Division 44
Environment and Infrastructure
Sector project: “Transport Policy Advice”

Sustainable Transport:
A Sourcebook for Policy-makers in Developing Cities
Module 3d:

Preserving and Expanding the Role of Non-motorised Transport

Deutsche Gesellschaft für
Technische Zusammenarbeit (GTZ) GmbH

OVERVIEW OF THE SOURCEBOOK

Sustainable Transport: A Sourcebook for Policy-Makers in Developing Cities

What is the Sourcebook?

This *Sourcebook* on Sustainable Urban Transport addresses the key areas of a sustainable transport policy framework for a developing city. The *Sourcebook* consists of 20 modules.

Who is it for?

The *Sourcebook* is intended for policy-makers in developing cities, and their advisors. This target audience is reflected in the content, which provides policy tools appropriate for application in a range of developing cities.

How is it supposed to be used?

The *Sourcebook* can be used in a number of ways. It should be kept in one location, and the different modules provided to officials involved in urban transport. The *Sourcebook* can be easily adapted to fit a formal short course training event, or can serve as a guide for developing a curriculum or other training program in the area of urban transport; avenues GTZ is pursuing.

What are some of the key features?

The key features of the *Sourcebook* include:

- A practical orientation, focusing on best practices in planning and regulation and, where possible, successful experience in developing cities.
- Contributors are leading experts in their fields.
- An attractive and easy-to-read, colour layout.
- Non-technical language (to the extent possible), with technical terms explained.
- Updates via the Internet.

How do I get a copy?

Please visit www.sutp-asia.org or www.gtz.de/transport for details on how to order a copy. The *Sourcebook* is not sold for profit. Any charges imposed are only to cover the cost of printing and distribution.

Comments or feedback?

We would welcome any of your comments or suggestions, on any aspect of the *Sourcebook*, by email to sutp@sutp.org, or by surface mail to:

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Modules and contributors

Sourcebook Overview, and Cross-cutting Issues of Urban Transport (GTZ)

Institutional and policy orientation

1a. *The Role of Transport in Urban Development Policy* (Enrique Peñalosa)
1b. *Urban Transport Institutions* (Richard Meakin)
1c. *Private Sector Participation in Transport Infrastructure Provision* (Christopher Zegras, MIT)
1d. *Economic Instruments* (Manfred Breithaupt, GTZ)
1e. *Raising Public Awareness about Sustainable Urban Transport* (Karl Fjellstrom, GTZ)

Land use planning and demand management

2a. *Land Use Planning and Urban Transport* (Rudolf Petersen, Wuppertal Institute)
2b. *Mobility Management* (Todd Litman, VTPI)

Transit, walking and cycling

3a. *Mass Transit Options* (Lloyd Wright, ITDP; GTZ)
3b. *Bus Rapid Transit* (Lloyd Wright, ITDP)
3c. *Bus Regulation & Planning* (Richard Meakin)
3d. *Preserving and Expanding the Role of Non-motorised Transport* (Walter Hook, ITDP)

Vehicles and fuels

4a. *Cleaner Fuels and Vehicle Technologies* (Michael Walsh; Reinhard Kolke, Umweltbundesamt – UBA)
4b. *Inspection & Maintenance and Roadworthiness* (Reinhard Kolke, UBA)
4c. *Two- and Three-Wheelers* (Jitendra Shah, World Bank; N.V. Iyer, Bajaj Auto)
4d. *Natural Gas Vehicles* (MVV InnoTec)

Environmental and health impacts

5a. *Air Quality Management* (Dietrich Schwela, World Health Organisation)
5b. *Urban Road Safety* (Jacqueline Lacroix, DVR; David Silcock, GRSP)
5c. *Noise and its Abatement* (Civic Exchange Hong Kong; GTZ; UBA)

Resources

6. *Resources for Policy-makers* (GTZ)

Further modules and resources

Further modules are anticipated in the areas of *Driver Training*; *Financing Urban Transport*; *Benchmarking*; and *Participatory Planning*. Additional resources are being developed, and an Urban Transport Photo CD (GTZ 2002) is now available.

Module 3d:

Preserving and Expanding the Role of Non-motorised Transport

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With additional input by Oscar Diaz, Institute for Transportation and Development Policy

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GTZ Transport and Mobility Group, 2003

Cover photo: Bike lane in Bogotá, Colombia, Feb. 2002. Photo by Karl Fjellstrom

About the author

Walter Hook received his PhD in Urban Planning from Columbia University in 1996. He has served as the Executive Director of the Institute for Transportation and Development Policy (ITDP) since 1994. He has also served as adjunct faculty at Columbia University's Graduate School of Urban Planning. ITDP is a non-governmental organization dedicated to encouraging and implementing environmentally sustainable transportation policies and projects in developing countries.

1. Benefits of a greater role for non-motorised transport

Many developing cities have implemented policies which reduce the appeal of cycling, encouraging people to travel by motorised means even for short trips. However, an increasing number of city governments in developed and developing cities have recently begun actively promoting bicycling and walking.

Pedestrians, bicyclists, and cycle rickshaw passengers generate no air pollution, no greenhouse gases, and little noise pollution

Reducing these emissions and noise are critical to slowing global warming, reducing incidents of asthma and other upper respiratory and cardio-vascular disease, and reducing sleep disorders. In both developed and developing countries, upper respiratory illnesses, particularly asthma, are increasing dramatically. While emission standards and cleaner vehicles can greatly reduce certain emissions, reducing carbon dioxide, nitrogen oxides, and ground level ozone through tailpipe-focused measures alone is proving exceedingly difficult. These emissions are growing rapidly in most developing country cities as the use of motor vehicles increases. Sleep deprivation is also a problem of growing seriousness, the medical significance of which is only beginning to be understood.

Bicyclists and pedestrians are more efficient users of scarce road space than private motor vehicles, helping to combat congestion

While fully occupied public transit vehicles are the most efficient users of road space, bicyclists use less than a third of the road space used by private motor vehicles, and pedestrians use less than a sixth. Even cycle rickshaws use considerably less road space per passenger than motorised taxis and single occupancy private motor vehicles (see Figure 1).

Bicycling and walking are the most efficient and environmentally sustainable means of making short trips

In most developing cities, average trip distances are extremely short. Often over 60% of trips are under 3 kilometres long. In well planned German cities, over 80% of trips under 3 kilometres would be made by walking or bicycling, generating no pollution and minimal traffic congestion. Surabaya, for example, is only 15 kilometres north to south. This means virtually no trip inside the city is too far for an average healthy cyclist's average commute.

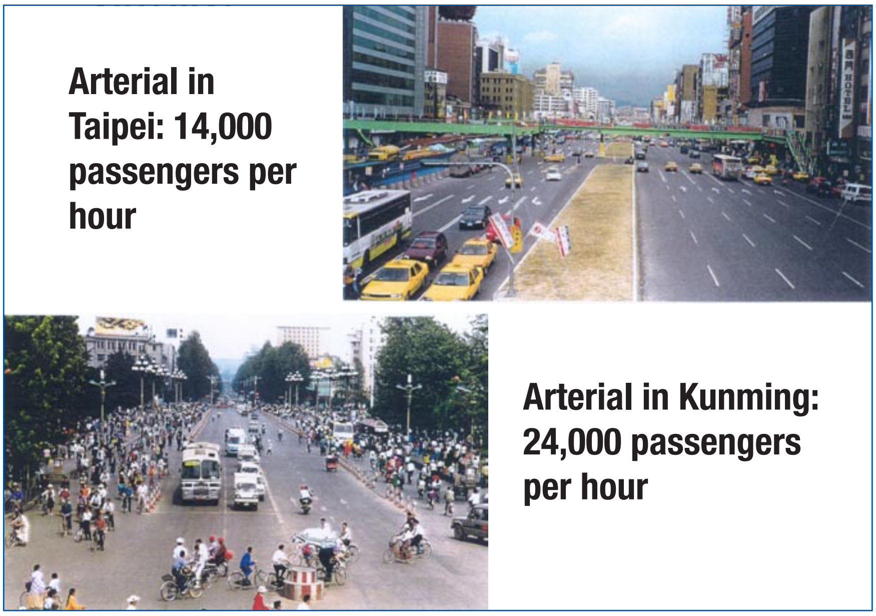


Fig. 1 ▲
Arterial road capacity in two cities.
M. Traber, EWE

In Bogotá, in 1998 70% of the private car trips were under 3 kilometres. Even though this percentage is lower today thanks to the bike and pedestrian facilities, it is still too high compared to some Northern European cities.

In Asian cities, however, even with per capita incomes less than one-twentieth of Germany, over 60% of these short trips under three kilometres are made by motor vehicles, usually motorcycle, moped, or paratransit (see Figure 2).

Our studies indicate three reasons for this:

1. Few pedestrian or cycling facilities have been provided in many cities. Over 60% of the roads in Jakarta, for example, have

Fig. 2 ▼
Mode split for trips between 1km and 3km, Surabaya, Indonesia, compared to Germany.
GTZ & ITDP 2000

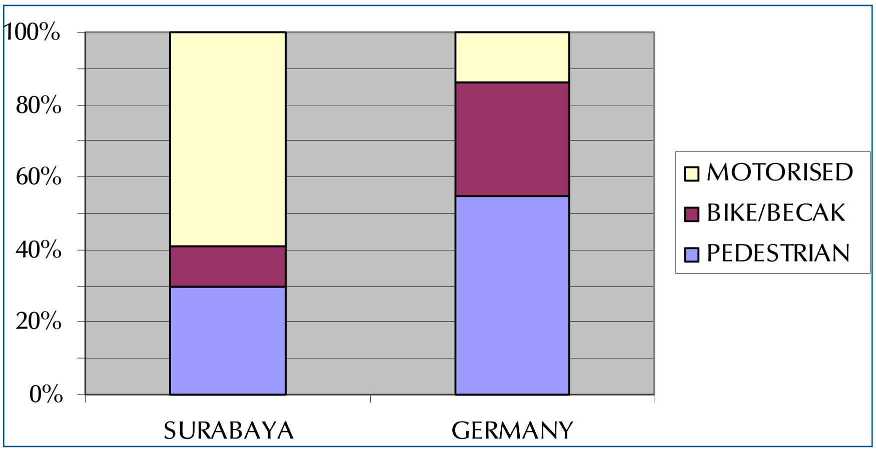


Fig. 3 ▲
Narrow, obstructed walkway in Hyderabad forces pedestrians onto the street, consuming a full lane of road space.
Walter Hook, ITDP

no sidewalks, and those that exist are heavily obstructed by telephone poles, trees, construction materials, trash, and open sewer and drainage ditches (see Figure 3).

2. Secondly, the traffic system has been designed to increase motor vehicle speeds, at the expense of pedestrian and bicycle safety. Many Asian cities make minimal use of traffic lights with zebra crossings and medians which provide a place for pedestrians to cross safely. As a result, the number of roadway fatalities per vehicle is many times higher than in Europe or the US.
3. Finally, pedestrian barricades and one way streets have been used to facilitate long distance motorised trips but which simultaneously impose huge detours for short distance cycling and pedestrian trips (see Figure 4). People wishing to cross a main shopping street often find it easier to take a taxi two kilometres than to walk across the street. In Surabaya, a World Bank financed study estimated that these measures generate an additional daily 7000 kilometres of needless vehicle traffic.

Most people feel that culture and heat are reasons for low levels of cycling in parts of the developing world where cycling is no longer ubiquitous. In terms of heat, average temperatures in Asia are not significantly higher than summer temperatures in Europe when cycling trips are at their peak. Streets need to be designed to provide shade and pavements that do not radiate heat. Cultural factors are clearly involved, but cycling culture did not happen overnight anywhere. In Holland the cycling culture has long historical roots, but the dramatic increases in cycling in the last two decades resulted from concerted government efforts. Use of the Mayor's Office as a 'bully pulpit' in Bogotá coupled with the construction of extensive cycling paths has resulted in an increase of cycling from 0.5% of daily trips to 4% of daily trips in only 3 years.

Improving the efficiency of non-motorised travel is economically vital

Virtually every trip begins and ends with a walking or cycling trip, whether between a parking lot and an office building or a home and a bus station. Because walking trips and cycling trips are very slow, inefficiency in making these trips, forcing people to walk or bicycle a long way out of their way, has very high economic cost because of the slowness of travel by these modes. At three kilometres per hour, having to walk a kilometre out of your way adds 20 minutes to a trip. In some countries it now takes as long for people to walk from their homes to the nearest bus stop as it takes to fly from Sao Paulo to Rio de Janeiro. Similarly, new studies of modern logistics indicate that the cost of making the last

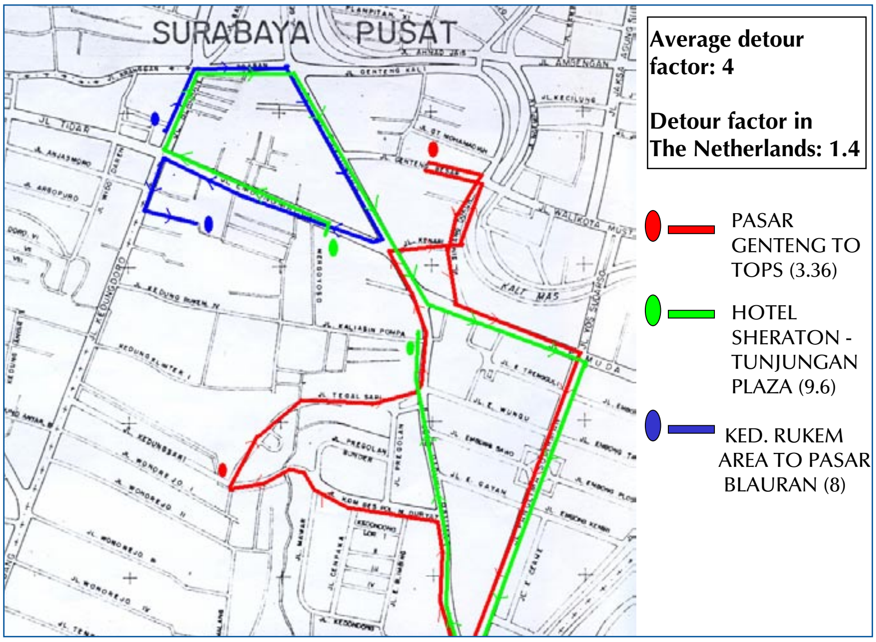


Fig. 4 ◀
Detour factors in central Surabaya. Bicyclists travelling between these origins and destinations have to travel from 3.3 to 9.6 times further than a straight line distance, largely due to one-way systems. Such detour factors can induce a switch to higher speed – where the detour factor impact is less significant – but more polluting modes.
GTZ & ITDP 2000

link in the supply chain – namely from the store to the consumer - costs as much as shipping products half way around the world. These studies indicate that the efficiency of short distance travel is much neglected and of critical economic importance.

