The Forgotten Transport Modes

Planning for the Future

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Summary

New Zealand transport practitioners seem to underestimate the potential of the transport modes walking, cycling and public transport and focus mainly on the private motor vehicle. This paper examines possible improvements for these ‘forgotten transport modes’ based on European concepts that are applicable for New Zealand conditions.

The requirements of pedestrians are analysed, which show that speed reduction, ease of crossing the road and the provision of space on the footpath are the main issues.

Emphasis should be put on providing for cyclists, with this being a sustainable form of transport but under-utilised in New Zealand. Cycling could be a major catalyst for improved community health. A coherent network with emphasis on stress point treatment is required.

It is shown that New Zealand cities (large and small) should and could have attractive public transport systems. Bus priority, improved ticketing and concepts so far only used overseas can help in making public transport more attractive.

The paper gives helpful concepts of how to engineer the transport sector for the whole community without reducing the options available to future generations.

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TABLE OF CONTENTS

List of Illustrations

1 INTRODUCTION

The private motor vehicle is the dominant form of urban transport in many cities around the world and certainly in New Zealand. Although the social benefits of car use clearly exist, problems arise especially in urban centres, like high crash rates, air and noise pollution, congestion and community severance to name a few.

The author has lived in some German cities where the problems are certainly more pressing than in New Zealand, but has witnessed some remedial measures that reflected the need to implement drastic changes in order to achieve a difference. With increasing traffic volumes, New Zealand is heading towards similar problems. It is from this background that the author believes that urban traffic problems can be addressed by providing mainly for other transport modes than the car.

Many New Zealand transport practitioners focus mainly on the private motor vehicle. This paper therefore addresses 'the forgotten transport modes': walking, cycling and public transport. It is the author's experience that their potential is completely underestimated.

Table 1: Capacity of a 3 to 4 m roadway[1]

Mode	Maximum Capacity (people/hour)
Car	2,300
Bus	7,000 to 10,000
Cyclists	13,300
Tram	18,000 to 25,000
Pedestrian	20,000
Light Rail	40,000 to 50,000

An example is road capacity for cars, often the main concern of traffic engineers, ignoring or not knowing that the capacity for every other mode is significantly higher as Table 1 shows. Another example is the different space requirements for bus users and motorists, as illustrated in Figure 1.

[1] reproduced from Monheim et al (1990), page 157

This paper gives some examples of how pedestrians can be provided for so that walking becomes more desirable and safer. It discusses why cycling should be promoted and which facilities cyclists require. Finally, possible improvements for public transport in New Zealand are investigated.

