Chapter 11

TRANSPORT

Improving traffic flows in Stellenbosch

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Introduction

No community can reach its full potential without an effective transport system. Be it the daily commute to or from work, school or university, or other activities such as business, shopping and recreation, transport has a direct bearing on most human activities in most communities. The economic viability of a town is highly dependent on the efficient movement of goods and the delivery of essential services by means of a transport network. Moreover, the safety of all users of transport has become a critical issue in many developing countries, and especially so in South Africa.

In the global village of the twenty-first century, the sustainability of communities and even nations is dependent on the efficient use of energy in the transport sector. Not only do we see the end of the availability of fossil fuels in the not too distant future, but we have also become painfully aware of the consequences of the use of fossil fuels, particularly the pollution of the atmosphere and resultant global warming.

For many years, the focus of 'sustainable transport' internationally has been on developing new forms or systems of transport with low environmental impacts, and these priorities will remain important in future. Transport is the largest end-user of energy in developed countries and the fastest growing one in most developing countries. In terms of developing sustainable communities, efficient and appropriate transport systems are important to ensure access to markets, employment, education and basic services. As such, efforts to improve traffic flows through urban areas in order to reduce emissions; develop appropriate and workable public transport systems and non-motorised transport to reduce dependence on private car ownership; and provide a road network that maximises efficiency while optimising environmental protection, will continue to require coordinated effort.

In the local context, issues around sustainability are framed largely in terms of what the current transport conditions are, and how they can be redesigned locally to achieve the desired long-term improvements. In this chapter, we will be discussing the *status quo* of transport in Stellenbosch; the specific problems and challenges that transport issues present for the town; and the way forward towards the implementation of a sustainable, integrated and intermodal transport system.

The current transport situation in Stellenbosch

In his book, *Transportation for liveable cities*, Vukan Vuchic (1999) noted that the era of projects aimed at maximising vehicular traffic was coming to an end, with the focus shifting towards the broader goal of achieving liveable cities, i.e. economically efficient, socially sound and environmentally sustainable. Considering that our goal here is also the development of a sustainable and liveable Stellenbosch, we need, as a first step, to understand the characteristics of the current traffic situation in the town and the problems facing its residents and visitors.

The two primary problems are those of congestion and road safety, both of which result in significant economic and social costs; and both of which must be addressed if our goal is to be realised. While congestion and road safety have specific dimensions, both are compounded by three common factors: lack of public transport, poor provision for non-motorised transport, and patterns of transport operation and enforcement that often undermine efficient transport flows.

The problem of congestion

⊡ *General issues*

Considering the size of its population and the extent of its road network, Stellenbosch carries a disproportionately high number of vehicles on its roads and parking areas (legal and otherwise). There has been considerable growth in traffic volumes over the past ten years, to the extent that the majority of intersections on the main roads operate at Level of Service F.[1] For example, the annual average daily traffic on the R44 at the Blaauwklippen Road (just outside of town, towards Somerset West) increased from 20 500 in 2000 to 35 400 in 2009 – an average growth rate of 6.2% per year (see Table 11.1), compared to the average Western Cape growth rate of 3.7%. If this 6.2% growth rate is maintained, traffic volumes will triple by 2030; even at 3.7%, they will still double by 2030.

Apart from the simple fact of a steep increase in the number of vehicles on the roads, there are a number of reasons for the high rate of vehicle use in Stellenbosch, the primary one being the lack of public transport within the town. In addition, many students from surrounding towns make use of private transport to commute to campus, mainly because of the unreliability of the rail system, but also other problems related to safety and security on trains. There are also a large number of people who travel to, from and through Stellenbosch on their way to or from other towns to the south and north. Finally, there are the heavy vehicles using the R44 through Stellenbosch to avoid the weighbridges on the N1 and N2 freeways.

⊡ *Freight and congestion*

Freight transport in the Stellenbosch Municipality consists primarily of local traffic and through traffic to neighbouring municipalities, since none of the major corridors runs through this municipality. Local freight relates mainly to the agricultural industry, construction in the area and the needs of the inhabitants and business sector, for example Fast Moving Consumer Goods (FMCGs), fuel and other consumables.

Table 11.1 shows the 2009 and projected 2030 Average Annual Daily Traffic (AADT) volumes[2] on the respective roads around Stellenbosch. The projected volumes are approximately double the current volumes.