Full pedestrianisation of downtown commercial areas has been observed in Chinese, Colombian, European, Brazilian, and other cities to dramatically increase the profitability of shops in the area, and led to an increase in land values (see Figure 5).

Fig. 5 ▲
Nanjing Road, Shanghai was recently pedestrianised and is one of the highest rent districts in China.
Walter Hook, ITDP

Bicycling and walking provides important aerobic exercise which is important to combating high cholesterol, obesity, diabetes, and depression

Increasing evidence, according to the US Centre for Disease Control, indicates that the global epidemic of obesity, high cholesterol, diabetes, and depression are directly linked not only to diet but also to the sharp decrease in average daily aerobic exercise. Bicycling and walking can help address these issues. Rather than driving two kilometres to use a stationary exercise bicycle in an expensive health club, for example, it would make more sense to make it possible for people to simply walk or bike comfortably to work.

This phenomenon is also evident in developing cities, where poor conditions for pedestrians result in motor vehicle use for even short trips. Health problems associated with lack of aerobic exercise are not limited to rich cities.

Increasing the modal share of bicycling and walking can reduce a country's dependence on imported oil

Many developing countries are going deep into debt to continue subsidising oil, which is overwhelmingly used by higher income motorists. The Indonesian government up to 2001 spent more than $4 billion annually to prop up these unsustainable fuel subsidies. (These fuel subsidies have been considerably reduced by the current government since early 2002, through a series of price rises.) The volatility of oil prices, and the risk of diminishing global reserves over the next two decades, make a reduced reliance on oil critical to avoiding serious exogenous economic shocks to the national economy.

Promoting safe bicycling and walking are crucial to improving the accessibility of the poor, and social cohesion

In some developing country megacities, reaching centres of employment from low income settlements is an arduous journey consuming over one quarter of a family's disposable income and more than 4 hours each day. For trips less than 3 kilometres, the poor of Surabaya are already more dependent on motor vehicles than Germans, who have incomes 40 times higher. This is imposing an enormous, needless burden on the poor, and inhibiting their ability to participate in the workforce, as well as gain access to education and health care. Viable and safe walking and cycling are also crucially important in allowing people to reach public transit facilities, but little attention is generally paid to these access modes.

Investments in walking and cycling facilities are investments for the poor. This creates a new society where people of all incomes can meet as equals on a bike path or a sidewalk. In the developing world where income disparities are often very high, this potential role of non-motorised transport is very important. In Bogotá the safest place in the city is the Ciclovia. On Sundays 120 kilometres of main arteries are closed to traffic allowing about 2 million people to cycle, rollerblade or just jog and walk. It is a meeting place were the highest income earners ride beside the lowest earners (see Figure 12).

Benefits of planning for cycling

Contributed by Roelof Wittink, I-ce, and based on the chapter: "Planning for cycling support road safety", in the book: "Creating Sustainable Transport", ed. Rodney Tolley, Woodhead Publishing Ltd. UK, 2003 (forthcoming)

Safety-related benefits

Data from different countries shows that an increase in cycling use and an increase in the safety of cycling can go together very well. The *Dutch Bicycle Masterplan*[1] concludes that in 1998 the number of fatalities among cyclists was 54% lower than in 1980 in spite of the increase in both car use and bicycle use. The increase of car kilometres was about 50% and the increase of cycling kilometres was about 30% over the same period. In Germany the total number of cyclist fatalities fell by 66% between 1975 and 1998 while the share of cycling in transport increased substantially, from about 8% to 12% of all trips.[2] In the city of York in the United Kingdom 15 cyclists were killed or seriously injured from 1996 – 1998 compared to 38 in 1991 – 1993, while cycling levels rose from 15 to 18% of trips.[3]

The best explanation for these effects is the integration of cycling – and of walking – in our traffic and transport systems. A good mix of motorised and non-motorised modes of transport brings the traffic system onto a more human scale. This required a change in the planning and the design of the roads. The measures also have a huge positive impact on the motorised modes.

This approach fits very well with the modern road safety approaches that aim to minimise the risk of serious accidents, such as the Dutch concept of Sustainable Safe Traffic and the Swedish 'zero road fatality vision' concept. A key element in these modern approaches is the prevention of risk by giving due consideration to the limited abilities of human beings, meaning that conflicts between road users with huge differences in mass and speed should be made technically impossible. The traffic environment should enable all road users – with their huge differences in skills and experiences – to behave predictably and respectfully to each other.
The consequences for the road network are a categorisation that accommodates the efficient flow of all different modes to a certain extent and protects our urban areas from domination by motorised traffic. The vast majority of the whole road network has a low speed limit and is adapted to facilitate cycling and walking in a safe way.

This policy provides the right conditions for safe cycling. It may not be primarily the cycling facilities to segregate cycling from other modes on the road that will increase the safety of cycling, but the integration of cycling in the overall design. By catering for a safe mix of modes, cycling can even become a catalyst for a very successful road safety policy.

1. The Dutch Bicycle Master Plan, description and evaluation in an historical context, Min. of Transport, 1999.

2. Pucher, J. (1997), "Bicycle Boom in Germany: A Revival Engineered by Public Policy" in: 'Transportation Quarterly 51 (4) and Pucher J. (2001), "The role of public policies in promoting the safety, convenience & popularity of bicycling", in 'World Transport Policy & Practice, Volume 7, (4), 2001.

3. Harrison, J.: "Planning for more cycling: The York experience bucks the trend", in 'World Transport Policy & Practice, Volume 7, (4), 2001.

Fig. 6

Costs and benefits of bicycle lanes in Bogotá.

The Economic Significance of Cycling; VNG/I-ce; The Hague/Utrecht; 2000

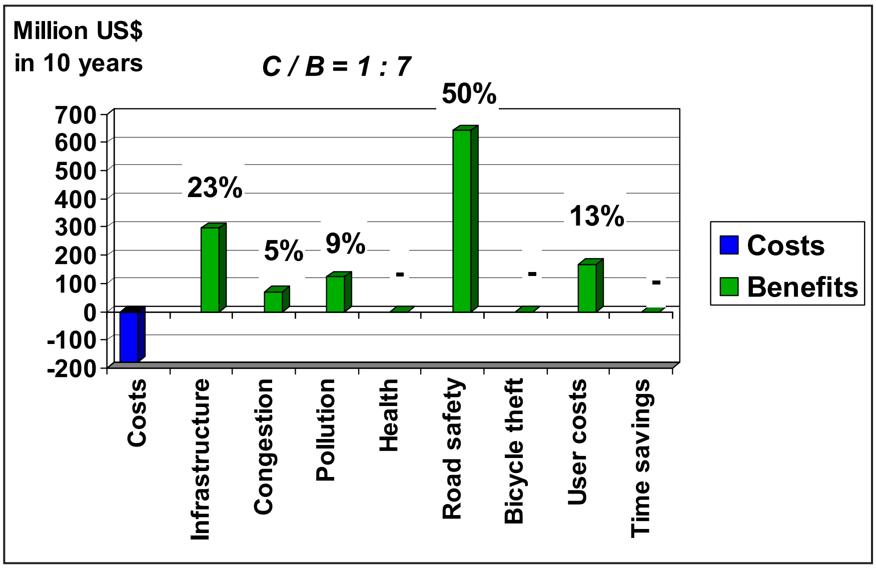


Fig. 7

A narrow street shared by cars and cyclists and a bicycle lane allowing bi-directional road use only for cyclists in Florence, Italy.

Roelof Wittink, I-ce

Fig. 8

mini roundabouts lower speed and facilitate safe integration between cars and cyclists (Utrecht, The Netherlands).

Roelof Wittink, I-ce

Fig. 9
Separate bus and bicycle lanes through an intersection in Utrecht, The Netherlands.
Roelof Wittink, I-ce

Economic benefits of planning for cycling

I-ce calculated the economic value of planning bicycle facilities in four cities, one of which was Bogotá.

The costs of building bicycle tracks, their maintenance as well as promotion and education campaigns were calculated to be US$186 million over a period of 10 years. The construction costs of one kilometre of high quality bicycle track were about US$200,000.

Cost savings from reduced infrastructure needs, reduced congestion and reduced pollution due to the replacement of car kilometres over 10 years amount in total to US$493 million, of which more than 50% results from saved parking spaces.

Road safety is expected to be improved by 50%, based on experiences abroad. This results in savings with an economic value of US$643 million.

Savings in running costs for road users by not using a car or a bus amount to US$167 million.

The overall result is that the benefits have an economic value of US$1302 million over 10 years, compared to US$178 million costs. The benefits are 7.3 times higher than the costs.

For further information visit: www.cycling.nl; *The Economic Significance of Cycling*; VNG/I-ce; The Hague/Utrecht; 2000.

Fig. 10
An advanced stop line for cyclists makes them more visible and provides them with right of way (Utrecht, The Netherlands).
Roelof Wittink, I-ce

Fig. 11
Segregated bicycle tracks in Bogotá, Colombia.
Roelof Wittink, I-ce

Fig. 12
Ciclovia: Car-free Sunday in Bogotá.
Institute for Sports and Recreation, City of Bogotá

Promoting safe bicycling and walking is vital to reducing over 500,000 premature deaths from traffic accidents each year

There are an estimated 1.1 million traffic deaths globally each year, and among young people in developing countries traffic accidents are the second leading cause of death according to the World Health Organisation. In developing countries, the vast majority of the victims of traffic accidents are pedestrians and cyclists, though with increasing motorcycle use, motorcyclists are fast becoming the majority of highway fatalities in higher income Asian countries. Having a father or mother killed or disabled in a motor vehicle accident, horrible in itself, will almost certainly throw a lower middle class family into destitution.

Bogotá had in 1997 a traffic death rate of 2 to 3 people every day, which is one of the highest in Latin America. Even though it is still very high it has dropped to 1 to 2, due largely to dramatic improvements in cycling and walking facilities.

Non motorised goods transport

Source: Niklas Sieber, GTZ

In urban areas non-motorised vehicles (NMVs) are not only relevant for the movement of people, but also for the transport of goods. In many African towns handcarts are used to transport goods to and from markets. This can be done either by the seller or by a small scale entrepreneur as a service provision for the customer. In Asia, rickshaws designed for passenger transport are often used to transport goods in towns (as for example in the picture below).

Niklas Sieber

A special form of rickshaw is used in Bangladesh, the bicycle van, which has basically the same design as a rickshaw, only the back (load area) is designed to carry goods. Using this vehicle, a human is able to transport up to one metric ton on a flat terrain without the aid of an engine. Most bulky goods are transported by rickshaw vans; not only goods to and from markets, but also raw materials and products of small-scale industries. The abundance of rickshaw vans in Bangladesh towns shows the economic importance of this mode for the local economy.

Non motorised goods transport is often important for intermodal goods transport. Farmers often carry their produce with buses to the market town and than load them onto NMVs. Bottlenecks occur when loading facilities are non-existent or inadequate and unloading on the road causes traffic jams around bus stops. Additionally, often little or no space is provided for NMVs around markets.

These types of non motorised transport services are in most cases offered by small scale entrepreneurs, which underlines the economic viability of these NMVs. They are not only essential for urban goods transport, but are also important for the urban economy, because they give employment to many drivers and entrepreneurs. As a matter of course, these types of jobs are mostly taken by poorer citizens.

2. Regulation of non-motorised transport

Non-motorised vehicles (NMVs) are regulated in a manner similar to motorised vehicles. They face regulation of the:

1. Vehicles
2. Operators
3. Design of new and existing roadway facilities
4. Use of existing facilities
5. Use of commercial vehicles under commercial codes
6. Planning and decision-making process
7. Import and export of non-motorised vehicles.

2.1 REGULATION OF THE VEHICLES

It is instructive to compare the regulatory frameworks for non-motorised vehicles and motorised vehicles. For motor vehicles, governments regulate the types of vehicles that are allowed to operate. The vehicles, parts, and components are all generally registered by the International Standards Organisation (ISO) and new cars generally are subject to 'type approval' standards to certify their quality, safety, and emissions. Motor vehicles are also generally registered with the police or motor vehicles department in case they are involved in criminal activity or are stolen vehicles. In developed countries and more and more developing countries motor vehicles are also subjected to inspection to ensure compliance with tailpipe emission standards and roadworthiness. For commercial vehicles, such as taxis and trucks, they are also likely to need a license or plate/sticker in order to operate as a commercial vehicle, and pay some sort of taxes or fees.

As bicycles, cycle rickshaws, and other NMVs generate no pollution, and operate at slow speeds, very few countries require these vehicles to be inspected for roadworthiness or emissions. Some countries insist that bicycles be manufactured up to a certain ISO quality standard, but because of the complexity of the number of new manufacturers and new components, the process of approval by the International Standards Organisation is cumbersome and slow, and the cost high relative to the cost of the product. As such, the trend in the industry is to approve the quality control of a manufacturer rather than of a specific product.

In many developed and some developing countries, it is illegal to sell non-motorised vehicles without reflectors in the front and rear, as well as to operate the bike without the reflectors and front and rear lights if operated at night. Enforcement is generally lax. Some laws specify the use of reflectors of a specific quality standard. Some safety experts have suggested that requiring the bicycles and cycle rickshaws to be painted yellow might also solve the visibility problem, but the proposal seems to run against the strong desire to personalise the vehicle.

Finally, in some countries owners register their bicycles or other vehicles with the police. In some cases this is mandatory (as in Chinese cities) but in most it is voluntary and used primarily as a mechanism to facilitate recovery in case of a theft. Outside of China, bicycle registration as an anti-theft measure has not proven to be very successful. In Bogotá people can voluntarily register their bike with the police.

2.2 REGULATION OF NON-MOTORISED VEHICLE OPERATORS

To operate a motor vehicle generally requires having a driver's license. This is because operating a motor vehicle is a skill that requires training, and untrained drivers are a risk to themselves and others. The relative simplicity of operating a bicycle or other non-motorised vehicle has made operating licenses unnecessary the world over for non-commercial uses.