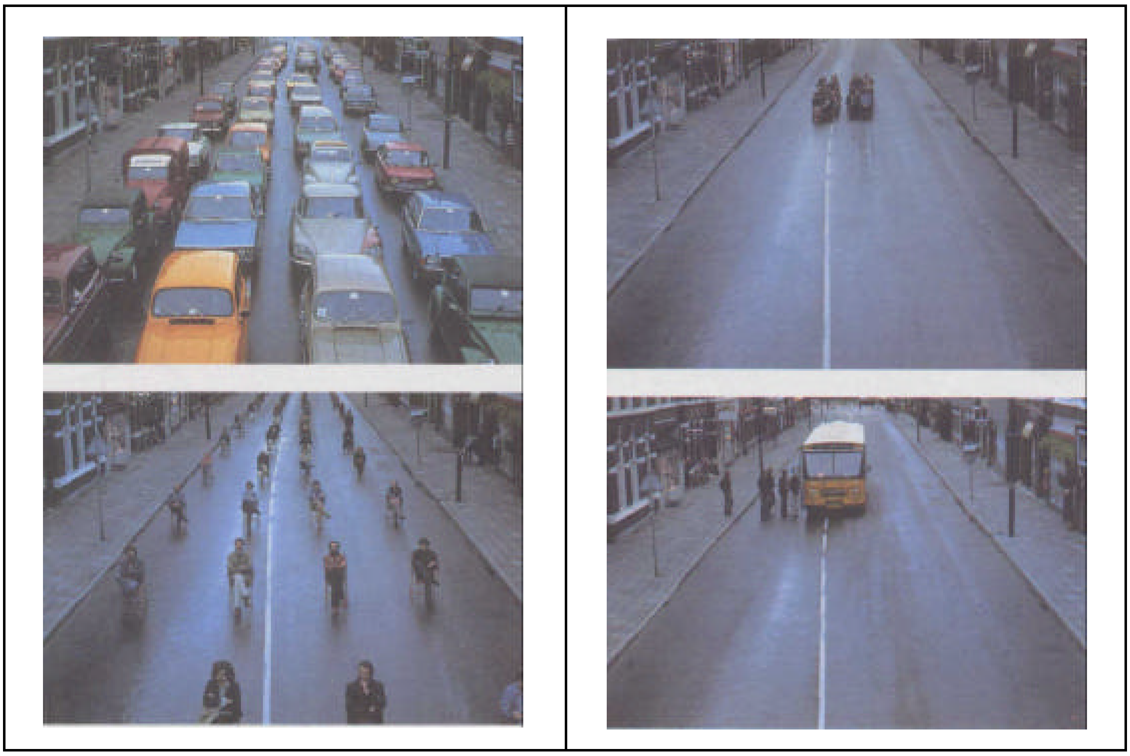

Figure 1: Space Requirements of Different Modes

By writing this paper, the author has several objectives:

- To encourage considering pedestrians, cyclists and public transport users as legitimate modes of transport.
- To share workable examples of providing for the 'forgotten transport modes' with other practitioners.
- To challenge some existing practices.

Overall, the topics provide tools for engineering the transportation system for the whole community. Some of the examples given are appropriate for larger cities only, whereas others are also applicable for provincial centres.

2 FEET FIRST

The flair of European cities is to a large extent due to pedestrians that walk, stand, communicate, sit, play etc. On the contrary, planning mistakes have resulted in barren American city centres without pedestrians. The author believes that the positive European examples should be examined more closely rather than following the American trend.

Speed

In 1985, legislation for area wide speed restrictions to 30 km/h was introduced in Germany.

