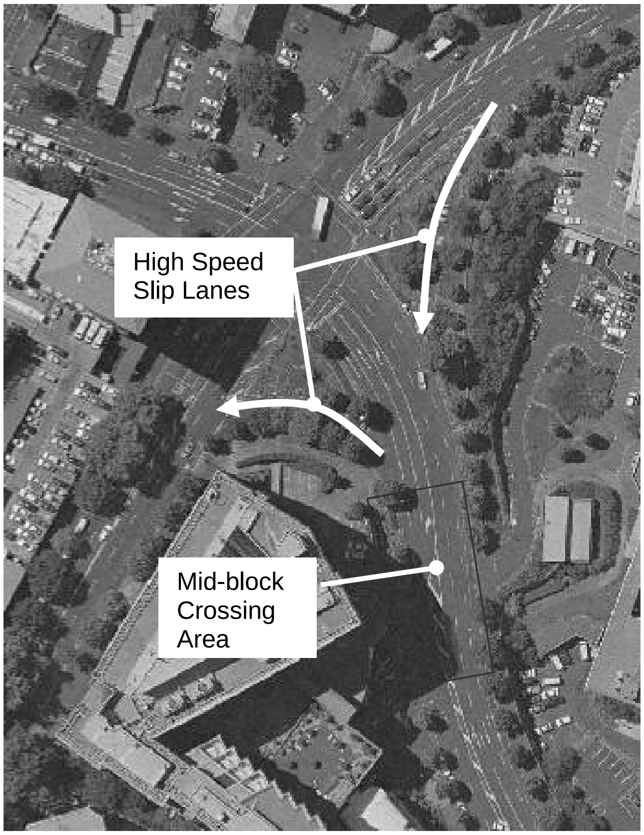

Figure 1 – Studied Intersection Layout

A VISSIM micro-simulation model was developed to represent the existing conditions of this intersection. Vehicle and pedestrian demands were derived from real-time data together with actual signal timings/phasing and observed pedestrian walking routes. Profiles were also established to reflect the unique arrival and departure patterns of both vehicles and pedestrians. As well as modelling a distribution of driver behaviour, a range of pedestrian behaviour was modelled, taking into account the 'risk-taking' crossing behaviour at the mid-block location through accepting smaller gaps in approaching vehicular flows. Attention was given to accurately reflect the vehicle travel speeds at the slip lanes, the level of queuing for critical movements and the interaction between pedestrians and vehicles at the mid-block crossing.

Case Study 1 - Key Findings

The proposed improvement scheme looked at installing a pedestrian refuge at the mid-block crossing location along the desired line of crossing. This may increase safety by providing some form of protection to pedestrians, and creating a waiting area before completing the crossing. In addition, the potential effects of removing the slip lanes were investigated to minimise the conflicting area.

Table 1 summarises the model predicted vehicle average delay time at the intersection and pedestrian average delay time at the mid-block crossing with corresponding Level of Service shown in parentheses. These key performance indicators were chosen to assist a statistical comparison and to illustrate the impact of such an improvement scheme.

Table 1 – Vehicle and Pedestrian Performance

Scenario	Vehicle Delay, s/veh	Pedestrian Delay at Mid-block, s/ped
Existing	41.6 (D)	25.9 (D)
With Improvements	43.2 (D)	19.6 (C)

The results above suggest that installing the pedestrian refuge reduces the pedestrian delay time as the crossing can now be made in two stages and therefore the opportunity of seeking a gap can be reduced to one direction only. Although the removal of slip lanes at this intersection may cause some delay to the vehicular traffic, especially to the left turners, the impact could be slight, depending on the traffic flows and pedestrian volumes. Removing the slip lanes may also encourage more pedestrians to cross at the signalised intersection. The slip lanes are perceived as unsafe and informal surveying has indicated that people choose to cross mid block to avoid the safety hazard posed by the crossing of the unsignalised slip lanes. In the case of this intersection, the improvement scheme tested is considered feasible and does not significantly affect the normal traffic operations. Figure 2 illustrates the proposed intersection layout.

Figure 2 – Proposed Intersection Layout

Case Study 2 - Methodology

The use of microsimulation modelling including pedestrians is particularly important where new generators of traffic, both vehicular and pedestrian, are planned. Kerr (2008) undertook a study into the impact of introducing a new underground railway station (on the proposed Crossrail line) adjacent to an intersection on an already busy pedestrian shopping street (Oxford Street) in the heart of London, in the UK.

A number of different analysis techniques were used. Survey data were collected to quantify the current levels of pedestrian and vehicle flow in the area around the intersection. Two levels of pedestrian model were then developed to forecast the impact of increasing footfall associated with the introduction of the new station. The first was a bespoke macro scale model (developed using a modified Saturn based modelling package) designed to forecast the dispersal characteristcs of rail passengers from both the new station, and an existing station in the relative vicinity of the new station. It was important to incorporate both stations because, although the new station generated significant new demand, it resulted in a redistribution of demand from the existing station. The second stage in the modelling involved the construction of a detailed micro-simulation model using the Legion software tool. The purpose of this was to understand, in detail, the interaction between pedestrians entering or leaving the station and those circulating on the surrounding streets.