In some US states and municipalities the use of a bicycle helmet that is in conformity with a particular safety and quality standard is required by local law. In most developing countries helmet use is less regulated on bicyclists and even rare on motorcycles. In Bogotá, the use of helmets for motorcycles and bicycles is now mandatory, but in the case of bicycles it is not enforced.

Many bicycling advocates oppose mandatory helmet laws as paternalistic (the only person affected is the operator himself and thus it should be their decision) and argue that they limit the use of bicycles. Most agree that the use of helmets should be encouraged, despite ambiguity in the data regarding their effectiveness.

2.3 REGULATION OF THE DESIGN OF NEW AND EXISTING ROADWAY FACILITIES AND THEIR IMPACTS

In most countries, developed and developing, the law tends to authorise certain branches of government (or in a few cases professional associations of civil engineers) to develop design standards for new highways and for the configuration and signage on existing roadways.

One that has had a significant impact is the US American Association of State Highway and Transportation Officials *Green Book*, or the *Policy on Geometric Design of Highways and Streets*. This book sets parameters for geometric design of highway and roadway facilities. In the US, all roads that are defined as part of the National Highway System (NHS) and hence eligible for Federal funding must fall within these design standards. Most US states have also passed laws authorising the State Departments of Transportation (DOTs) to set up design standards, and these standards are generally based largely on the *Green Book.*

Transport master plans

While transportation master plans are not heavily used in the US, in many European and developing countries master plans are widely used. These plans sometimes have status as law passed by national and local governments, and any new developments have to be in compliance with these plans that are modified regularly. Sometimes the new master plan will stipulate design standards. In the Netherlands a Bicycle Master Plan was passed which made the promotion of bicycle use a clear policy of the Dutch Ministry of Transport. Many cities then developed specific bicycle master plans. One of the first and most famous was developed by the City of Delft.

Bogotá's 10-year Master Plan for the first time stipulates as a matter of policy that priority be given to the pedestrian, and indicates the projects that will be built in the city in the short, mid and long term. This is further specified in transportation master plans. The 2000 Transportation Master Plan stipulates that all new highways and road facilities include grade-separated bicycle paths and sidewalks of specific dimensions. The design specifications are based on the *Taller del Espacio Público,* a manual in which the design for bike paths and public space is established.

Design standards

In developing countries, design standards have historically been based on standards from developed countries, modified somewhat to meet local conditions. The prevalence of the *Green Book* in setting roadway design standards has historically been problematic. It was developed originally with very little acknowledgement of the existence of non-motorised travel. As such, earlier versions of these standards, which have been around since the 1930s, propagated infrastructure designs that were neither safe nor convenient for non-motorised travel. It was the proliferation of these NMV-hostile designs which, much more than regulations restricting access, led to a decline in non-motorised travel. Today, less than 1% of daily trips are made by non-motorised vehicles in the US.

The adoption of similar designs and design standards in developing cities, like in India and China, where sometimes 70% of the traffic on urban roads is non-motorised, is resulting in a similar decline in non-motorised travel and dramatic increases in accidents involving pedestrians, cyclists and other vulnerable road users.

In recent years, in developed countries these design standards are increasingly trying to ensure that new road designs are safe and efficient for non-motorised vehicle use, and to retrofit existing roadways to facilitate safe and efficient non-motorised vehicle use.

For bicycle design standards, the *Green Book* refers to a new 1999 publication, *Guide for the Development of Bicycle Facilities.* Most State DOTs have adopted this guide as the basis for bicycle facility design standards. It is available at www.aashto.org. These standards are something of a compromise between the wishes of the bicycle advocacy community and what will be tolerated by the highway engineering community. Another commonly used manual is the Dutch *Sign up for the Bike: Design Manual for a Cycle-Friendly Infrastructure*, published by the Centre for Research and Contract Standardisation in Civil and Traffic Engineering - The Netherlands.

The *Green Book* itself provides limited design guidance for pedestrians. It stipulates only that pedestrian facilities (sidewalks and crosswalks) should be sufficiently wide to handle the volume of pedestrian traffic safely, and recommends the use of refuge islands, street lighting, and multiple visible pedestrian crossing signs at intersections. The US Federal Highway Administration and AASHTO (American Association of State Highway and Transportation Officials) have developed design manuals for traffic calming and other pedestrian facilities. *Traffic Calming: State of the Art Practice* by the Institute for Transport Engineers and the FHWA is mainly used in the US. These guidelines have been translated into state level guidelines in many states. In Germany, England, and other European countries similar guidelines exist.

Similarly, in the US, there is a *Manual on Uniform Traffic Control Devices*. The design of the devices themselves (such as road signs, traffic lights, crosswalks, etc.) must conform to this manual. It does not, however, require that these devices be installed. The use and installation of these devices is at the discretion of the agency under whose jurisdiction the road falls.

All these regulations and guidelines set fairly wide parameters within which local governments and engineers have the freedom to determine under what conditions to use these guidelines. The guidelines do not stipulate that there must be a traffic light at every intersection for example, nor do they stipulate that there should be bike lanes on roads with speeds over a certain level. Such decisions are all left to local government departments to determine at the local level based on local conditions.

Design standards for operating speeds

Most design standards are developed for specific operating speeds. By setting speed limits on specific routes, then, governments are simultaneously dictating the appropriate design standard. Because these design standards were developed to ensure the safe operation of a motor vehicle at a given speed, but do not necessarily ensure a safe environment for pedestrians and NMVs, the standards themselves played a role in worsening safety conditions for vulnerable road users.

For example, in New York City, the State of New York set the state minimum speed limit at 30 miles per hour (50 kilometres per hour). New York City roads had to be designed to allow motor vehicles to travel safely at that speed. This made a large number of traffic calming measures illegal until the Slow Speed Bill finally repealed the residential minimum speed limits, and allowed the City to selectively reduce minimum speed limits. It is certain that many of the over 350 annual pedestrian deaths in New York City could have been avoided by design standards which took vulnerable road user safety into account as well as vehicle operator safety.

"Simply designing all roads for high speed motor vehicle use will destroy the commercial, recreational, and residential character of entire sections of the city"

Design standards and the road hierarchy

In many developing countries the road hierarchy has never been defined, speed limits are unclear, and engineers are not sure which design standard to use for a given roadway. In Surabaya, Indonesia, for example, in theory a road classification system and road hierarchy has been defined, with allowable speed limits associated with the road classification, but no traffic police were aware of legal speed limits, nor were any speed limit signs posted anywhere in the city. Design standards are meaningless unless they are associated with a clear functional road hierarchy and corresponding speed limits.

In China there is currently a national effort to increase motor vehicle traffic speeds on all urban roads through roadway design changes, even though on some roads it might actually be more appropriate to alter design standards to slow motor vehicle speeds. Similarly, in Indonesia, most city traffic improvement plans aim to increase vehicle speeds, rather than increasing vehicle speeds on long distance corridors and reduce them on residential and commercial corridors.

This problem is also embedded into the cost benefit analysis process. The cost benefit analysis done for the Surabaya Integrated Transport Network Project, which was funded by the

World Bank, calculated economic benefits based solely on increased vehicle speeds even on roads where speed limits had not been defined in relation to appropriate speed limits given the road's function.

Settling the conflicting design needs of safety and convenience for non-motorised traffic and the safety and convenience of motorised traffic can best be settled through a careful definition of a functional road hierarchy, establishing appropriate speed limits, and designing roads in a manner appropriate to the road's use. Simply designing all roads for high speed motor vehicle use will destroy the commercial, recreational, and residential character of entire sections of the city.

2.4 REGULATION OF ROADWAY USE

2.4.1 Developed countries

Vehicle use of roadways are also regulated through traffic codes. In most countries, bicycles and cycle rickshaws are defined as 'vehicles' under the traffic codes, and have all the same rights to use roadways as any other vehicle unless the traffic code specifically says otherwise. Usually there are special provisions in traffic codes pertaining to non-motorised vehicles and pedestrians.

Some cycling advocates argue that from the point of view of the traffic codes there should be no other special regulations pertaining to non-motorised vehicles, and any form of special treatment is inherently discriminatory. Certainly, any special treatment of non-motorised vehicles in the traffic code should be justified on the basis of the special operating characteristics of these vehicles, and all other vehicles with similar operating characteristics should face similar treatment under the traffic code.

City governments or higher levels of government might restrict the use of non-motorised vehicles on certain roads or types of roads to increase motor vehicle speeds and to reduce the risk of serious collisions with pedestrians and cyclists. Ultimately, the criteria for whether or not non-motorised traffic should be allowed on a particular road should be based on:

- whether the facility can accommodate and has been designed to accommodate both motorised and non-motorised travel safely and efficiently
- whether a convenient alternative non-motorised route exists, and
- the number of short distance trips served by a given road link.

Even high speed, limited-access freeways can be designed in ways which protect non-motorised traffic, though almost certainly such facilities will be fully separated from the roadway. Most accidents occur at intersections or as a result of traffic crossing unexpectedly at non-intersections. Few accidents occur between motorised and non-motorised vehicles continuing forward on a higher speed road. The availability of a paved shoulder, a wide curb lane, or a fully separated bicycle path can make cycling reasonably safe and cause no travel time delay for motorised traffic even on fairly high speed roads. Non-motorised vehicles are allowed on parts of the US National Highway System, and on many intercity highways in both developed and developing countries.

Historically, many high-speed, limited-access freeways were not designed to accommodate non-motorised travel. Limited access freeways are defined as those roads where access to the road from adjacent properties is not allowed. As most of these highways were designed following the design standards set out in the *Green Book,* and these designs do not accommodate non-motorised vehicles safely. In most state laws, non-motorised vehicles are not allowed on all limited access freeways, unless there is a specific local ordinance which allows them.

For lower grade roads in the US and most of Europe, there is no general law prohibiting the use of non-motorised vehicles on certain types of roads. Rather, non-motorised vehicles are allowed to operate on all roads unless specifically prohibited under a state, municipal, or local ordinance. In New York State, for example, non-motorised vehicles are not allowed on most of the Parkways and on some specific bridges where there is no paved shoulder. All major arterials in New York City are open to non-motorised vehicle use. In each case, however, the criteria is the road design, and discretion usually lies with more local levels of government.

In all cases, the reasons for the restrictions on non-motorised vehicles, safety and efficient use of the roadway, apply also to other slow moving vehicles, whether motorised or not. As such, the restrictions should not be based on vehicle type but rather on operating characteristics such as speed and vulnerability. Such restrictions should be placed also on other slow moving motor vehicles (motorcycles with engines under a certain size, electric bicycles, the Segway, roller blades, electric or gas powered scooters, tractors, and animal traction vehicles). Arguably, it should be sufficient to set both minimum and maximum allowable speeds.

"Except on very high speed roads, cyclists should be allowed to use either the bicycle lane or any other part of the roadway, with advanced cyclists basically operating like any other vehicle and more vulnerable and slow cyclists relying on bike paths"

In many developed country cities, if bicycle or NMV use is allowed on a particular road, and no bicycle path is provided, non-motorised vehicles are required to operate in the curb (slow) lane except during turns. In most developed countries, and most recently in Bogotá, if a bicycle lane or path is provided, use of this bicycle lane or path is required by law unless it is obstructed.

Some cycling advocates feel that the requirement to use a bike lane and/or the curb lane is discriminatory, and oppose such restrictions. On roads with travel speeds 60 km/hr or less, an increasing number of cyclists are able to maintain these vehicle speeds and do not want to be forced onto narrow bike paths which are often obstructed by pedestrians or refuse, are poorly maintained, or are of a design standard inappropriate for speeds that advanced cyclists can easily achieve. Such controversy arises because the average vehicle speeds for cyclists vary widely. For this reason, it is recommended that except on very high speed roads, cyclists be allowed to use either the bicycle lane or any other part of the roadway, with advanced cyclists basically operating like any other vehicle and more vulnerable and slow cyclists relying on bike paths.

In most countries, pedestrians are required to use sidewalks if they are provided, and to walk on the side of the road facing into the traffic if one is not provided. Pedestrians are required to use crosswalks if one is provided and if there is a crosswalk within a reasonable distance. If no crosswalk is available in a reasonable distance, crossing of the roadway is allowed generally but the motor vehicles have the right of way, just as pedestrians have the right of way when motor vehicles cross a sidewalk. Interestingly, in many countries including the United States ***a person is NOT required to use a pedestrian overpass if one is provided***, but if the overpass is not used then the motor vehicle has the right of way.

Increasingly in the US and in Europe, and in some progressive developing country cities, laws actually require that any new facility on which non-motorised vehicles and pedestrians are allowed be designed to facilitate safe pedestrian and cyclist use.

Limited access roadways and busy arterials with few pedestrian crossing and traffic lights create particular hardships for non-motorised, short distance travel, known as '***severance***' problems. In developed countries, state, provincial, and national laws increasingly include clauses which stipulate that ***transportation plans and projects shall provide due consideration for contiguous routes for non-motorised vehicles and pedestrians***. Federal law in the US now stipulates that action that will result in the severance of existing or potential major non-motorised routes is forbidden unless a reasonable alternate route for this traffic already exists or is provided.

2.4.2 Developing countries

Restrictions on non-motorised vehicles

In Asia in recent years restrictions on the use of either certain classes of non-motorised vehicles or all non-motorised vehicles have gone considerably beyond the regulatory restrictions that these modes faced in Western traffic codes. While in the West the roadway design standards made bicycling difficult and unpleasant, which proved sufficient to drop non-motorised vehicle

mode share down to below 1% in the US, this was not generally the result of regulatory restrictions on access to the street network except on limited access freeways and parkways.

In most of Africa and in much of South Asia, limited access freeways are relatively few, and bicyclists and other non-motorised and animal traction vehicles are generally tolerated on the roadways by authorities. Often the use of bikes on highways is a legal gray area, not explicitly forbidden, but not specifically allowed either. Restrictions on the use of bicycles and other vehicles on some limited access freeways are of relatively recent origin.

In Bogotá, as was typical of many Latin American cities, prior to the construction of the new bicycle infrastructure there, bicycles were allowed on all urban streets, but the design of these streets was so hostile to bicycle travel that by 1998 bicycle trips accounted for less than 1% of total trips. (After some 250 km of new bicycle facilities were constructed at a cost of US$500 per metre, by 2001 ridership had increased to 4% of total trips).