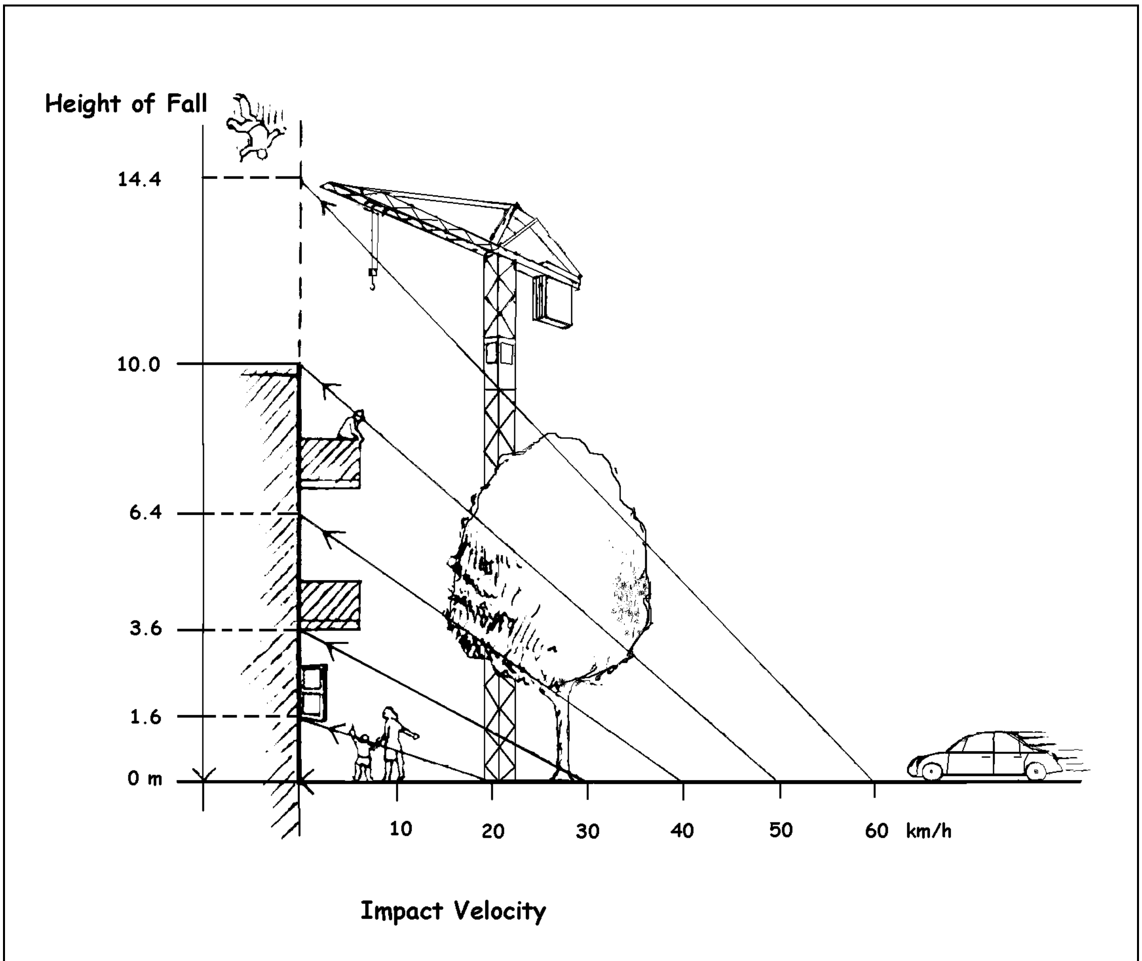

Figure 2: Relationship of Injury Severity and Speed [2]

This resulted in noise reductions, traffic redistribution to faster flowing arterials and safety improvements for pedestrians due to speed reduction, as Figure 2 illustrates. Roads became

[2] Reproduced from Monheim et al (1990, page 195)

easier to cross, as there was less traffic, which was moving at a slower speed, with the gaps between vehicles increasing. Within five years, some 600 area speed limits were established in Hamburg alone (Monheim et al, 1990, page 201).

Following these early improvements, the German government ratified legislation in 1998 that cities have the option to reduce the general speed limit to 30 km/h and signpost only important network roads with higher speed limits.

Figure 3: Traffic Calming based on Co-Existence of Modes

The above measures are examples of speed reductions, but the roads are still dominated by vehicles. The principle of co-existence is used in specially sign posted traffic calmed areas (Figure 3). Pedestrians and vehicle drivers have the same rights in these areas, with the speed limit being walking speed. Pedestrians are allowed to walk anywhere, cross diagonally, and children can play on the road. It does not surprise that the rate of serious or fatal accidents reduces by 40 to 60% when these areas are established (Monheim et al, 1990, page 200).

Crossing

Crossing the road is obviously the most dangerous activity for pedestrians. A combination of kerb extensions and refuge islands is being used to improve the situation, with the following mechanisms achieving positive results:

- The crossing distance and hence the exposure time to moving traffic is reduced.

- The probability of finding a gap more quickly is higher. Research shows that pedestrians become impatient after only a few seconds of delay, accepting reduced gaps and thus increasing their risk [3].
- The pedestrian waits closer to moving traffic and is more visible to motorists, not hidden behind parked cars.
- Kerb extensions have traffic calming effects, as they visually and actually narrow the road, which often reduces traffic speeds. This effect is more pronounced when parking demand is low.

Although the positive effects of kerb extensions are plentiful, their provision is an exception. Rather than having the odd kerb extension as a remedial safety treatment in otherwise wide carriageways, why not provide a narrower carriageway with parking bays wherever these are needed?

Figure 4: Arterial Road [4] with Parking Bays and Cycle Lanes

Most residential streets are oversupplied with on-street parking, it seems only logical to use some of this vacant space for other purposes. It could be an interesting consultation exercise

[3] Abley (1999) discusses some research findings. He consequently recommends 15 and 30 seconds as maximum tolerable delays for local/collector and arterial roads, respectively.

[4] Adelaide, Australia

for a carriageway reconstruction to give residents the choice between on-street parking using parking bays and a wide, landscaped berm.

The community loves them, traffic engineers consider most of them as being dangerous: Zebra crossings. For the pedestrian, this crossing type offers a convenient facility with right of way. But numerous studies exist showing a high crash rate for zebra crossings. Often, the answer of the road controlling authority is that the zebra crossing has to be removed, which regularly causes emotional debates with residents. In 1989, some 127 zebra crossings existed in Christchurch. Seven years later, only 83 crossings remained. Half of the removed number has to be accounted for the installation of traffic signals and the other half was just taken away (Abley, 1996).