Table 11.1 Daily traffic flows around Stellenbosch

Counting station	Total vehicles		Heavy vehicles	Total vehicles	Heavy vehicles
	Observed 2000	Observed 2009	Observed 2009	Projected 2030	Projected 2030
R44 Blaauwklippen	20 510	35 406	1 266	73 224	3 213
R44 Cloetesville	12 928	19 339	1 106	39 995	2 824
R304 Kayamandi	14 151	18 247	867	37 737	2 203
Polkadraai	13 641	19 207	1 216	39 722	4 360
Helshoogte	5 358	6 893	373	14 256	1 131

Given the current level of congestion in Stellenbosch, it is clear that the estimated growth in freight volumes cannot be accommodated by the existing infrastructure and traffic management systems.

1 Level of Service is defined by the Highway Capacity Manual (Transportation Research Board, USA, 2000) in terms of the average delay per vehicle with Level A being the best (less than five seconds) and Level F the worst (greater than 80 seconds).

2 The average annual Western Cape traffic growth rate of 3.7% was used to calculate the volumes for 2030.

⊡ *The consequences of congestion*

Traffic congestion, especially during the morning peak, has a number of negative effects. Saturated traffic flows are financially costly, because they contribute significantly to loss of productivity and economic inefficiency of business and pose huge problems for service delivery in the local area. In urban areas, a reduction in the average speed to below 30 km/h has a marked effect on time spent on the road. It has also been shown (Pienaar 1981) that, in terms of fuel and tyres, the cost of vehicle operation during congestion is much higher than during free-flow situations. This is exacerbated by the accelerations and decelerations necessitated by stop-start driving. Table 11.2 shows the daily fuel consumption of vehicles on the major roads in and through Stellenbosch.[3] These are the only roads for which recent traffic volume are available, and on them alone the total daily fuel use is in excess of 40 000 litres.

Table 11.2 Calculation of fuel consumption on major Stellenbosch roads[3]

From	To	Distance (km)	AM volume	PM volume	Daily volume	Peak speed	Off-peak speed	Peak fuel	Off-peak fuel	Total fuel (l)
R44 Strand-Adam Tas										
100 km/h	Webersvallei	0.350	3 392	3 263	33 275	60	80	201.2	844.8	1 046.1
Webersvallei	Technopark	0.682	3 360	3 400	33 800	45	80	447.0	1 672.2	2 119.3
Technopark	Blaauwklippen	0.915	3 524	3 594	35 590	30	80	814.4	2 362.3	3 176.7
Blaauwklippen	Van Reede	1.800	3 889	4 038	39 635	20	70	2 333.9	4 918.5	7 252.4
Van Reede	Safraan	0.439	2 703	2 814	27 585	20	50	396.2	890.3	1 286.5
Safraan	Dorp	0.487	3 304	3 209	32 565	20	40	518.8	1 317.9	1 836.7
Dorp	Adam Tas	0.310	2 095	2 094	20 945	20	40	212.4	539.6	752.0
Adam Tas	Merriman	0.556	3 258	2 869	30 635	20	40	557.2	1 415.4	1 972.7
Merriman	Bird	0.931	1 221	1 484	13 525	20	50	411.9	925.7	1 337.7
Bird	Cloetesville	2.530	1 968	1 900	19 340	50	70	899.3	3 373.3	4 272.7
Bird Street										
100 km/h	2nd Avenue	0.450	1 447	1 869	16 580	20	35	244.1	674.6	918.7
2nd Avenue	Adam Tas	0.758	1 112	1 765	14 385	20	35	356.7	985.9	1 342.6
Adam Tas	Molteno	0.494	1 120	1 170	11 450	20	35	185.0	511.4	696.4
Molteno	Merriman	0.390	1 099	1 194	11 465	20	35	146.3	404.3	550.5
Merriman	Dorp	0.832	1 214	1 356	12 850	20	35	349.8	966.6	1 316.4
Merriman										
Adam Tas	Bird	0.550	1 130	1 167	11 485	25	40	178.3	524.9	703.2
Bird	Ryneveld	0.312	1 026	1 201	11 135	25	40	98.0	288.7	386.7
Ryneveld	Marais	1.080	988	1 105	10 465	25	40	319.0	939.2	1 258.2
R310 Adam Tas										
Strand	80 km/h	3.17	1 978	1 887	19 325	30	50	1 532.0	4 503.9	6 035.8
Helshoogte Road										
R44	80 km/h	3.02	701	678	6 895	45	55	403.8	1 473.1	1 876.9
TOTAL (Litres/day)										40 138.1

The environmental consequences of traffic congestion are also a major concern. While South Africa has not yet implemented any robust monitoring of traffic-related pollution, international research (for example, Carslaw, Ropkins & Bell 2006) has shown that gaseous and particulate traffic-related pollutants increase in direct relation to traffic congestion. Increased air pollution, in turn, has been causally linked to respiratory illness, particularly among children, and so poses a direct health risk to local populations.