Case Study 2 – Key Findings

The results showed the forecast change in pedestrian density following the opening of the new station was not geographically consistent. Although there were some significant increases in density forecast on certain pavement sections, there were also some significant decreases reflecting the shift in demand away from the existing station, and the change in trip patterns caused by the opening of the new station. This demonstrates the value of undertaking this kind of analysis as it enables policy makers and planners target their investment on the areas where the impact is greatest.

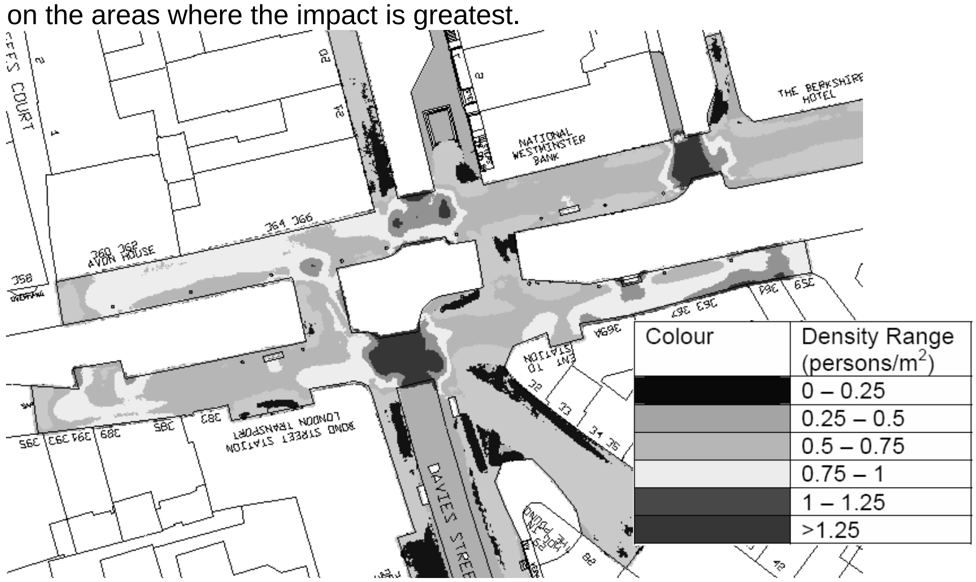

Figure 3 – Pedestrian Densities in the Study Area

Figure 3 is a sample output from this study showing the pedestrian densities forecast for the study area following the opening of the station. This highlights particularly high densities around the pedestrian crossings (as well as on sections of footpath close to bus stops). As a result of this finding, the study was expanded to incorporate an AIMSUM microsimulation model of the vehicle movements in the study area. The models were constructed in such a way as to be compatible with each other. This provided the following benefits to the study:

- The interaction between vehicles and pedestrians at crossings could be modelled and the signal timings adjusted to optimise performance for all road users;
- Informal crossing, red-man crossing and gap acceptance could be modelled more accurately to gain a better understanding of the crossing capacity of road sections;
- Bus stops in the area could be represented with a greater degree of precision; and
- More realistic visualisations could be produced providing more confidence in the output for the client.

PEDESTRIAN MOVEMENT AROUND LARGE SPORTING EVENTS

Modelling the interaction between pedestrians and vehicles is also relevant for large scale sporting events. A major international event currently being planned requires the efficient movement of large volumes of pedestrians between sporting venues and transport interchanges along and across streets which have significant traffic movements.

One particular such route crosses a busy urban arterial, which is required to remain operational during the 16 days of sporting events at the nearby venue. Two models have currently been produced. The first is of the pedestrian movements between the venue and the nearby railway station, showing the required pavement width to accommodate the forecast demand as well as the required green-man time across the arterial. The second model is of the vehicle movements around the venue (including the aforementioned arterial). This shows how much priority needs to be allocated to vehicular movements to ensure efficient operation.

The next stage in this particular study is to construct a combined model of both pedestrian and vehicular movements. This will deliver the following benefits:

- It will show the impact on traffic circulation of providing enhanced green-man time for pedestrian movements;
- It will show the impact on pedestrian queuing at the crossing (and therefore journey times between the venue and the station) of providing sufficient green time for vehicular movements;
- It will indicate whether informal crossing will deliver extra capacity; and
- It will enable an optimisation process to be undertaken to determine the optimal signal timings for all road users.

CONCLUSIONS

Conventional microsimulation traffic modelling with a vehicle-based focus may no longer be sufficient for busy urban environments, especially where pedestrians play a key role in sharing the road space with other modes of transport. Improving pedestrian amenity needs to be considered in every intersection design and modelling tools offer the opportunity to understand the interaction between pedestrians and vehicles. They are also powerful visual tools, for engineers, planners, urban designers and policy makers to 'visualise' future operations. Sophisticated pedestrian modelling software has also proven to be of great benefit for high pedestrian density situations, such as sporting events. Therefore, moving towards a "People Focus Strategy" will add value to the day-to-day engineering decisions for traffic engineers and urban designers in creating a more pedestrian friendly environment.

REFERENCE

KERR, A.P. (2008), Assessing the impact of underground railway stations on busy pedestrian streets – a case study of Bond Street Crossrail station, Association of European Transport