To the author it seems that their removal is the most convenient way to deal with the problem of high crash rates; a system failure as the zebra crossing seems to be wanted by the community. The more complex course would be a combined effort of education, engineering and enforcement to reduce the crash rate, which would surely be the more pedestrian-friendly approach.

Space

Looking at historic photos, one can find all sorts of street furniture on the carriageway. These days, everything is placed on the footpath with some clearance from the kerb to cater for a vehicle envelope.

A good example for an improvement of the conditions for pedestrians comes from the Netherlands. In the 60s and 70s, roads in subdivisions were built too wide. As a traffic calming measure, the roads were retrofitted with central islands for lampposts and signs. The visibility of signs was increased, traffic speeds were reduced and the footpaths were effectively widened and made more pedestrian-friendly by the removal of the street furniture.

3 CYCLING INTO A HEALTHY FUTURE

3.1 Why Promote Cycling

Fuel Resources

It can be expected that within the lifetime of most of us, oil production will peak with fuel shortages and price increases being a consequence. Fleay (1995) recently modelled world oil production, predicting a peak around 2015. If we are serious about planning for the future, we should certainly not be implicitly assuming that we would have cheap fuels early in the next millennium.

Reduce Emissions

Cycling is, next to walking, the only emission-free form of transport. Especially in urban centres, a significant replacement of short trips undertaken by car could make a difference.

Table 2: Percentage Urban Trips by Bicycle [5]

City	**Cycling: Percentage Urban Trips**
Groningen	60
Beijing	48
Münster	48
Delft	43
Odense	25
Copenhagen	20
Basel	20
Christchurch	8.7
London	2
Auckland	1.8

An international comparison of the proportion of cycle traffic of the modal split shows the potential for future developments (Table 2). In the Christchurch region, some 20% of home

[5] reproduced from Lowe (1999), Müller (1998), Statistics New Zealand (1996)

based work trips are within 3 km long and some 45% are within 5 km (Gabites Porter Consultants, 1993). As these data for the region include places like Rolleston and Rangiora with a high proportion of the community commuting to Christchurch, it can be assumed that the percentage for short distance home based work trips in the Christchurch urban area is higher than the above values. 5 km is well within the range that can easily be done by bike, indicating a possible high increase in cycle trips.

Improve Community Health

The World Health Organisation and the World Bank jointly published a report on global health. (Murray et al, 1996) The report examined not just the incidence of disease and death rates but also the impact of diseases through the prevalence of disability and years of life lost. In developed world countries, the two risk factors associated with the greatest number of deaths and years of life lost are tobacco and physical inactivity.

The National Heart Foundation of Australia estimates that about half the people taking drugs for high blood pressure would not require drug treatment if they had 20-30 minutes of moderate exercise most days. Although the most prevalent risk factor for heart disease is physical inactivity, most health spending is on treatment of heart disease not prevention. (Owen, 1999)

To date health promotion has concentrated on “special” exercise. The Hillary Commission (1999) lobbies doctors to prescribe exercise in so-called “green prescriptions”, e.g. walk for half an hour every day. But most people are so busy they just don’t have time to exercise. There is a realisation among preventative-health professionals that the physical activities that are continued throughout life are those that become a natural part of everyday life. In this way exercise is incidental to lifestyle, it doesn’t require special arrangements, it just happens. Longitudinal surveys reveal there are three activities that are maintained throughout life: walking, cycling and gardening. (Ibid.)

3.2 **Providing Cycle Facilities**

Network

Providing for cyclists in an urban area requires the development of a network of interconnected facilities. This leads to the interesting question which corridors should be chosen for the cycle network. It may be hard to accept by the practitioners, but plotting the roads with the highest volumes of cyclists will most certainly result in a map that approximates the arterial network. In practise, comprehensive cycle count data for a city will be the exception.