Congestion has also been shown to be a factor in the growing incidence of transport-related stress, potentially resulting in depression, aggression and disaffection, which have the potential to impact on driving behaviour and hence to undermine road safety. The psychological consequences of repeated exposure to traffic congestion

3 The fuel consumption was calculated from the distances travelled and the average speeds of the vehicles (Pienaar 1981).

are only now beginning to be understood. What is significant is that traffic congestion may have a direct impact on the psychosocial health of a population.

While congestion is most commonly conceived of as a problem specific to the through movement of vehicles at specific times of the day, it is also related to the general density of vehicles within a town and the facilities provided for these vehicles. One particular problem in this regard in Stellenbosch is the lack of sufficient provision for parking, which is seriously exacerbated by the high level of illegal parking that occurs in the town. Apart from adding to the challenges for through traffic, as well as to environmental and social problems, the parking problems create major obstacles for pedestrians and often have a marked impact on sight distance at intersections. It has been estimated (Vela VKE 2010) that the current shortage of parking spaces is between 4 000 and 5 000 on the university campus alone. To provide these spaces on open land (if available) would cost about R80 million. In parking garages and basements, the cost would be R500 million.

The problem of road safety

⊡ *International features of the problem*

Past debates on sustainability have often overlooked the impacts of transport on the actual road users and, in particular, have ignored the problem of poor levels of road safety. Indeed, at the World Summit on Sustainable Development held in Johannesburg, South Africa, in 2002, there was not a single agenda item that addressed road safety, in spite of the fact that this is one of Africa's biggest and fastest-growing public health concerns.

In 2002, road traffic injuries ranked as the tenth leading cause of death in the world (United Nations World Health Organisation (WHO) 2002). By 2004, that ranking had risen to seventh, and it is expected that road injuries will rank as the fifth highest leading cause of death by 2030 (WHO 2005). While other causes of premature mortality worldwide are showing signs of improvement, road injuries are instead increasing in importance.

A lack of reliable data across the continent makes it difficult to pin down an accurate estimate of lives lost, but the number of fatal traffic injuries in Africa was estimated to be around 200 000 in 2002 (WHO 2009). As a continental average, the WHO has estimated that the aggregate rates of road traffic fatality per 100 000 members of the population in Africa are 28.0, compared to 11.0 for Europe (Peden, Scurfield, Sleet, Mohan, Hyder, Jarawan *et al.* 2004). At 32.0 per 100 000 people, South Africa's aggregate rate exceeds that of the continental average. Between 13 500 and 15 000 people are reported killed in traffic collisions in South Africa annually. Around 100 000 people are seriously injured, often resulting in significant long-term financial and social challenges and the perpetuation of poverty cycles.

There can be no sustainable development when the prevailing transportation systems allow for loss of life and lack of human safety at such a scale. According to a 2007 national Medical Research Council of South Africa (MRC)/University of South Africa (UNISA) study, which collected mortuary and police data related to all types of non-natural deaths across South Africa, 48% of all non-natural deaths occurred on roads, surpassing all other potential locations by a factor of at least 2.4 (Donson 2008). But if roads are the locus of many fatal and serious injuries, one should also point to the broader existing transport systems – of which roads are just one element – as being largely responsible for creating circumstances and road-user behaviour that precipitate collisions and hence injuries.

⊡ *Road safety trends*

South Africa shares a number of road safety trends with other developing countries. These include:

- Road collision deaths affect the young and economically active disproportionately.
- Significantly more males than females are killed annually: the percentages in most developing countries equate to approximately 25% female: 75% male, and this is true for South Africa as well (see Figure 11.1).
- Pedestrian deaths account for a significant proportion of traffic fatalities. In South Africa pedestrians accounted for 35% of traffic fatalities in South Africa between 2007 and 2009 (Road Traffic Management Corporation (RTMC) 2008), and this figure was higher in the Western Cape, at 44% (see Figure 11.2).
- Buses, minibuses and trucks are over represented in accidents.
- Single-vehicle collisions or loss-of-control collisions are common.