Fig. 13

Bicycles are prohibited on many roads in Shanghai, with bans either full-time or during peak morning and afternoon periods. Above, cyclists, prohibited from entering a road, are forced to dismount and merge with slower-moving pedestrians. Top, a main road in Nanjing is reserved during peak periods for cars and buses. While bicycles previously had exclusive access to a wide lane, they must now share this space with other modes.

Karl Fjellstrom, Jan. 2002

In China and Southeast Asia, bicycles and other NMVs were allowed on all intercity and urban roads until the 1990s. For the last decade China has been building a national limited access freeway network on which non-motorised vehicles are not allowed. NMVs are generally allowed, however, on the old highways which tend to parallel these roads. In India there are even fewer limited access freeways. While NMVs are allowed on these roads, they were not necessarily designed to allow safe travel by these modes, and traffic safety is often a serious problem.

In Guangzhou, bike use in the 1990s dropped from 34% of trips to around 16% of trips in 2000

In recent years, restrictions on normal bicycles and other non-motorised modes have been introduced on some urban arterials in China which serve primarily local traffic. Shanghai, Guangzhou, Beijing, and other cities have imposed restrictions prohibiting bicycle use on some major roads. Many of these roads are virtually impossible or extremely inconvenient to cross by bicycle, severing millions of short distance origin-destination pairs that previously could have been made by bicycle. In the past bicycles dominated the use of service roads. Now, these service roads are used primarily by buses and taxis, while bicyclists are being pushed onto shared facilities with pedestrians (see Figure 13) where only much slower travel speeds can be maintained. Chinese cities have thus been using a combination of both design changes and regulatory changes to restrict bicycle use, with unfortunate consequences. In Guangzhou, bike use in the 1990s dropped from 34% of trips to around 16% of trips in 2000. These trips were almost entirely shifted to motorcycle and taxi trips, with a small increase in bus trips.

In Indonesia, entire classes of vehicles are not allowed on certain primary arterials. Not only are bicycles not allowed on the major arterials and limited access freeways in Jakarta, but Bajaj, Bemo, becak, and other slower moving motorised modes are also not allowed. In most Indian cities, and in most cities in Indonesia other than Jakarta, bicycles are generally allowed on all but limited access highways.

Beijing to reverse direction; promote bicycles for Olympics?

Excerpts from "Bicycles can save Beijing" in China Daily, 20 Sept. 2002

Two-wheelers encouraged for environment

"In order to help curb air pollution, Beijing will adopt administrative measures to encourage people to ride bicycles," said a special plan on environmental protection in the Olympic Action Plan, which was issued earlier this month by the organizing committee of the 2008 Olympics.

The plan did not reveal details of the future measures. Special bicycle routes will be built in the Olympic Village by 2008 with bicycles provided, the plan also said.

"Aiming to help fulfil Beijing's commitments to the International Olympic Committee on environmental protection, the provision is also based on the reality in Beijing," said Wang Kai, director of the Department of Comprehensive Planning at the Beijing Municipal Bureau of Environmental Protection which drafted the plan.

Wang said bicycle routes will not only be formed in the Olympic Village but also the Olympic Green. The layout on routes will be decided in the next two years, he said.

Bicycle lanes will continue to be drawn on city streets, said Chen Jinchuan, a researcher with the Beijing Transport Development Research Centre, a think-tank for the municipal government.

Li Wenhua, dean of the school of environment studies at Renmin University of China, agreed with Beijing's decision to push bicycles and he said he hoped the government could make bicycle usage more convenient through various measures, such as creating more bicycle parking lots and renting locations.

"I am sure Beijing's action will play a demonstrating role in the industry's development," said Sui Songjiang, secretary-general of the China Bicycle Association.

China continued to be the world's leading country in bicycle production and consumption as the output of bicycles in China reached 50 million last year. Chinese bicycles were also exported to over 100 countries and regions.

Manfred Breithaupt

Cycle rickshaws

Cycle rickshaws in their various forms have been, by contrast, subjected to particularly tight restrictions on their access to certain streets or certain zones of various cities. Manila banned cycle rickshaws on its main roads initially in the 1950s, and they re-emerged after the economic crisis in the 1990s, but only on some local streets. Karachi banned cycle rickshaws in 1960, and Bangkok in 1962. Kuala Lumpur also banned them. In Jakarta, and New Delhi, cycle rickshaws were banned in the 1980s, with selective enforcement (Figure 14). Surabaya, Dakar, and Ho Chi Minh City restricted their use on certain major roads starting in the 1990s. These roads are spelled out in specific municipal decrees. These roads include all limited access highways but also many primary or secondary arterials serving both short and long distance trips in congested urban areas. In Surabaya, they are also not allowed in industrial areas, new economic zones, and many new gated housing estates, mainly for image reasons. These restrictions on NMV use on major urban arterials sever numerous short distance origin destination pairs, forcing numerous potential non-motorised trips to rely on motorised modes.

Fig. 14

Delhi richshaws seized by police for operating in areas where they are banned.

Walter Hook, ITDP

Fig. 15

The first modern cycle rickshaws in India were sold to the drivers operating across the street from the Sheraton in Agra, India.

Walter Hook, ITDP

Fig. 16

The entire fleet of over 1000 cycle rickshaws in the city of Vrindavan, India, has been modernised.

Walter Hook, ITDP

Indian Cycle Rickshaw Modernisation Project

Another innovative way of increasing the use of non-motorised transport is to work with the human powered vehicle industry to modernise non-motorised vehicle technologies.

While the bicycle is constantly being modernised by a dynamic and competitive industry, in many Asian countries bicycle rickshaws continue to be manufactured based on outmoded design developed in the 1950s. As a result, they are extremely heavy, slow, and uncomfortable, weighing around 80kg. Their outmoded designs make life hard for the low income operators. This has made it possible for politicians to ban the vehicles on supposedly humanitarian grounds. Unfortunately, banning the vehicles only takes away a valuable job from a low income person, and forces people to walk long distances or use more expensive and polluting motorised vehicles.

An innovative project sponsored by US AID and carried out by the Institute for Transport and Development Policy succeeded in modernising the Indian bicycle rickshaw. There was never any shortage of alternative designs, but until the recent project none of them had ever been commercially adopted. As a result of the project, today there are more than 10,000 much lighter (55kg) and more comfortable bicycle rickshaws operating on the streets of Delhi, Agra, and a half dozen other Indian cities (see Figures 15 and 16). These vehicles actually cost less to manufacture than the traditional cycle rickshaws. Operators of the new vehicle saw their incomes increase by from 20% to 50%. Surveys also indicate that around 20% of the passengers of the new vehicles would otherwise have taken a polluting motorised vehicle.

Successful commercial adoption of a better cycle rickshaw required not only the development of a superior design (see Figure 15), but also an extensive marketing push and the entrance into the market by at least one corporate entity willing to compete to capture the traditional bicycle rickshaw market, forcing the traditional industry to respond.

The project is now being replicated with support from GTZ's GATE program in Yogyakarta, Indonesia. For more information, see ITDP's Website, www.itdp.org.

Cycle rickshaws do have operating characteristics which make them less efficient users of road space than normal bicycles. They are wider, they move slower, they start and stop frequently, they take up public space while parked and cruising for passengers, and their capacity flow ratios are much lower than for bicycles. However, their capacity flow ratios are similar to those of motorised taxis, and all of these problems are also true for normal taxis. There is thus no traffic system efficiency justification for a blanket ban on cycle rickshaws in entire areas or on normal streets serving short distance and long distance trips where taxis and other relatively slow moving vehicles are allowed to operate.

Nonetheless, their image of backwardness and exploitation and the role they play in facilitating urban-rural migration has made this mode the subject of hostile government regulation which cannot be justified from a safety or traffic management perspective.

At the very local level, a neighbourhood may decide for whatever reason that it simply does not want a particular class of vehicle to operate in its community. On streets used only for very local travel, decisions about vehicle restrictions should be made by the local community, and a reasonably democratic local decision-making process is recommended.

In Jakarta, and New Delhi, for example, the local governments passed regulations making the use of non-motorised cycle rickshaws, or *becaks* illegal in the entire city. While this was no doubt agreeable to certain communities, other communities with very narrow streets, with women who relied heavily on becaks or cycle rickshaws for shopping and taking children to school, found the loss of *becak* services caused them considerable hardship. In these districts over 70% of the population favoured retaining *becak* services. Local government regulation should allow the flexibility for such issues to be decided at the community or at least at the District or Ward level.

Conflicts between motorised and non-motorised modes

Conflicts between motorised and non-motorised travel are particularly acute in Asia and developing countries because of the frequent lack of an interconnected secondary and tertiary street network which would allow slow moving vehicles to bypass major arterials. As a result, short distance non-motorised travel is more dependent on the major arterials and even many intercity highways than in developed countries. Restricting rather than accommodating short distance non-motorised trips in Asian cities has led to a dramatic decline in the number of trips being made by non-motorised means to levels well below European and Japanese levels.

In some countries there are not only issues regarding whether NMVs are allowed on normal streets, but there are also issues about whether motorcycles and mopeds are allowed on bicycle lanes. Even the Netherlands and Belgium allow motorcycles on some bicycle paths. Chinese, Malaysian, and some other cities don't allow motorcycles on some major roads, and force them to use bicycle lanes. With the growing number of electric bicycles in China, this is a growing issue. China is currently trying to decide whether to require electric bicycles to operate on bicycle lanes or on normal traffic lanes. Currently it varies from outright bans in central Wuhan to legal limbo in Beijing to required operation in cycle lanes in Shanghai. Kuala Lumpur, Malaysia, has an extensive network of shared bicycle and motorcycle facilities. The motorcycle speeds tend to drive off the ordinary cyclists but speed restrictions, design standards encouraging slow speeds, and emission and noise controls on the motorbikes could at least mitigate some of the conflict between these two modes.

There are also issues about whether bicycles, and more recently whether electric scooters and the 'Segway' are allowed on sidewalks or not. Travel speeds between bicycle and pedestrian are sufficiently high to justify keeping bicycle and pedestrian traffic separate for safety and efficiency reasons. In Tokyo there are numerous shared bicycle and pedestrian facilities that work mainly because the crowds ensure slow bicycle speeds. In New York City, operating a bicycle on the sidewalk if you are over 14 years of age is illegal. Bike use is also sometimes restricted in pedestrianised areas in both Europe and the US. The new electric scooter Segway has recently received permission in numerous US states to operate on sidewalks, over the objections of local bicycling advocates.

Non-motorised transport and raising public awareness

Many of the best examples of awareness-raising, organisation and advocacy about sustainable urban transport come from groups promoting improved conditions for cycling.

Module 7: *Raising Public Awareness about Sustainable Urban Transport* discusses many such initiatives, including a recent bicycle path program in Sao Paulo.

In developing countries, typically pedestrians walk in the road because sidewalks have been so poorly designed that they are virtually unusable as sidewalks. Conflicts over the use of sidewalks are most acute between pedestrians, street vendors, and parked cars.

2.5 REGULATION OF COMMERCIAL NON-MOTORISED VEHICLES

Some non-motorised vehicles operate as commercial vehicles, and as such are subject to further regulation. Most commercial vehicles are regulated for at least three valid reasons:

1. to protect consumers
2. to limit adverse traffic and related impacts
3. to protect the operators.

In most US cities, like New York City, cycle rickshaw taxi services are relatively few and completely unregulated. No licenses are required and fares are unregulated and negotiated on a case by case basis. They are required by municipal authorities only to hold insurance for the passengers in case of an accident. In European cities these vehicles are sometimes required to have a vending or operating license and in others they are not.

In developing countries, regulation of cycle rickshaws varies from country to country and city to city. In Bogotá, the situation is similar to developed countries, as pedicabs are unregulated. Their numbers are only about 200, and they circulate only on main bike paths which were designed wide enough for their use in most places. These pedicabs are privately owned and have ads in the rear (advertising mobile phone and liqueur products) and there is no formal charge for their use, but a decent tip to the driver is expected for a home-to-work ride.

In most Indian cities where cycle rickshaws are allowed, operating them nominally requires a license. In Delhi, getting the license is often not easy and often requires going through a *malek*, (a fleet owner) who rents the vehicles or a financier (who sells the vehicle on credit at fairly high interest rates). Oddly, the vehicle licenses are issued by the Veterinarian Department of the Municipality because they were historically lumped together with animal traction vehicles. These regulations stipulate very specific sizing requirements that did not in fact correspond to any of the actual sizes of the mass manufactured models. They also required the presence of mud guards and a canopy for the sun, but did not require that the canopy be functional.

Often municipalities try to limit the number of licenses issued in order to reduce their total numbers, in some cases with the aim of phasing them out altogether. Delhi, Agra, and many other Indian cities have restricted their numbers, but generally ineffectively. In fact, in Delhi there are an estimated 500,000 cycle rickshaws operating without a license, mostly in outlying areas. In Surabaya, there is active discussion regarding the ability and desirability of limiting the numbers of becak operators. The ideal number, according to the becak union, is around 30,000 – 40,000, and there are currently around 42,000. Since 1974, the numbers of becaks have been officially regulated, but in fact the regulation does not work. The unions would support controlling the numbers as it would increase their income, but as both the police and the Road Traffic Office make money from issuing the licenses, they are not extremely interested in regulating the total numbers. Currently they pay Rp. 7,500 ($0.75) for a three year operators license to the Road Traffic Office, and they pay a one-time Rp.40,000 fee ($4.00) to the police to have the permission to own the vehicle. In Yogyakarta, Indonesia, the situation is similar. Fees are paid to register the vehicle and to be allowed to operate the vehicle.

Recently, the Prime Minister of India has suggested scrapping the old licensing system and allowing anyone with an identification card or willing to pay the fee to get an identification card to automatically get the registration free of charge. Their argument is that the main reason for the registration is in case there is a problem the customers can report the driver. The new proposal also suggests dividing up the city into green zones, amber zones, and red zones. In green zones, there would be no restrictions on the number of vehicles allowed to operate. In the amber zones there would be restrictions on the number, and in the red zone they are not allowed to operate at all. This would more or less formalise the existing informal status quo, unless the zones are substantially changed.

In Jakarta, not only is the operation of becaks illegal, but their manufacture and sale is also illegal. As a result, frames for those becaks that continue to operate on the outskirts of Jakarta are manufactured outside of Jakarta, usually in relative secrecy, and they are assembled by the operator from widely available bicycle parts.