It can be assumed that in general, motorists and cyclists have the same motives for travel and will both choose the quickest route. Planning for motorists supports this by the network hierarchy. The more direct a route, the higher it is in general in the hierarchy, the higher are the vehicle volumes. Thus vehicle volumes may indicate where cycle facilities are needed. Exceptions will occur where convenient paths exist that are not accessible for motorists, e.g. through a park or along a riverbank.

Figure 5: Parking Problems in Münster, Germany

Arterial routes offer direct travel, unimpeded by stop or give way signs, and as a result become the preferred route for both motorists and cyclists. However, the corresponding high traffic volumes and higher speeds may make these routes dangerous for cyclists if they are not catered for, and as a result some will not use them. Other deterrents might be intersections that are perceived to be dangerous, i.e. the routes themselves are attractive, but the junctions are the constraining factor. A network development should therefore not only take existing demand into account, but also future potential.

The Dutch design guide sums up what five main requirements for cycle facilities are: coherence, directness, attractiveness, safety and comfort (CROW, 1993, p.24). The cycling infrastructure must form a coherent unit with continuous routes. Just like the network for motorists.

Success in planning for cyclists might result in its own set of problems, though, as Figure 5 shows.

Stress Point Treatment

Stress points may be defined where cyclists are vulnerable or where they feel unsafe. This may be at intersections, in weaving areas, at the inside of bends, or in narrow lanes. An analysis of European cycle design guides [6] reveals an emphasis on careful treatment at these stress points. Cycle facilities should be obvious to every road user. The facilities should continuously guide the cyclist through the area and indicate to motorists that they can expect cyclists here and what their likely path is (see Figure 6).

Figure 6: Cycle Lane Treatment at Intersection [7]

[6] CROW (1993), Sustrans (1996), FGSV (1995)

[7] Mirror image for reasons of readability.

The British design guide recommends the use of a red coloured surface material at stress points indicating that a higher level of alertness is required by the road users (Sustrans, 1996, Figure 5.12).