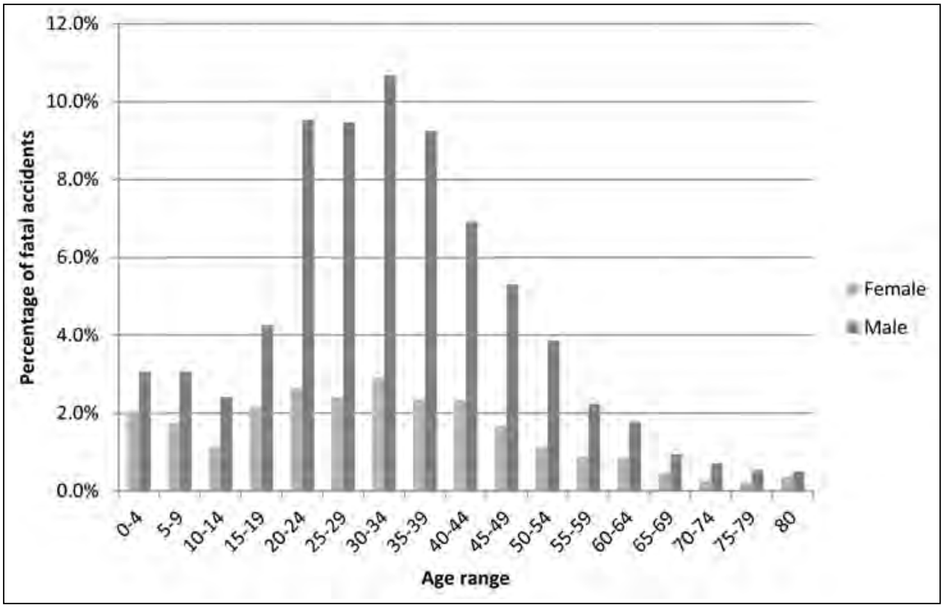

Figure 11.1 Age/gender comparison of fatal road accidents in the Western Cape, 2007-2009[4]

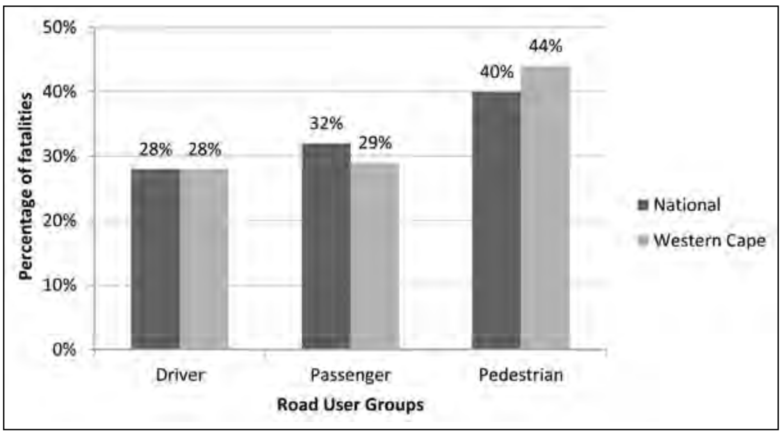

Figure 11.2 Comparison of fatalities by road user type, 2007-2009[4]

⊡ *Problems specific to South Africa and the Stellenbosch area*

South African road safety problems are a result of a combination of factors that are common to Africa, including poor road infrastructure, poor road maintenance, lack of facilities for non-motorised transport, behavioural issues related to road users (including aggression, lawlessness, etc.), alcohol abuse and drug use, and the fact that police enforcement of traffic laws is limited and sporadic. However, two further features have shaped current road safety problems in South Africa.