This module recommends that as a minimum the vehicles and operators be registered to give a minimum amount of protection to passengers. The vehicles should also be required to have proper reflectors. Whether restricting the total number of vehicles in a given zone is advisable or not, or whether the process should be left to be organised informally, depends on the degree to which greater government involvement will lead to a more fair and stable economic situation for the drivers and greater security for the residents.

"Rather than defining specific designs, the law can specify a process by which those designs should be developed and approved"

2.6 REGULATIONS AND THE PLANNING PROCESS

In both developed and developing countries one of the major reason that the concerns of pedestrians and cyclists in the traffic system are ignored is that responsibility for these modes is not clearly identified with one particular branch of government or one government agency. Typically the police, the department of public works, the department of transport, and the city planning agency will all have authority over different areas of critical concern to non-motorised transport. This inter-departmental confusion is bad in developed countries and extremely serious in many Asian countries.

For this reason, an increasing number of state or provincial laws mandate the creation of a special Non-Motorised Transport Coordinator (or Bike coordinator), and a Non-Motorised Transport Task Force. The Coordinator and the Task Force are then given certain regulatory powers.

Ideally, the Non-Motorised Transport Task Force will have representatives from not only all state (provincial) and municipal agencies involved in issues affecting non-motorised transport, such as the police, the road traffic agency, public works, city planning, the city council, etc, but also from civil society. At least one should represent non-motorised vehicle users groups (such as a becak union or cycling advocacy organisation) and there should be at least one representative of the private sector. This group in turn generally selects a chairman.

This Non-Motorised Transport Task Force, led by its Coordinator, is generally responsible for promoting and facilitating the safe and convenient use of non-motorised modes of transportation. They should also be given the right to comment on all new infrastructure projects to determine whether the concerns of non-motorised transport modes have been addressed, should supervise the inter-agency efforts needed to design and implement the development of facilities for pedestrians and non-motorised vehicles, and public education, promotion, and safety programs.

In other words, rather than defining specific designs, the law can specify a process by which those designs should be developed and approved.

2.7 REGULATIONS ON IMPORTING NON-MOTORISED VEHICLES

Tariffs on bicycles vary widely from country to country. In some Asian countries, tariffs on imported bicycles have been kept high to both protect domestic industry and to discourage non-motorised vehicle use. In Bangladesh, for example, in 1989, taxes on imported bicycles and most components were 150%, while import taxes on automobiles were only 50%, and on small transit vehicles, motorcycles, and trucks, only 20%. While some of these measures were aimed at protection against Indian bicycle manufacturers, for 80% of the components Bangladesh has no domestic manufacturing capability.

Since both India and China have joined the World Trade Organisation (WTO), tariff barriers on bicycles in both countries are falling. Both countries have large low cost domestic bicycle manufacturing, but Indian bicycle manufacturers are already facing competition from Chinese imports and Chinese-owned manufacturers in Bengal.

Basic mobility now costs less

Reducing bike tariffs

On June 13th, 2002, the Kenyan government announced the elimination of bicycle import duties. The decision comes on the heels of a rise in petrol prices, and should give a significant boost to bike sales and use. The International Technology Development Group in Kenya was a key force behind the decision.

The Tanzanian government has yet to remove bicycle import duties, although they have recently reduced the duty on bicycle tires by 10%. In a country where the average price of a bike is Tanzania Shillings 60,000 and the per capita income is Tanzania Shillings 270,000 per annum, this is an important first step but does not go far enough.

The Association for the Advancement of Low-Cost Mobility, (AALOCOM), the organisation that lobbied for the reduction, is taking their campaign farther, hoping to convince the government to follow Kenya's lead and reduce the duty on the entire bike.

The benefits of reducing or eliminating the tax are numerous. With access to this low-cost transportation, villagers can take grain to the market in larger quantity and more quickly; children in rural areas can reduce their travel time to school by hours; traditionally disadvantaged groups, such as women, can increase their access to self-employment opportunities. In short, the benefits of the reduction or elimination of the import duty are significant.

Adapted from ITDP sustainable transport newsletter, August 2002, **www.itdp.org/STe/STe2/index.html**

3. Non-motorised transport planning

Historically, little attention was paid to systematising a transportation planning methodology for non-motorised transport. Transportation planning evolved in the 1950s and 1960s in the US and England as a response to the growing chaos on the roads caused by the increasing use of motor vehicles. The planning methodologies developed during that time, from the traditional 'four-step planning process', to the cost benefit analysis procedures codified in the World Bank's Highway Design and Maintenance (HDM) model largely ignored non-motorised travel (and public transit and freight trips as well initially). The problem began at the level of data collection, where no data was collected about origins and destinations made by non-motorised means. The result was a set of planning methodologies often hostile to non-motorised travel.

Since that time, as a result of thirty years of advocacy efforts to modify or change these planning methodologies, most traffic demand models in developed countries are based on origin and destination surveys that include some information about bike trips, though often not about walking trips. Even if specific origin destination surveys do not have information on bicycle or other non-motorised vehicle travel, all trips under roughly 10 kilometres are *potential* non-motorised vehicle trips and hence can be used in the planning process. As a result, bicycle planning can build on traditional transport planning models, whereas information about very short pedestrian trips is likely to require further data collection and some different techniques.

Planning for bicycle and cycle rickshaw facilities should be integrated into standard transportation planning as much as possible. However, as much of the existing infrastructure is likely to have been designed in a manner which is hostile to non-motorised travel, some corrective measures specifically focused on improving conditions for non-motorised travel are often called for.

In fact, in many cities the critical locations for non-motorised vehicle and pedestrian facilities is rather self evident, because there is visibly a large number of bicycle and walking trips in these locations. Some cities have a few major corridors which account for most trips, and non-motorised trips will follow the general traffic flows for other short distance trips.

There is a debate among traffic planners whether new bike facilities should be located based on the rational planning methodology described below, or whether they should be placed opportunistically on all urban roads where they can be justified by high vehicle speeds and political expediency. Political expediency generally means the following criteria would be used:

- The road is being newly built or rebuilt, offering an opportunity to put in a new bike lane.
- An existing road has sufficient space that a bike lane will not disrupt motorised or pedestrian traffic.
- A canal, a park, railway right of way, or other facility can be modified so that bike lanes can be built without antagonising motorists.

The new Bogotá bike system (see Figure 17), which has dramatically increased trips, was a combination of focusing on major known corridors based on surveys done in a JICA planning study, other origin and destination studies, combined with putting the facilities where space was available, namely along canals, in the median strips of roads, on roads which are much wider than needed to serve existing motorised traffic, and on all new road construction.

Putting good bike facilities on all roads with speed limits above 50 or 60 kph serving a significant number of trips under 10 kilometres is not a bad planning methodology if the political commitment is present.

There is, nonetheless, something to be said for the rational planning approach, which helps to build a case for the interventions and more carefully prioritises investments on truly needed facilities. This rational planning process is usually broken down into the following steps:

1. Establishment of a project team and a non-motorised transport task force or committee
2. Selection of area to be improved
3. Inventory of existing regulations and conditions

Fig. 17
Bogotá's bike lanes were built predominantly in median strips on major arterials, some of which were in the process of reconstruction.
Institute of Urban Development, City of Bogotá

4. Development and prioritisation of planned improvements
5. Selection and design of facilities
6. Testing after implementation.

3.1 PROJECT TEAM AND TASK FORCE FORMATION

When initiating a non-motorised transport improvement project, a ***project team*** must be selected. Normally this team should initially consist of an international planning consultant, an international civil engineer, a local partner with influence and contacts inside the city government (could be a government agency, the Mayor's office, a retired senior planner now with an NGO, or the local staff of a development organisation) and a local NGO, university, or planning firm with experience in working with and surveying the affected population (pedestrians, cycle rickshaw drivers, community organisations, local politicians, and so on.).

The project team will work for the project's sponsors, but one of its first tasks is to review governmental responsibility for non-motorised transport in the project city, and the responsible persons within each relevant government agency. These responsible persons should be invited to join a ***Non-Motorised Transport Task Force or Committee***, which in turn might select a Chairman of this Committee responsible for inter-agency coordination. This Committee should involve all the relevant government agencies such as municipal planning agencies, public works, police, traffic management, and any relevant public authorities, but it should also include some key stakeholders such as cycle rickshaw union representatives and other potential stakeholders. Formation of this Task Force early in the planning process can avoid obstacles to implementation in later phases.

This Task Force will be responsible for hosting public hearings when more developed plans are completed, for overseeing the proper implementation of the plans, and for acting as an advocate for the plans within the administration.

3.2 SELECTION OF AREA TO BE IMPROVED

Identifying key stakeholders will depend to some extent on the location for which non-motorised travel is to be improved. The planning methodology is also going to differ depending on whether it is a ***neighbourhood-specific pilot project*** or a ***city-wide master plan*** that is being developed.

For pilot projects, there are several factors to consider. A pilot location should have:

1. A high level of political commitment to NMT improvements by the district or ward (most local level) government. A city-wide project should be considered if it has the backing of the Mayor.
2. A high level of support for NMT improvements in the community.
3. A high level of existing NMT traffic in the community
4. A high level of potential NMT traffic in the community
5. A high number of traffic accidents involving vulnerable road users.

In our experience, certain types of facilities tend to generate a large number of non-motorised trips. Among them are:

1. Schools and universities
2. Popular markets and shopping centres
3. Factories and other employers of large numbers of people who do not have access to motor vehicles
4. Mosques (they are visited frequently).

For this reason, some municipal programs in Europe and the US focus specifically on school access, and are known as 'Safe Routes to Schools' program. For cycle rickshaws, the vast majority of trips are to schools, public transit stations, popular markets, and tourist locations. Programs can also focus only on such locations. This would greatly simplify the planning and prioritisation process.

3.3 INVENTORY OF EXISTING REGULATIONS AND CONDITIONS

Once you have selected your project area, you need to decide how much more data collection you really need. While appropriate locations for prioritising non-motorised vehicle facilities may be fairly self-evident to people familiar with the area, the data collection process also can play an important educational role with municipal officials. For example, an astounding number of transport professionals in developing countries are completely unaware that people travel by non-motorised means, or if they are aware of it have never paid any attention to it, and lack even basic information about it. Simply demonstrating that 30% of the trips on a given road are made by pedestrians and cyclists, or that 60% of the victims of traffic accidents are non-motorised road users, can help to sensitise policy makers and the public to the importance of the measures that later stages will propose. The following data will all be relevant:

3.3.1 A review of the laws, regulations, and design standards pertaining to non-motorised travel

Obviously, if bicycles and other non-motorised vehicles are banned or restricted on certain routes, or certain design standards exist, this information will be pertinent to the planning process.

3.3.2 A review of existing data

Before conducting expensive new surveys, the availability of data from pre-existing surveys should be fully explored. It is common for one municipal or national agency to be unaware of the fact that another municipal or national agency has recently completed surveys of the very data you are looking for. In some cities in Asia there may be a fully functional traffic model. In most cities there will be some household survey data, (though it is likely to be outdated) some origin and destination survey data, and some vehicle counts at specific locations. Most police departments collect at least some data on traffic accidents that can be mapped, and some cities may actually have decent traffic safety database and black spot mapping.

3.4 COLLECTION OF USEFUL ADDITIONAL DATA

If your pilot project is only going to focus on safe routes to schools, markets, or public transit hubs, for example, a lot of further data collection will not be necessary. One advantage of targeting schools is that a handful of pilot schools can be selected, and the students, parents, and teachers can be directly utilised in the data collection process. For a full review of one "safe routes to schools" methodology, check www.saferoutestoschool.org for some recent resources. Some methodologies will be discussed below.

To comprehensively improve non-motorised travel in a pilot location or for the city as a whole, the following additional information would be useful. This data needs to be mapped.

3.4.1 Division of the project area into zones

In order to map the data you are going to collect, the project area needs to be divided into 'zones.' For bicycle and cycle rickshaw plans, the Dutch recommend that each zone be roughly 250 sq. metres, and that maps roughly 1:10,000 scale be used initially. For pedestrian improvements 1:2000 or smaller are necessary. If pre-existing origin and destination surveys of sufficiently small scale exist, the same zones and the same zoning codes should be used.

3.4.2 Supplemental household surveys

If pre-existing household surveys exist but do not have any information about bicycle and walking trips, and about bicycle and motorcycle ownership levels, some additional surveying should be done that includes this data. More intensive surveying might be done in areas of different income levels, and in areas with different NMV-friendliness factors (explained later), and assumptions made about other areas of similar income and type. Origin and destination data should be coded to correspond to the 250 sq. metre zones you have identified for the project area, and should also identify specific origins and destinations (ie. home address to the supermarket, or the local green market). Information on all trips of all family members must be collected, including trips by women and children. Trips by public transport should be broken into a trip to the bus stop and the bus trip.

3.4.3 Roadside surveys

More information about popular trips by non-motorised vehicle and pedestrians should be collected through roadside surveys. These interviews will be much simpler than the household survey, consisting only of origin and destination surveys. This information is necessary to supplement the household survey data to capture those trips originating outside the study area.

3.4.4 Roadside counts

Because many vehicle counts exclude bicycle, cycle rickshaw and walking trips, it is good to collect baseline data on the number of bicycle, pedestrian, and other NMV trips on the major roads. It is better to simultaneously collect information about motor vehicle trips in the same location to get an accurate estimate of the modal split along specific roads at a given base year. Peak hours and midday counts are probably sufficient but full day counts would be ideal. Information about how many people are crossing these main road links by each mode during the same time period is also useful. Ideally this data can be collected for all roads leading into the CBD, or in a 'cordon', (all bridges over a river bisecting the city for example).

3.4.5 Origin and destination mapping

Ideally a map identifying all significant origin - destination (OD) pairs for trips under 10 kilometres should be mapped. For longer distance trips it is reasonable to assume they are rarely going to be made by non-motorised means. All OD pairs currently made by bicycle, walking, or other non-motorised mode can be coloured in green. All OD pairs made by public transit can be coloured in yellow. All OD pairs currently made by motorcycle or other private motor vehicle can be mapped in red. This colour coded mapping should give a good picture of those trips which could be made by non-motorised modes but are currently not made by these modes. They give one indication of where the most significant increases in non-motorised travel could be achieved with facility design changes. It is also useful to locate on this map major specific trip attractors such as popular markets and schools and draw the OD pair lines to these points. (See Map I in GTZ & ITDP 2000, for an example).

A model can be developed with this data indicating the factors which explain the divergence between the non-motorised trip mode share in some corridors compared to others. Such a model can be used then to calculate the potential modal shift impact of various non-motorised facility interventions. From this modal shift data, emissions reductions and fuel savings can be calculated.