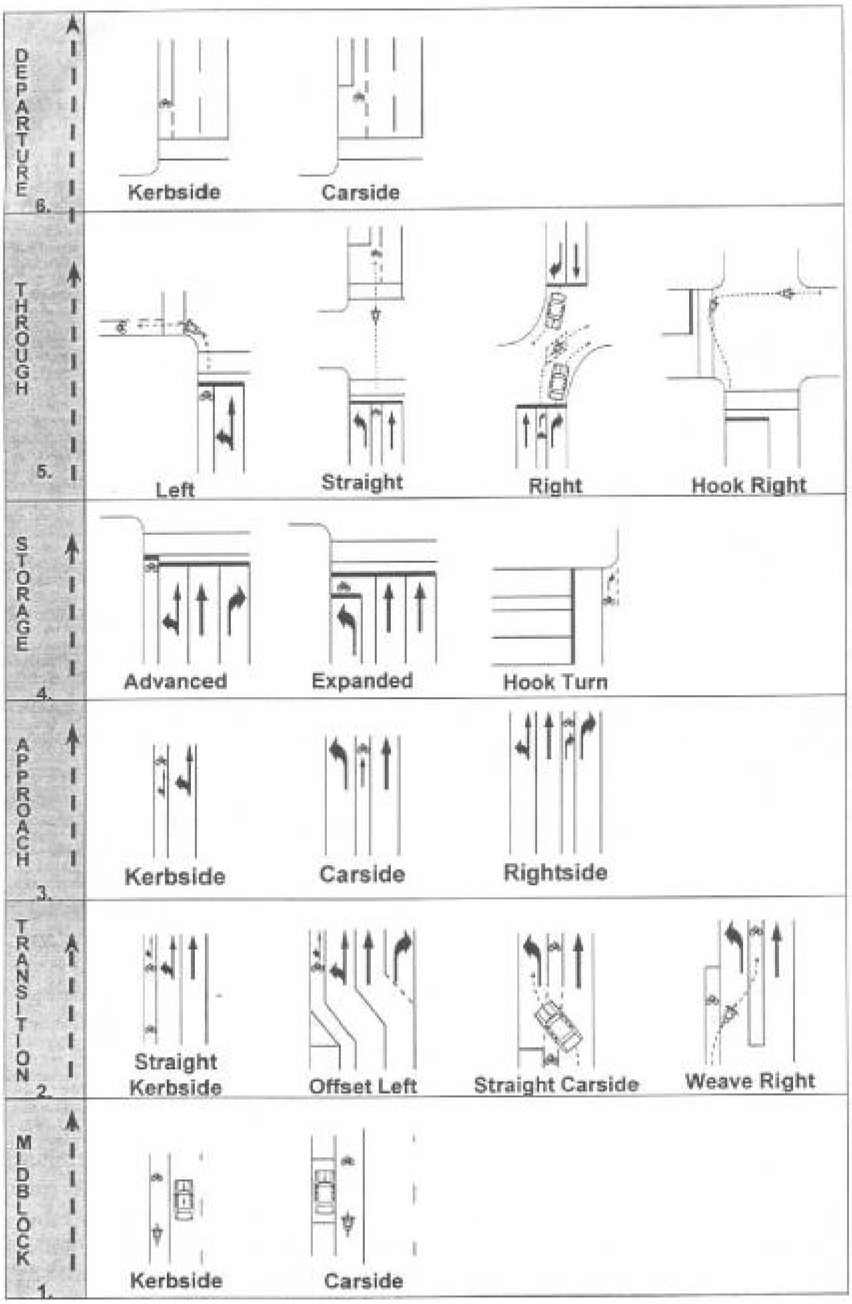

Figure 7: Intersection Model for Cycle Design [8]

The Transit New Zealand road-marking manual (TNZ, 1994, page 3-50) has a completely different philosophy. Cycle facilities "should terminate at the end of the parking zones or at

[8] Reproduced from Cummings (1999)

least 7 m ahead of the formation of the turning lanes”. Where the facilities are most needed, the guide recommends discontinuing them. My recommendation is to leave the TNZ manual on the bookshelf, to refer to one of the European guides and to adjust the designs achieving compliance with the New Zealand legislative framework.

Intersection Design

Cumming et al (1999) have developed a tool for designing intersections for cyclists. The complex design task has been broken into a number of smaller and simpler design issues. The six elements of the model bicycle intersection are mid-block, transition, approach, storage, through and departure (see Figure 7). This model is also an effective tool for reviewing intersection design. The number of elements used in a design can be taken as an indicator of its cycle-friendliness.

4 GREEN LIGHT FOR PUBLIC TRANSPORT

4.1 The Need for Public Transport

Public transport is widely regarded as the transport mode for people who cannot afford a car. We have to overcome this view, as bus and, in the larger cities, light rail have a far more vital role to play for our city centres: public transport will allow us to keep our cities easily accessible, even during peak times. As Table 1 showed, a bus system provides four times the capacity of a lane as compared to the car.