Firstly, apartheid planning created spatial inequalities of access for different race groups, leaving poor communities on the outskirts of urban areas and forcing them into long commutes to work and school, while at the same time providing no safe pedestrian facilities or effective public transport. This is arguably the most crucial safety issue facing commuters in Stellenbosch today. Stellenbosch is a town where just less than 25%

4 Data for Figures 11.1 and 11.2 sourced from the RTMC National Collision Database, a copy of which was provided to Stellenbosch University by the RTMC in April 2010.

of its population is 15 years old or younger, indicating a high dependency ratio and a high percentage of the population relying on non-motorised or public transport. School buses, serving predominantly rural areas around Stellenbosch, are the primary means of school transport for approximately 13 000 children in the area. Recent efforts by the traffic police to regulate these buses have seen a crackdown on large numbers of unroadworthy buses and unlicensed drivers; yet such problems persist. The safety of school children is also compromised on a daily basis by the location of pickup and drop-off sites along main arterials and the fact that children as young as six years of age regularly cross fast-flowing arterials at informal crossing points.

Secondly, over the past decade South Africa has experienced an unprecedented increase in the registration of new vehicles, with the number of vehicles registered increasing by 38.8% between 2000 and 2009 (from 670 000 to 930 000 vehicles, respectively) (RTMC 2008). Increased traffic flows are undoubtedly a factor in the levels of traffic collisions, yet more work is needed to determine the specific nature of this relationship.

Stellenbosch is unusual in the sense that it is a university town, and its traffic flows (and collision levels) are significantly affected by the presence or absence of students. This is most noticeable in a monthly breakdown of collisions, which shows a marked decline in collisions during the month of December, when students are away on summer vacation.

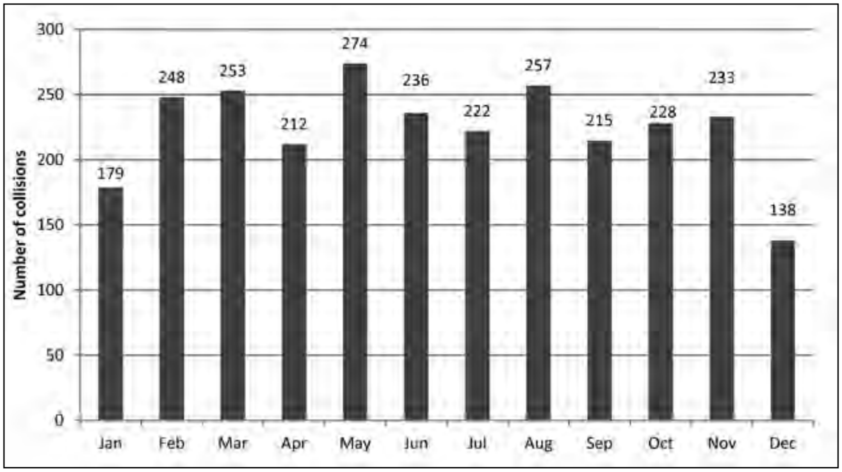

Figure 11.3 Stellenbosch collisions reported by month, 2009 [Data provided by Stellenbosch Municipality Traffic Department]

For the remaining eleven months of the year, the traffic police recorded an average of 232 collisions per month, 20% of which result in injuries. Over the three-year period from 2007 to 2009, 38 collisions generated 45 fatal injuries, while a further 1 534 people were injured, 224 of whom sustained serious injuries. During this time, 72 collisions with pedestrians were recorded, 22% of which involved hit-and-run drivers.

Issues contributing to congestion and poor road safety

⊡ *Non-motorised transport (NMT)*

Many of the trips made in Stellenbosch are still made on foot. Here one thinks of students, tourists, people from the poorer communities who do not have access to motorised transport, and all the motorised transport users who have to go to and from their parking areas and public transport interchanges. Very few trips are made by bicycle, which is largely ascribable to the narrow streets in Stellenbosch and the lack of a network of safe cycle routes.

The largest flow of pedestrians outside the university campus is from Kayamandi, along Bird Street to the central business district (CBD) – a route with a high number of pedestrian accidents.

In June 2008, Stellenbosch Municipality appointed consultants to draw up the Development of a Non-Motorised Transport (NMT) Network Plan for Stellenbosch, which included the identification of the various NMT generators and trip purposes, such as commuting, shopping, school and university, and recreational and competitive sport. Priorities for implementation were defined in terms of the needs for the 2010 World Cup (SSI Engineers & Environmental Consultants 2009).

Prior to this, the Stellenbosch Town Transport Master Plan (STTMP) identified the following routes and areas for priority attention (Arup Transport Planning 2007):

- Kayamandi – CBD;
- Pedestrianisation of Church and Andringa Streets;
- Town-wide NMT network upgrade;
- CBD street network;
- Stellenbosch Station – CBD;
- University – CBD;
- Kayamandi – Plankenbrug; and
- Kayamandi – Cloetesville.