3.4.6 Actual route mapping

It is then often useful to map all actual routes between each different major origin and destination pair in the project area. If there is a major trip attractor in the destination zone, (shopping centre, school, hospital), use this as the destination point. If not, use a central point in each zone. This can usually be done by asking someone on the Task Force or the Project Team familiar with bicycling and riding cycle rickshaws in the project area. If no one is familiar with the popular routes, the project team will have to travel these routes on their own.

On this map it would be useful to highlight any roads or streets where bicycle or cycle rickshaw use are strictly forbidden by regulation.

This actual route mapping can be used to calculate ***detour factors***. Detour factors are the most systematic way of identifying major ***severance*** problems. Severance problems can be created by unsafe, high-speed roads, by restrictions on non-motorised vehicles on specific streets, by barriers to crossing streets, by a one-way street system, and by large canals, railroad tracks, and other impassable infrastructure. Detour factors are the distance that the average cyclists or cycle rickshaw operator needs to travel out of their way in order to reach their destination, relative to the distance as the crow flies (straight line distance). In a typical European or American traffic grid with no restrictions on non-motorised vehicle travel, the detour factors are generally very low. A detour factor of 1.2, as observed in Delft, Holland, is extremely low. This means that the average cyclist only needs to travel 20% farther than a straight line distance in order to reach their destination.

A mapping of some detour factors in Surabaya (see Figure 4, page 2 of this module) indicates that Asian cities with many one-way streets, few intersections, a weak secondary and tertiary street system, and unsafe high speed roads can have fantastically high detour factors. These detour factors impose far fewer economic costs on motor vehicles traveling at high speeds than they do on non-motorised modes which travel at slow speeds. Nonetheless, they generate enormous unnecessary emissions, congestion and fuel consumption, and also discourage non-motorised travel.

When identifying necessary NMV improvements, reducing these detour factors is a primary objective. It can be assumed that the modal split for non-motorised modes should be similar for similar trip distances. As the share of NMV trips increases the shorter the distance between OD pairs, shortening the actual OD pair trip distance should increase the number of NMV trips to those typical of that trip distance. Based on this, changed detour factors can be used to calculate potential fuel savings and CO_2 and other emissions reductions from planned infrastructure changes that reduce detour factors.

3.4.7 Mapping of existing NMT facilities and perceived quality of NMV travel

Some bicycle and pedestrian planners recommend mapping each of the actual and potential NMV routes and colour coding them based on the perceived quality of the bicycling environment, coding:

- *red*: very dangerous and uncomfortable
- *yellow*: somewhat dangerous and uncomfortable, and
- *green*: adequate.

More levels of quality could be used and more attributes defined. For example, a street with a shaded bike lane or wide paved shoulder and relatively low vehicle operating speeds would be green, and a high-speed road with no shade, no shoulder, and no bike lane, would be red. In the case of many developing country cities, it is highly likely that *all* major arterials would be coded red, rendering this exercise unnecessary. Similar mapping may be done for pedestrian facilities (see Figure 18). Similar codes can be developed for crossing facilities. These maps can be useful tools to planning departments for prioritising NMT facility improvements.

3.4.8 Mapping of existing NMV flows

If an urban area still has a significant amount of non-motorised travel, it is important to map the current levels of non-motorised vehicle trips. The roadway traffic counts and the OD pair data should make it possible to map the number of motorised and non-motorised vehicle trips on most main roads. For this data to be useful,

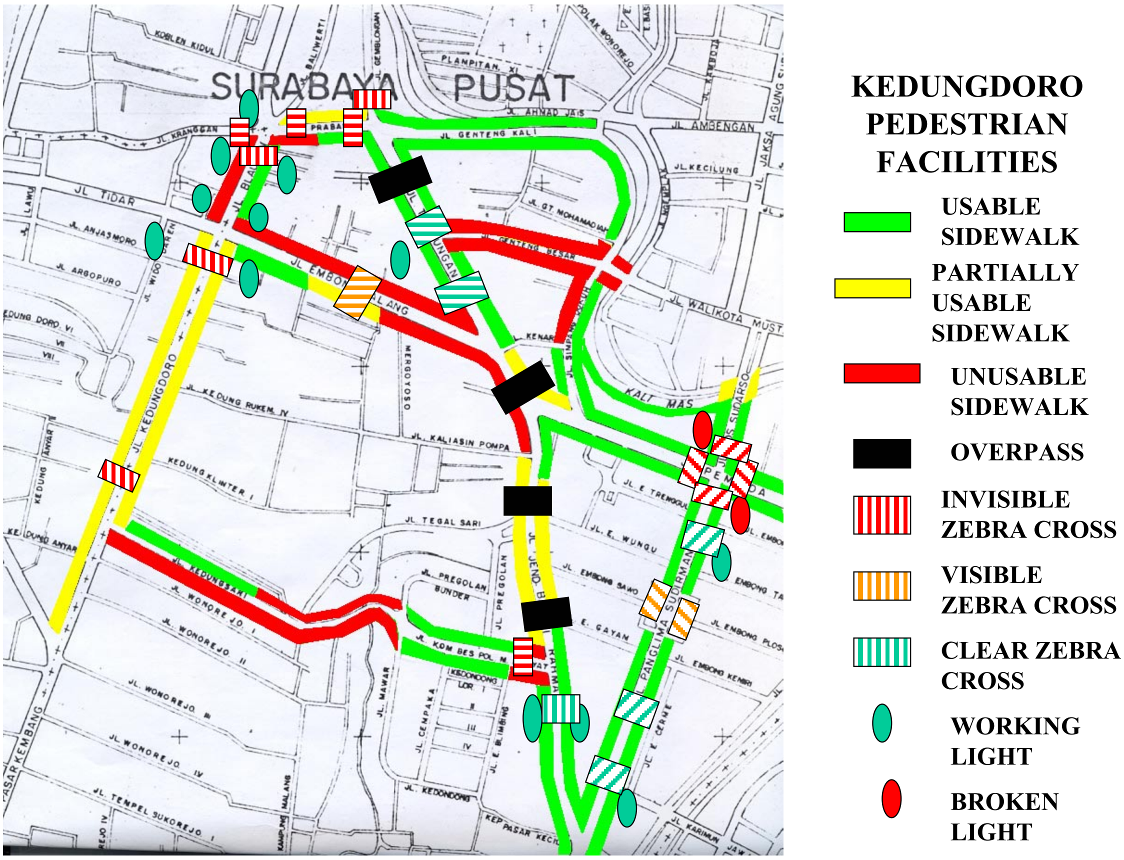


Fig. 18
Simple map of existing NMT facilities, Central Surabaya, Indonesia.
GTZ & ITDP 2000

pedestrian trips need to be counted separately. Pedestrian flow diagrams must be based on block by block counts. Bicycle and cycle rickshaw trips need to be converted into a common unit (passenger car equivalents to be comparable with other data). Pre-existing pedestrian trips should justify additional sidewalk infrastructure, and very high pedestrian flows might justify expanding sidewalks. Pre-existing bicycle and cycle rickshaw trips might also justify segregating motorised and non-motorised trips through cycle rickshaw lanes or service lanes.

This data should give you a good idea where current NMV travel is concentrated, but it will not by itself tell you where the greatest potential for increased NMV travel may be.

3.4.9 Mapping of traffic accidents

It is also useful to collect traffic accident data for accidents involving non-motorised road users from the police and map the locations as precisely as possible. A division at least between intersection and non-intersection accidents is required. Even though the numbers are likely to be significantly undercounted, this simple mapping exercise should make it possible to identify particularly dangerous locations (see Figure 19) To the extent possible, this effort should be grounded in overall road safety efforts (see Module 5b: *Urban Road Safety*), which may be non-existent or may ignore or propose remedies hostile to vulnerable road users.

3.4.10 Intersection conflict diagrams

Once an intersection has been identified as dangerous through mapping of traffic accidents (as above) or based on the perceived danger of cycling groups, a detailed mapping of likely conflicts at this intersection is likely to be necessary. These diagrams should indicate the location and type of design interventions that will be necessary.

3.4.11 Additional pedestrian and safe routes to schools mapping

Because pedestrian trips are so short, some additional information is sometimes used by planners for pedestrian and safe routes to schools programs: a. mapping of children's walking routes to school, and b. mapping of pedestrian 'desire lines'. The most successful safe

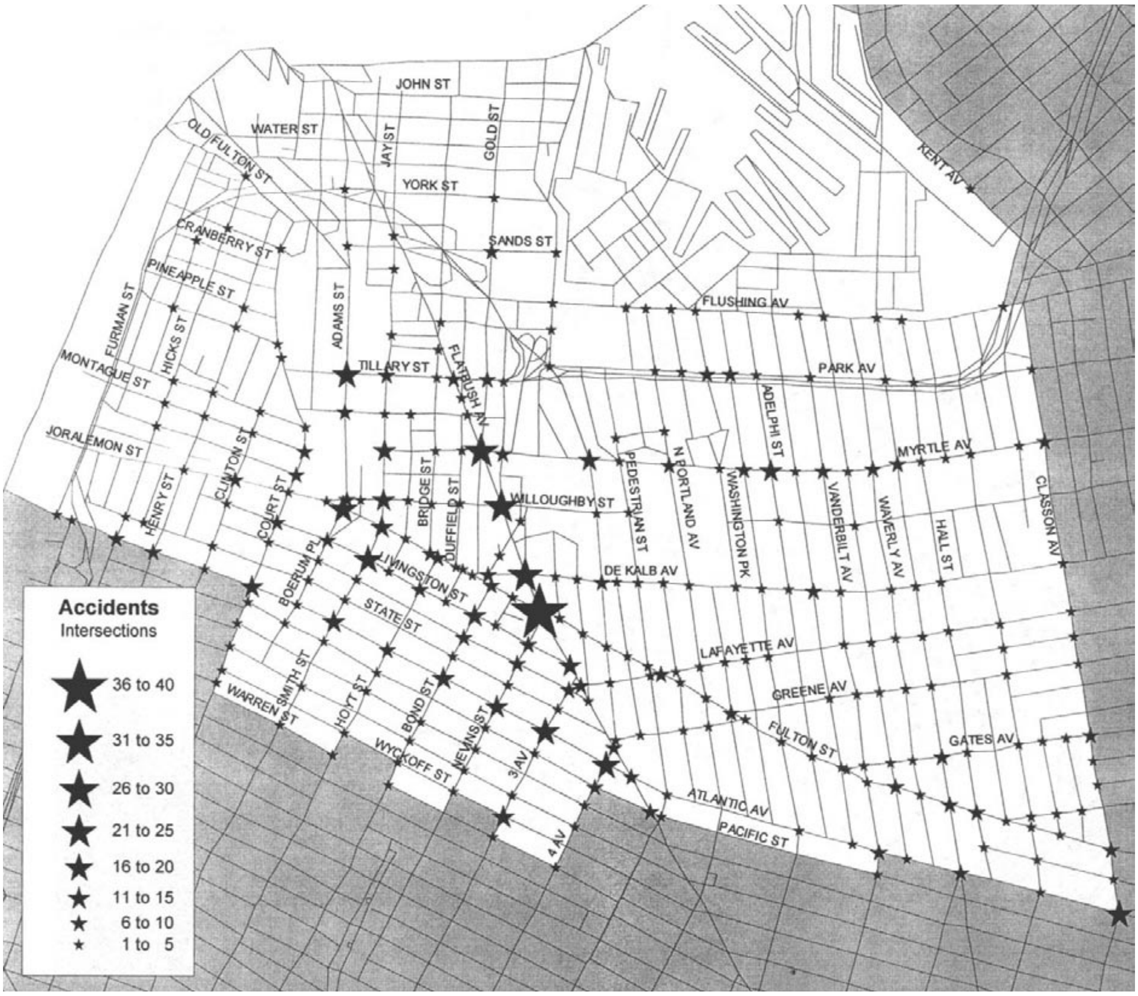


Fig. 19
Pedestrian accidents, Community District 2, Brooklyn, April 1989 to March 1994. Mapping of incidence of accidents at intersections is more relevant in cities where the majority of accidents occur at intersections. In developing countries, far more accidents occur between intersections, which requires more detailed mapping.
Michael King

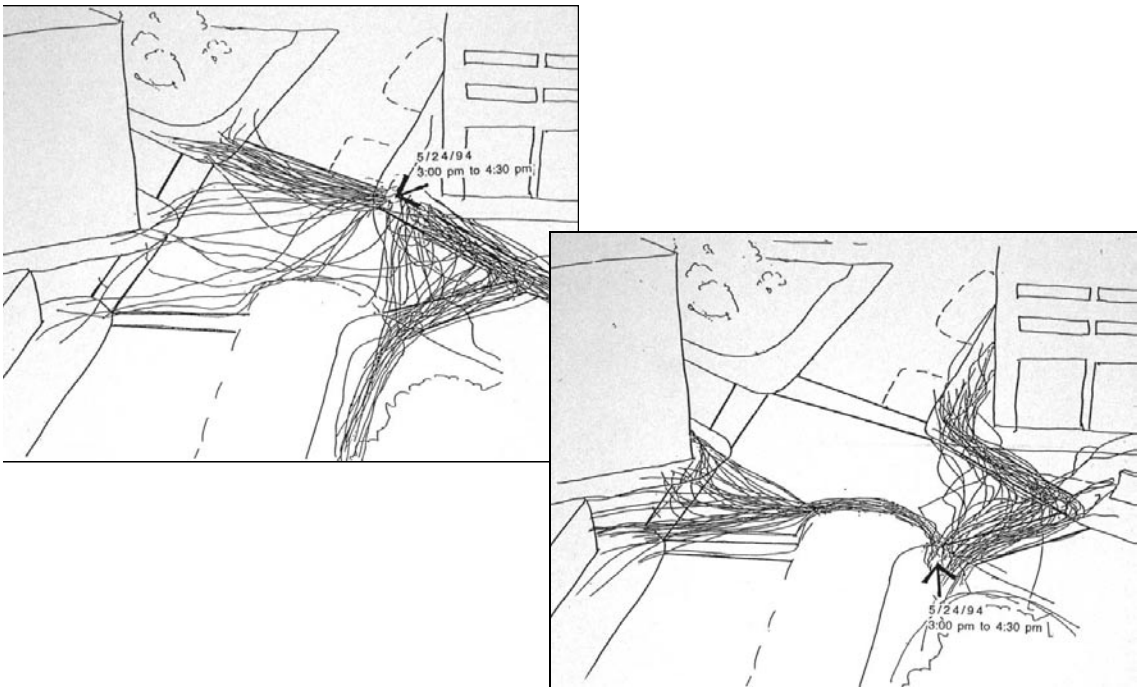


Fig. 20
Manhattan, New York – Mulry Square: Tracking pedestrians.
Michael King, Transportation Alternatives

routes to schools program directly involve parents and older students in the data collection process. Students and parents can be provided with detailed maps and asked to simply draw their specific route to school. This data can simply be collected in the form displayed in Figure 20. These maps can also indicate locations of perceived danger, and of potential high pedestrian level detour factors. Again, when a specific intersection has been identified as being dangerous, planners can simply take a detailed map of the intersection and map over the course of a peak hour how people are actually crossing the street, and locations of conflict. This very localised data is helpful when designing pedestrian safety measures.