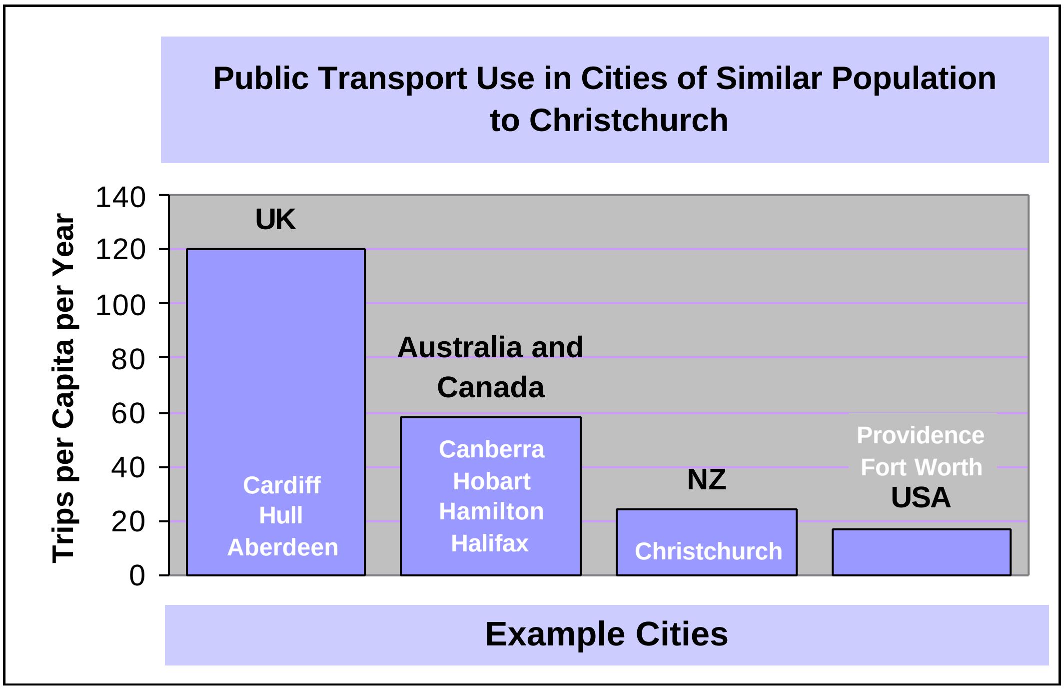

Figure 8: Comparison of Public Transport Use [9]

It is generally known that commuters are easiest to attract by public transport, as their travel patterns generally do not change from one day to the next. This has not only the potential to ease congestion during peak travel times, but also reduces the number of car parks taken up by this group for whole days. These parks are in turn available for people who want to reach the city centres for shopping purposes and who generally need their cars for transporting goods. Attracting commuters to public transport can therefore be seen as a tool to vitalise city centres, as it is better accessible by people who need to bring their cars.

[9] Reproduced from CRC (1998), page 3

4.2 The Public Transport Myth

Many New Zealanders, including members of the transport profession, believe that only very large cities can have an attractive public transport system. This is clearly not the case, as a study of the Canterbury Regional Council shows (CRC, 1998). Figure 8 tells us that Australian and Canadian cities of similar population to Christchurch have 200 to 300% higher use, UK cities have 300 to 600% higher use. In fact, other European cities of similar population have 1000 to 3000% higher uses.

These comparisons suggest that we make poor use of our public transport system. Increasing the use of public transport will make better use of our existing transport system. Attractive public transport systems can even be found in small cities (see Figure 9).

Figure 9: Central Bus Interchange in a small German City [10]

[10] Lemgo, a city of 42,000, operates 6 buses that meet in the city centre every 30 minutes for convenient interchange.

4.3 Bus Priority

Bus priority, applicable in larger cities or in smaller cities with some congestion, comprises a whole range of measures to reduce delays for public transport. In Christchurch, for example, commuter public transport travel time is about 200% of car travel time (CRC, 1998, page 7). The aim is to shift the percentage value closer to 100, thus making public transport more attractive.

The following list gives an overview of available tools suitable for bus systems. It shows that many different options exist for improvements.

Bus Lanes

The aim is to provide unimpeded passing of traffic queues (see Figure 10) or using a part of the network that is restricted for use by other modes of transport.

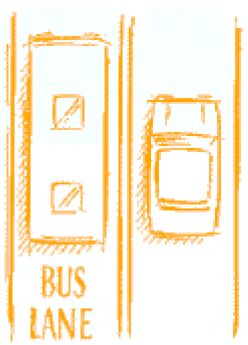

Figure 10: Bus Lane

- Bus-only lane is the simplest form.
- The lane may also be used by other transport modes (e.g. taxis, cyclists) or for specific movements (e.g. a kerbside bus lane may be used by left turning motorists) or may only be provided during certain times of the day (i.e. bus clearway).
- A contra-flow bus only lane may be used by buses in one direction during the morning peak and in the other direction during the evening peak.
- A bus only right of way.

Bus Signals

- Allows buses to enter controlled area ahead (or behind) of other traffic.
- Can be used at intersection, bus stops or for a bus advance area (see Figure 11).
- When bus signals are provided at intersections, the lane can only be used by other traffic if special signals are provided as well (e.g. cycle signals for shared use with cyclists, or turn arrows for shared use with motorists).

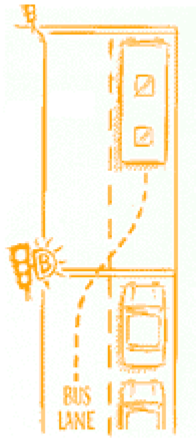

Figure 11: Bus Advance Area

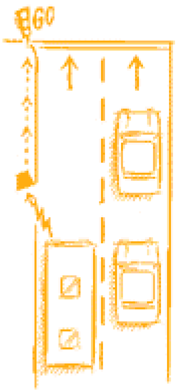

Figure 12: Signal Pre-Emption

Green Time Extension

- Keep signals green until approaching bus has entered the intersection.
- Problem: May conflict with co-ordination.