Public transport

Apart from school buses, there is no formalised bus system in Stellenbosch and minibus taxi services cover only the low-income residential areas and farm workers. On any given weekday, there are typically 100 taxis operating on 27 routes from five ranks in town, with 7 500 passengers carried on 940 vehicle trips. One-third of daily passengers are carried in the morning peak hour (07:00-08:00) strongly suggesting that the majority of passengers are commuters (Arup Transport Planning 2007).

The Stellenbosch railway station sees 492 boarding and 843 alighting passengers during the morning peak hour, with 8% fewer during the evening peak hour (Arup Transport Planning 2007). Rail travel certainly has the potential to be a more significant and popular means of accessing Stellenbosch, though investment is needed to improve the amenities and increase the safety of passengers, as well as to diversify routes and increase train numbers.

Transport operations and law enforcement

Traffic and transport regulations and control are important for regulating the traffic flow in an orderly and sustainable way, thereby reducing congestion. It has been shown that the delay to vehicles may be reduced by optimal phasing and coordination of traffic signals. In Stellenbosch, traffic signals on the main congested routes are not part of a single system – some operate on an isolated basis, while others are controlled from Cape Town. To complicate matters even further, some intersections that are not signalised are controlled by traffic officers. This makes coordination particularly challenging.

When traffic regulations are not enforced, the safe and orderly flow of traffic is not possible. The enforcement effort in Stellenbosch is concentrated around the use of speed and red light cameras. Recent research (Roux, GB 2010) has shown that speed cameras in Stellenbosch reduce the speed of vehicles only in the immediate vicinity of the cameras. Another study (Verlinde 2010), which looked at the behaviour of drivers at stop-controlled intersections in Stellenbosch and Somerset West, indicated that fewer than 15% of drivers come to a complete stop under free-flow conditions. The 85th percentile of minimum speeds through these intersections was 19 km/h. In a survey of students, only 7.9% indicated that they always stop at these intersections; and when questioned about the reasons why they do not stop, 11.6% cited the lack of law enforcement as one reason. A study on pedestrian behaviour (Roux, AW 2010) also indicated a large disregard for traffic regulations by both drivers and pedestrians.

Rethinking transport with a view to the future

Principles

The guiding principles of the STTMP are an excellent starting point for the development of an altered transport system for the town. These principles are as follows:

- *Promote choice for mobility:*
  - *support those who cannot afford private transport;*
  - *provide public transport as a viable alternative for car users; and*
  - *manage congestion.*
- *Ensure access to:*
  - *opportunities for all;*
  - *land and developments; and*
  - *transport for the disadvantaged.*
- *Develop great streets (liveable areas):*
  - *provide a safe environment;*
  - *provide spaces and facilities of dignity; and*
  - *consider aesthetics principles and the conservation of historical and cultural assets.*
- *Achieve sustainability through:*
  - *securing funding for capital investment and the maintenance of infrastructure;*
  - *financial viability of public transport operations;*
  - *preservation of the natural environment; and*
  - *support of social and economic objectives.*

[Arup Transport Planning 2007]

These principles highlight the rights of Stellenbosch residents to safe and effective transport opportunities, while at the same time acknowledging the need to protect the natural and cultural environment of the town. The achievement of these principles must occur through the development of a vision of what the town can and should become, as well as addressing existing problems and challenges that are already pressing. The paragraphs that follow contain some suggestions for achieving this end.

Addressing congestion and freight issues

Changing infrastructure

It has been shown worldwide that the problem of congestion cannot be solved by the provision of more road infrastructure (Vuchic 1999). However, this does not mean that bottlenecks in the infrastructure should not be improved. The intersection between the Strand Road and Adam Tas Road and the northern section of Bird Street are two examples where changes in the physical layout of roads could bring about an immediate improvement in congestion levels. The possibility of different bypass routes may also be considered.

Changing employment practices

Crucially, the data shows that the peak 15-minute period around 08:00 in the morning carries 40% more traffic than any other 15 minutes during the day (Arup Transport Planning 2007). This is a clear indication that there is considerable scope for transport demand management actions, such as variable working hours at different employers, or even flexible working hours at the same employer. Small changes in the employment practices of local businesses and even educational institutions could result in greater efficiency of traffic flows.