3.4.12 Collection and review of all other transport plans for the project area for impacts on NMT

It is very likely that as you prepare your NMT plans, other agencies are simultaneously working on the exact same corridors with proposals radically different from your team's. The piece of land you are proposing for the major new north-south bikeway is probably being eyed by a French Metro construction company and their local partner, a Japanese railway company and their local partner, and a big toll highway construction company and their local partner.

Armed with all the data collected above, your project team and the NMT Task Force should review all these parallel plans for their impacts on non-motorised travel, and propose concrete changes if necessary.

3.4.13 Identification of priority improvement locations

With all of the above information, the project team should present this data to the NMT Task Force and together a priority list of locations, corridors, and sites in need of improvement should be identified and mapped. The selection criteria should be similar to those which were used to identify the project area, namely:

1. A high level of political consensus that improvements are needed among the NMT Task Force members.
2. A high level of community support for NMT improvements in the location.
3. The interventions would greatly reduce accidents involving vulnerable road users.
4. The interventions would greatly increase the efficiency of non-motorised travel by reducing detour factors.
5. The intervention would greatly increase the efficiency of motorised traffic by grade separation.
6. The intervention would complete or connect a network or corridor for NMV travel in other areas.

3.5 SELECTION AND DESIGN OF APPROPRIATE FACILITIES FOR EACH LOCATION

Once you have identified the locations where improving non-motorised vehicle and pedestrian facilities are a priority, specific designs can be developed. This report will briefly review some of the key design considerations, but refers civil engineers implementing NMT projects to one of the various design manuals available. It will also comment briefly on how some of the design manuals, designed primarily for first world conditions, may need to be modified to suit developing country conditions. The CROW Manual, *Sign Up for the Bike: Design Manual for a Cycle-Friendly Infrastructure*, published by the Centre for Research and Contract Standardisation in Civil and Traffic Engineering - The Netherlands is an industry standard. AASHTO's *Guide for the Development of Bicycle Facilities* is another good guide. (www.aashto.org). *Productive and Livable Cities: Guidelines for Pedestrian and Bicycle Traffic in African Cities,* published by IHE Delft University, is also good and focused on African conditions. None of these guides, however, deal with large numbers of three-wheeled non-motorised traffic, nor what to do about large numbers of uncontrollable street vendors.

3.5.1 Bicycle and non-motorised vehicle facilities

3.5.1.1 Facilities for roadways

The *CROW Manual* makes recommendations regarding when to use different types of facilities. The two determinants are the volume of motor vehicles and the motor vehicle speeds. On facilities where traffic speeds are less than

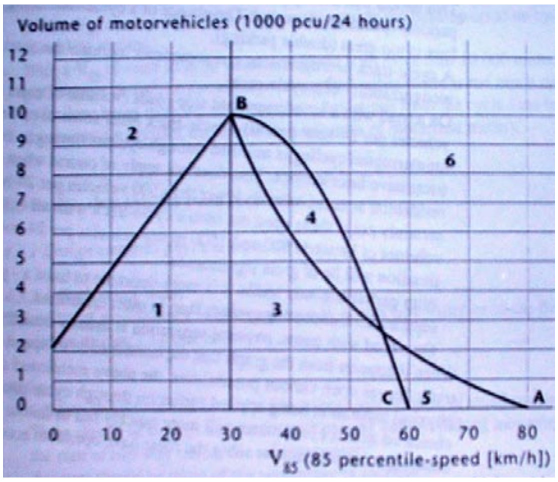


Fig. 21

Amount of separation between cyclists and motor vehicles with various speed-volume combinations.

CROW Manual 1993

30 km/hr, no separation is necessary (Figure 21). On facilities with speeds between 30 km/hr and 60 km/hr it depends on the traffic flow. At 40 km/hr, if there are more than 6000 passenger car units (pcu)/24 hours, separate bike facilities can be justified. At over 60 km/hr, with any significant volume of traffic, separated facilities are virtually always recommended.

Shared roadways and signed bikeways on normal streets

On many roadways, special bicycle lanes are not necessary. The main consideration is the speed limit and congestion on the roadway. For any facility where speed limits or actual motor vehicle speeds are 40 km/hr or less, special facilities for bicycles are not really necessary. If speed limits or actual operating speeds are higher than 40 km/hr, but the curb lane or a paved shoulder is wide enough to accommodate bicycles without any specially designated lane, a special bicycle lane is also not necessary, but may be desirable for reasons stated below.

Simple measures on ordinary streets can also be very important. A major consideration is the design of storm drains. They should be designed so that bicycle wheels do not fall into them. Steep open drainage ditches also present hazards for cyclists. Steep curb cuts are also more hazardous than rounded curb cuts. Cyclists are also as sensitive if not more sensitive to pot holes, cracks in the roadway, overgrown plants along the roadside, sand, gravel, and oil on the roadway, and other maintenance concerns that also affect motorists.

Sometimes the simple posting of bicycle route signs on existing streets can be important for two reasons. First, sometimes non-motorised traffic can be routed off major arterials by taking secondary and tertiary arterials. The availability of these routes, however, may not be commonly known. Coded bike routes, coupled with bike maps, can help cyclists identify more bicycle or NMV friendly routes. Secondly, it can be used to indicate that along this route traffic signals, intersections, and roadway maintenance have been designed to prioritise bicycle and other NMV use.

"For any facility where speed limits or actual motor vehicle speeds are 40 km/hr or less, special facilities for bicycles are not really necessary"

Sometimes bicycles and other NMVs might be recommended to use sidewalks in specific locations, and this too can be indicated by roadway signs. Typically, this may occur on bridges or short links of high speed facilities designed with sidewalks and high speed motor vehicle traffic but no space for special NMV facilities, where NMV access is critical to avoid a serious severance problem.

Non-physically separated NMV lanes

There is debate about the effectiveness of non-motorised vehicle lanes which are separated from the roadway only by a painted stripe. The main advantages of adding such a lane over having no special NMV lane indication are:

- If a road is highly congested, where actual motor vehicle speeds have declined to levels below average bicycle operating speeds (roughly 12 – 16 km/hr), and if the roadway is sufficiently wide to accommodate a bicycle lane in addition to the existing motor vehicle lanes (perhaps narrowing the motor vehicle lanes will be necessary), the addition of a NMV lane will allow the NMVs to operate at higher speeds than the motor vehicles, without compromising motor vehicle speeds.

This can encourage the use of non-motorised modes.
- A bicycle lane can give cyclists a greater sense of entitlement to the road, and sends a signal to motorists that the bicycles have a clear right to be there.
- The painted facility can lead to more orderly and predictable traffic behavior by the motorised and non-motorised modes, modestly increasing traffic capacity for the motorised modes by preventing the NMVS from occupying a full vehicle lane.

The advantages of having a non-physically separated NMV lane over a physically separated NMV lane are as follows:
- It is cheaper
- It is less likely to be occupied by street vendors and pedestrians
- It is less likely to become obstructed by refuse, debris, snow, or construction materials, or wide three wheeled NMVs.
- It is easier to clean, maintain, and remove snow and debris
- If it does become obstructed, it is easier for the cyclist to get around the obstruction.

"A bicycle lane can give cyclists a greater sense of entitlement to the road"

If a non-physically separated NMV lane is selected, some determination needs to be made as to whether the main users of the facility will be standard bicycles, three wheelers, or a combination of both. This can be determined based on the data collected above. Another consideration is whether or not parking is allowed on the curb lane.

On one-way streets, if the lane is not physically separated, the NMV lane should also be one-way. In countries where motorists drive on the right side of the road, it is preferable to have the NMV facility on the right side of the road. Bicyclists traveling the wrong direction on a one-way bike lane are a major cause of accidents.

Ideally, parking should not be allowed to the left or right of an NMV lane, as the greatest hazard for NMVs is having a motor vehicle passenger throw open their door right in front of them. However, this is not always possible. In the US, it is considered preferable to have the parking lane next to the curb, rather than the NMV lane next to the curb, though some cities have experimented with curb-side NMV lanes. (Andrassy Ut. in Budapest, and Copenhagen, for example). Bike lanes are not encouraged where angle or perpendicular parking is allowed.

In the US, the minimum allowable width of a bicycle lane is 1.2 metres if there is no parking adjacent to the lane. If there is parking adjacent it must be 1.5 metres or more. These measurements do not assume the use of three wheelers. If three wheelers are used, the minimum recommended NMV lane width for a one-way facility is 2 metres. This will just allow one three wheeler to pass another three wheeler which might be stopped. If NMV flows are high enough to justify wider lanes, they should be adjusted accordingly. For more detail, refer to the design manuals.

If the number of cyclists or cyclist equivalents (with three wheelers counting for three cyclists), rises above 150 per direction per hour, the *CROW Manual* recommends the width of the cycle lane be increased from a minimum of 1.5 to 2.5 metres, and if volumes are over 750 per direction per hour, they recommend 3.5 metres. If mopeds or other slow moving motorcycles are allowed on the same facility, the recommend increasing the width by another half metre (see Figure 22).

Physically separated or partially separated NMV lanes

There are several advantages and disadvantages of having physically separated NMV lanes as opposed to lanes only separated by road markings (see Figure 23). Advantages are:
- They are less frequently obstructed by double parked cars or illegal use by motor vehicles and motorcycles.
- They provided a greater sense of security to the NMV user.
- They can allow for two-directional NMV travel even on one-way roads.
- They ensure that NMV users will not make sudden movements into the motor-vehicle lanes or obstruct motorists.
- They are self-enforcing.

One-way traffic		Two-way traffic**	
	maximum of 10% moped-riders		
peak-hour volume in one direction	*effective width of cycle-track (m)*	*peak-hour volume in two directions*	*effective width of cycle-track (m)*
0 - 150 150 - 750 > 750	1.50* 2.50 3.50	0 - 50 50 - 150 > 150	1.50*** 2.50*** 3.50
	minimum of 10% moped-riders or three wheelers		
0 - 75 75 - 375 >375	2.40* 3.00 4.00	0 - 50 50 - 100 > 100	2.00*** 3.00 4.00

* A one-way cycle-track of 2.00 m or narrower should have a partition (preferably on the left hand side) which can be ridden over. This is so that cyclists have the possibility of taking evasive action with passing or overtaking manoeuvres. A one-way cycle-track of 2.00 m or narrower is not a good cycling-facility if it is designed as an adjoining cycle-track, because cyclists keep a certain safe distance from the partition; the effective width of a cycle-track is hereby decreased.

** A two-way cycle-track should not be an adjoining construction. If that was the case cyclists riding in one of the two directions would have to ride much too close to the main carriageway for motorized traffic.

* A two-way cycle-track 2.50 m wide or narrower should have a partition which can be ridden over on both sides, so that cyclists have room for evasive action.

Fig. 22
Preferred effective pavement widths for cycle tracks with various bicycle traffic.
CROW Manual 1993

Fig. 23
The new West Side bike lane, in New York, and a bike lane in Frankfurt, Germany.
Transportation Alternatives (left); Karl Fjellstrom (right)

The disadvantages include:

- If they are too narrow, a single three wheeler can obstruct the lane
- If the lane is obstructed, it is very inconvenient to go around the obstruction.
- They are more prone to filling with debris, vendors, snow, etc.
- They must be placed on the curb-side of any parking vehicles, or in the median strip.
- They can make truck deliveries to store-fronts less convenient.
- Facilities placed in the median strip cause special problems at intersections.

The dimensions for the facility will be roughly the same as for other bike lanes, with the exception that dimensions for two directional facilities can be suggested. The minimum width for a two-directional NMV lane with any three wheeler traffic should be 2.4 metres, with 4 metres recommended where feasible.

3.5.1.2 Intersection design

In developed countries, most accidents occur at intersections. In developing countries there are also a significant number of accidents between intersections, mainly caused by crossings of long arterials.

There are two basic theories about how to integrate non-motorised vehicles into intersections. One is to pull them out of the intersection, and the other is to have them pulled into the intersection and clear the intersection first.

- Figure 24 illustrates integrating bicycles into roundabouts.
- Figure 25 illustrates separating bicycles out of roundabouts.
- Figure 26 illustrates pulling NMVs out of standard intersections.
- Figures 27 and 28 illustrate pulling NMVs into the intersection and getting them to clear the intersection first.

In China and Bogotá, there are actually some major highway interchanges where bicyclists have their own fully grade separated route through the interchange, where motorists pass both above and below the bicycle paths (see Figure 29).

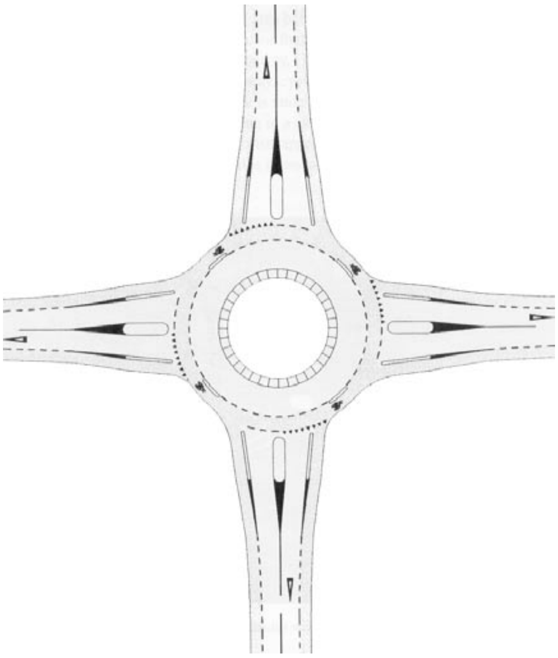


Fig. 24 ▲

Roundabout with cycle lane or recommended lane and physical separation (hedgehogs) on the roundabout and the connecting roads.