Signal Pre-Emption

- Reduce the queue length at congested traffic signals before the bus arrives (see Figure 12) reducing the delay experienced by the bus patrons.

Phase Sequence Change

- Introduce the phase the bus requires earlier compared to the normal sequence.

Displaced Traffic Jam

(a) Controlling access to congested network element at the periphery:

- Restrict access to a congested element where bus priority is not possible at a rate so that congestion does not occur.
- Provide bus priority at the restricting elements (usually signalised intersections)

(b) Controlling traffic in the vicinity of the bus:

- Provide bus stops at kerb build-outs (Figure 13).
- When the bus stops, the road ahead of the bus empties.
- Consequently, the bus has uncongested conditions after stopping.
- Bus stop can be reduced in length, as no manoeuvring is necessary.

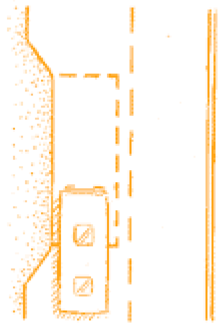

Figure 13: Bus Border

4.4 Ticketing

Despite all bus priority measures, the biggest potential for travel timesaving can often be found in the ticketing system. In Christchurch, up to 30% of the peak travel time is taken up by ticketing transactions (CRC, 1998, page 8). The driver deals with every patron, either selling a ticket or checking that the patron carries a valid pass, which is surely a very inefficient system.

By international standards, a bus driver's most important role is to drive the bus. The next most important role is to give information to patrons. Then it may be that the driver sells tickets to patrons who have not bought one elsewhere, although an increasing number of buses are fitted with ticket vending machines. That the bus driver also has to ensure that patrons have a valid boarding pass is a rarity in modern transport systems.

Once it is no longer the driver's role to sell and check tickets, boarding passengers can use all doors and are not confined to the front door. This reduces the boarding time considerably and results in reduced travel time for all passengers. Economic evaluations about the financial loss due to non-paying patrons versus the level of control by conductors have been available since the 1960s (Fiedler, 1968).

4.5 Creative Concepts

Friday and Saturday nights are the busiest times for taxi companies, which comes as no surprise as people enjoy themselves in the city centres and cannot drive themselves due to alcohol consumption. Yet no public transport is available when the majority of these people want to get home.

Night buses have quite some potential in raising the attractiveness of public transport and in gaining new customers. But a service needs to be offered that is to be perceived as safe, which can be achieved doing the following:

- Night buses should stop anywhere along their normal route at request (provided it is safe to stop) for setting down passengers, not just at stops. Not having to walk some distance from the bus stop to ones property in the middle of the night may be all takes to make a person feel safe.
- Co-operation with taxi companies during night times is a service well received wherever this has been implemented. When boarding, the passenger requests a taxi from the bus driver for the destination bus stop. This information is relayed to the taxi company, with the taxi waiting at the requested stop when the bus arrives. The bus passenger has therefore travelled the majority of the journey with the cheaper mode and enjoys the comfort and safety of a taxi on the final leg.

5 CONCLUSIONS

- With increasing traffic volumes, New Zealand is heading towards similar traffic problems as experienced in Europe or America. To address these problems, solutions that have been used overseas should be looked at.
- The potential of the transport modes walking, cycling and public transport are underestimated in New Zealand.
- The most important improvement for pedestrians is speed reduction of motor vehicles, which is followed by easing road crossing manoeuvres and providing space on footpaths.
- Cycling has a high potential for a reduction in emissions in New Zealand and could be a major catalyst for improved community health.
- Planning for cyclists should focus on a network and put emphasis on stress point treatment and intersection design.
- International comparisons suggest that we make poor use of our public transport system and that even small centres can provide attractive public transport.
- Bus priority, improved ticketing and creative operational concepts can all be used to make public transport more attractive.
- Engineering for the whole community requires paying particular attention to the requirements of all traffic modes, not just the private motor vehicle.

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