Managing freight

In terms of managing the needs of freight traffic, new ways will have to be found to organise freight flows in an efficient and sustainable way. Freight flows in the town centre include deliveries to supermarkets, shops, restaurants and offices. Therefore, the efficiency of freight logistics has a direct impact on product prices and on-shelf availability.

According to the *BESTUFS*[5] *Good Practice Guide on Urban Freight Transport*, commissioned by the European Union in 2007, the following measures may be implemented to manage urban freight:

- *designated routes for freight vehicles;*
- *limits on the size and weight of delivery vehicles;*
- *limits on access times to town centres;*
- *restrictions on emissions and noise produced by delivery vehicles; and*
- *"nearby delivery areas" – areas of street space dedicated to goods vehicles for the loading and unloading of goods destined for nearby shops.*

[Allen, Thorne & Browne 2007]

Such measures obviously have to be designed and introduced in collaboration with local business, and special attention should to be paid to the transport of hazardous goods.

⊡ *Traffic flow management*

Looking at the current traffic management of the town, it is clear that the existing control infrastructure may be utilised to far better effect. Traffic control must be appropriate and signals should be coordinated.

⊡ *Long-term answers*

Steps such as those described above may bring about significant changes to the flow of traffic through or around the town in the short to medium term.

However, the long-term, sustainable solution to congestion lies in a greater use of public transport – by commuters in particular – and in encouraging non-motorised transport for shorter trips. The aim must be to move more people with fewer vehicles, which would address both congestion and road safety in direct and lasting ways.

As a university town, Stellenbosch has tremendous scope for introducing and celebrating cycling as a major form of local transport. For this to happen, however, dedicated and safe cycle lanes must be made a priority by the local council. The present level of cycling collisions in the town indicates that current provision for cyclists is unsatisfactory, and that without the necessary commitment and resources, the potential for cycling will remain unrealised. The scale and amenities of the town also create an opportunity to make more provision for pedestrians. In terms of encouraging NMT, it is imperative that the town prioritise the provision of pedestrian and cycle spaces that are safe and attractive and do justice to the historic and cultural elements of the town.

Ultimately, the town must also consider whether there is merit in disincentivising vehicular traffic through the town, as is being done elsewhere by means of congestion charging and higher parking fees (see the 'Congestion charging' case study at the end of the chapter). However, this cannot happen until suitable alternatives, in the form of both efficient public transport and opportunities for NMT, are achieved.

Addressing road safety issues

When considering the vulnerability of pedestrian and other forms of non-motorised transport, it is commonplace to blame the engineering profession for a lack of protective elements. Indeed, the lack of safe public transport options certainly stands out as a key missing piece in the transport plan for Stellenbosch and is undoubtedly one area of improvement that the engineering industry should bring to fruition. There are clearly areas in town that accommodate large numbers of pedestrians on a daily basis, where safer pedestrian shelters and crossing points, and even barriers to pedestrian movement, could directly reduce pedestrians' exposure to vehicular traffic. However, a recent survey of pedestrian behaviour along Bird Street (the main pedestrian arterial through the town), indicated a marked lack of use of the crossings provided, with pedestrians motivated more by immediacy of access than safety (Roux, AW 2010). High-risk crossing behaviour was recorded on a frighteningly regular basis. While the study indicated that physical solutions may be found for some of the areas indentified

5 Best Urban Freight Solutions.

in it, any long-term answer to the pedestrian problems of Stellenbosch must involve re-educating pedestrians about not only their right to safety, but also their responsibilities.

A similar lack of compliance to traffic laws was noted by Liebenberg (2010), in his study of the yielding behaviour of cyclists at a four-way stop in Stellenbosch. Liebenberg found that cyclists exhibited little regard for traffic laws and operated inconsistently, sometimes functioning as vehicles and at other times behaving similarly to pedestrians. If the town is to achieve higher levels of cycling as a form of NMT, it will be essential to offer education and guidance to the town's cyclists in order to ensure more consistent and safer cycling behaviour.

Alcohol has been shown to play a causal role in injury collisions in South Arica in general; in terms of the Western Cape, the 2007 MRC/UNISA study on fatal injuries, based largely on autopsy results, found that 56.2% of drivers and 64.7% of pedestrians showed elevated blood alcohol levels (Donson 2008). This is certainly a challenging problem to overcome, but concerted efforts must be made to re-educate the public about the dangers of alcohol to all road users, and alternative means of transport must be prioritised in order to ensure that drunk driving may be avoided and inebriated pedestrians' opportunities for conflicts with vehicles are minimised.

Conclusion

Congestion and road safety already affect the daily lives of Stellenbosch residents, and constitute the core transport challenges to be addressed in developing a new and sustainable future. By identifying the common issues that contribute to these problems, namely the lack of public transport, the poor provision for non-motorised transport, and the challenges pertaining to traffic management, we are better placed to identify the key components of a future transport system for the town.

Stellenbosch needs an integrated, intermodal transport system that makes adequate provision for all the people of the town and effectively addresses their need for mobility, accessibility and safety. This must be attained through responsible planning to provide a system that is economically efficient, socially sound and environmentally sustainable. Such a system must be founded on a greater emphasis on public and non-motorised transport, yet without neglecting the requirements of vehicles that are necessary for essential services and economic activities.

Stellenbosch has an extraordinary opportunity to rethink its future as far as traffic flow, road-user safety and transport efficiency are concerned, and, through reprioritising the human users of our roads, to develop a new vision of transport that improves both environmental and human quality of life.

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CASE STUDIES

Multimodality

There are many examples of towns and cities across Europe where transportation policy has increasingly reflected the significance of ecological considerations, and where changes have been made to successfully reduce emissions and improve quality of life, while maintaining economic efficiency. **Freiburg**, in Germany, is one such example. While it benefitted from an early introduction of a tram system to its urban infrastructure, Freiburg has committed itself to reshaping its transport infrastructure to achieve the following objectives:

- increasing non-motorised mobility;
- increasing use of public transport;
- reducing car mobility;
- reducing car parks; and
- reducing energy consumption.

Over the past thirty years, Freiburg has concentrated its efforts on introducing an extensive network of 30 km/h zones, promoting bicycle use, and improving the public transport sector. This includes improvements to the size and synchronisation of the tram and bus systems and the introduction of a single regional fee card for public transport, which allows commuters to use multimodal transport opportunities without duplicate charges.

This policy of enhancing opportunities for public transport and making it affordable and accessible to residents has had very positive results: between 1976 and 1996, car use declined from 60% to 43%. Moreover, 90% of the town's university students use public transport or bicycles as their sole source of transport within the town.

Congestion charging

London is running the biggest congestion charging experiment in the world. As such, the city is widely used as an example when considering the potential benefits that congestion charging may bring.

In 2003, congestion charging was implemented in the central London boroughs. It had an immediate impact, reducing the amount of traffic in the heart of the capital by about 15%. Transport for London (TfL), who manages the scheme, claims that the total quantity of traffic in the city fell by 21% between 2002 and 2006, with public transport absorbing the bulk of the difference. In addition, bicycles have increased by 49%, taxis by 13%, and buses and coaches by 25%.

Overall, the scheme appears to have resulted in a significant reduction in congestion levels, and the surplus income generated has been reinvested back into improved public transport. In spite of these achievements, a high level of public opposition to theses charges remains and there are claims that small businesses have suffered. Such claims are, however, disputed by TfL.

Other cities, including San Francisco, are currently developing similar schemes to the London model, with congestion charging to be used to generate funds for the improvement of public and non-motorised transport facilities.

Minibuses as a component of public transport

Hong Kong transport officials have embraced small buses as a complement to their larger passenger buses for those city streets that are too narrow for conventional buses and for routes where the numbers of potential passengers are too low to support conventional buses. This system has also allowed the city to legalise the minibus taxi sector, much of which was previously operating without any formal management.

Minibuses, or 'light' buses, offer advantages over conventional buses in that they are typically faster and more efficient and can be deployed more frequently along routes at lower cost. Like their South African counterparts, the minibus taxis of Hong Kong carry a maximum of 16 seated passengers, with no standing room. The city has chosen to adopt formal routing and scheduling for the majority of these buses (known as 'green-line' buses), while allowing other minibuses to operate informally on demand ('red-line' buses).

In 2002, the government offered subsidies to convert minibuses from diesel to liquefied petroleum (LP) gas; it is now looking at repeating the scheme to facilitate a transfer to hybrid, or even electric, vehicles.

The Hong Kong example demonstrates how an existing transport sector may be used more efficiently and tied into a more synchronised system of multimodal transport opportunities to enhance passenger convenience.