CROW Manual 1993

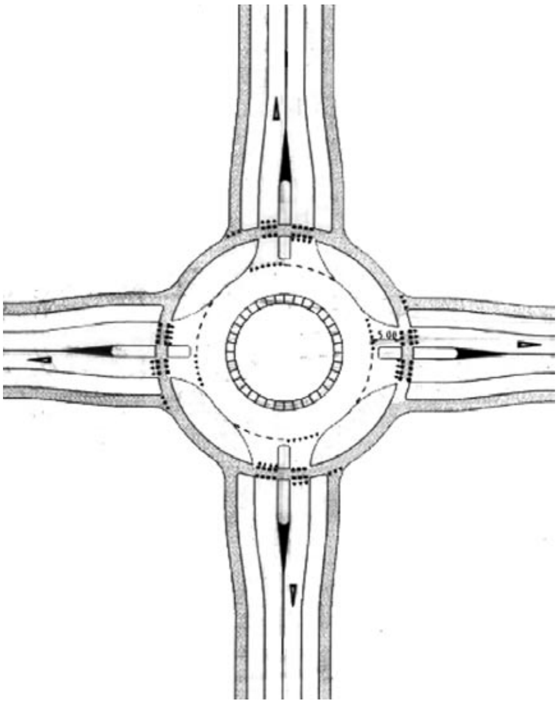
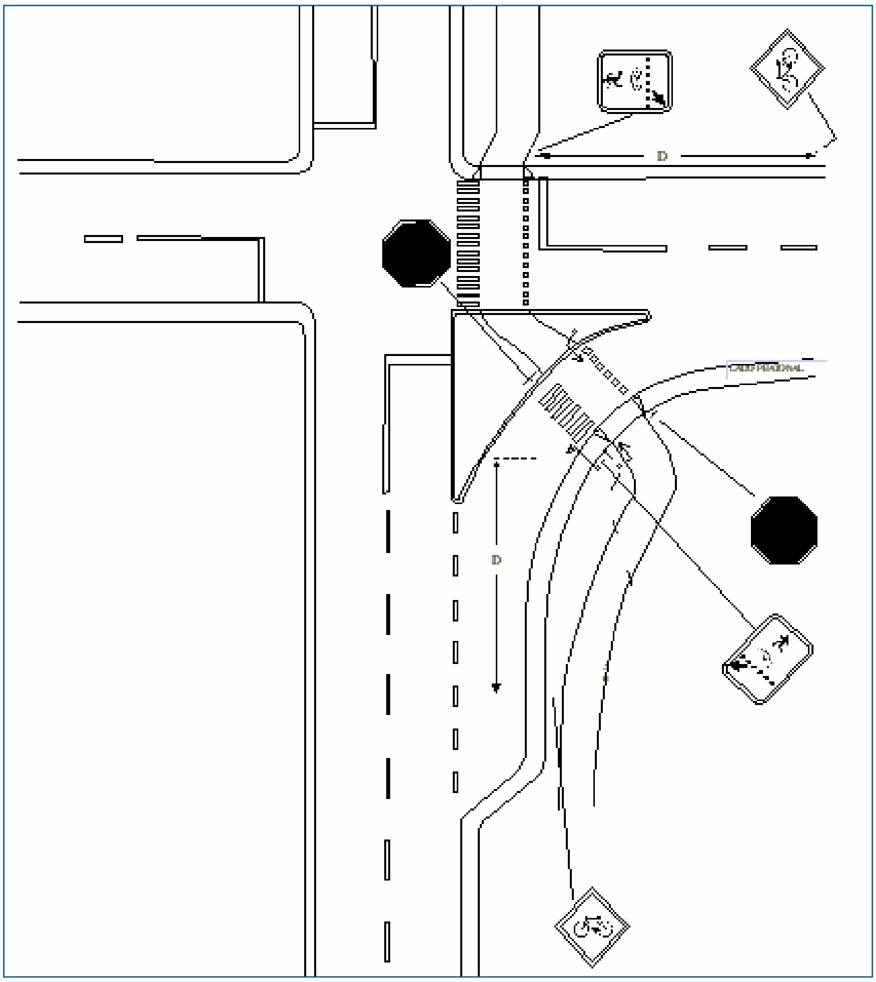


Fig. 25 ▲

Roundabout with separate-lying cycle track and cyclists having right of way.

CROW Manual 1993



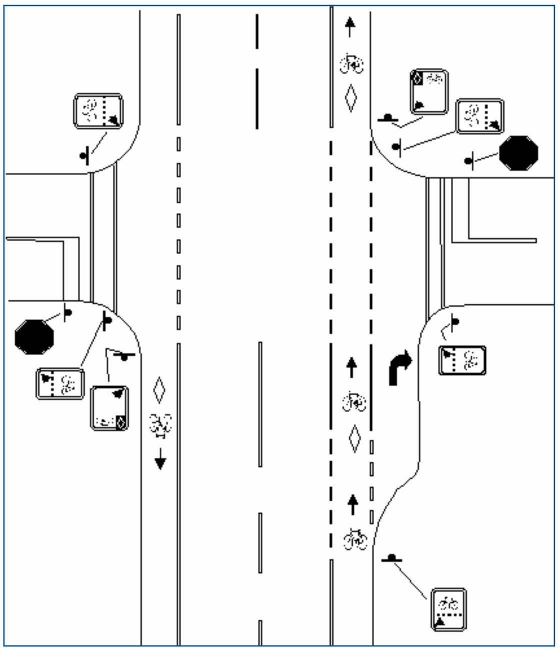


Fig. 27 ▲

A Bogotá intersection design (bicycles are 'pulled into' the intersection, to clear it first).

Bike Paths Master Plan, Institute of Urban Development, City of Bogotá

Fig. 26 ◀

A Bogotá intersection design (bicycles are 'pulled out' of the intersection).

Bike Paths Master Plan, Institute of Urban Development, City of Bogotá

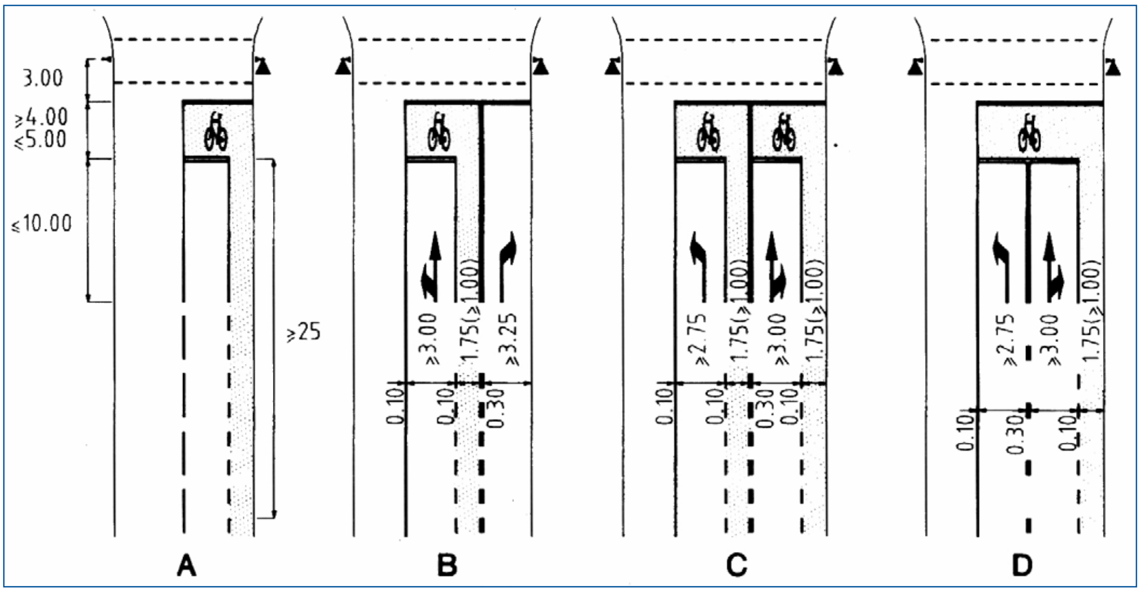


Fig. 28 ▲

Expanded bicycle streaming lanes.

CROW Manual 1993

A = Standard model
B = Right-turning model
C = Left-turning model
D = Left-turning model w/o a separate green phase

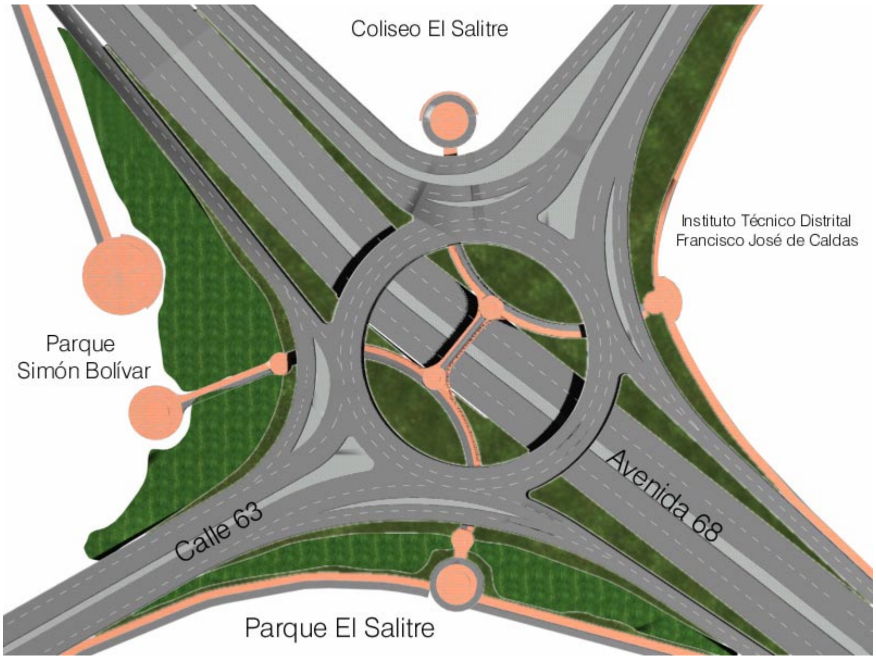


Fig. 29

A grade-separated bicycle intersection in Bogotá.

Bike Paths Master Plan, Institute of Urban Development, City of Bogotá

3.5.2 Pedestrian and traffic calming facilities

The British publication, *Traffic Calming in Practice: An Authoritative Sourcebook with Eighty-Five Illustrated Case Studies* (London Publishing) is a good resource for various pedestrian improvements. The number of basic options is fairly limited. The basic principles to protect pedestrians are:

a. Slow down traffic speeds through both speed restrictions and physical infrastructure changes:

- neck-downs at intersections
- restructuring roads to meander around trees and planters and medians forcing them to go slow (see Figure 30)
- sleeping policemen and raised zebra crossings (see Figure 31)
- changing from smooth to rough road surfaces or using rumble strips.

b. ***Reduce the distance pedestrian needs to cross at any one time at uncontrolled intersections:***

- Traffic islands (see Figure 32)
  There is a question about whether it is feasible to put traffic islands in the middle of a multi-lane one-way street. There are a few examples (including in Curitiba, Brazil), but they are rare. This is a major concern in many Indonesian cities which have very wide one-way streets with long distances between traffic lights or intersections
- Neck-downs at intersections, where the road is tapered, narrowing into the intersection
- Most roads are wider than they need to be at intersections. Narrowing road widths at intersections not only slows turning traffic, it also reduces the distance pedestrians need to travel to cross the road.

Fig. 30

Restructuring roads to meander, and make vehicles go slower. Photos from Germany.

Bike Paths Master Plan, Consorcio Projekta Ltda-Interdisenos Ltda., Institute of Urban Development, City of Bogotá

Fig. 31

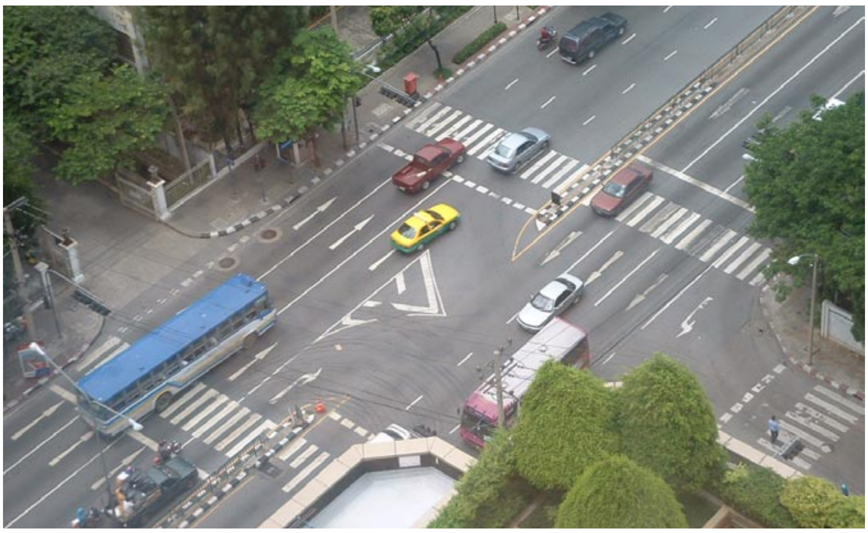
Speed humps (Butingford, United Kingdom) and raised zebra crossings (USA).

Bike Paths Master Plan, Consorcio Projekta Ltda-Interdisenos Ltda., Institute of Urban Development, City of Bogotá (left); Pedestrian and Bicycle Information Centre, US DOT, www.walkinginfo.org (right)

Fig. 32

Traffic islands to assist pedestrians and cyclists. Clockwise from top left, Marakina, Manila (under construction); Brisbane; Yokohama; and Bangkok.

Karl Fjellstrom, 2002



c. ***Reduce the amount of overall motor vehicle traffic on routes heavily used by non-motorised modes.***

This would include the entire array of traffic demand management measures. Some of the more interesting ones include traffic cells (rerouting through traffic out of neighbourhoods), parking restrictions, congestion or cordon pricing, reducing lane widths, closing streets to traffic and other measures.

d. ***Send signals to drivers that they are operating on areas intended for pedestrians***

Elevating pedestrian ways at intersections rather than having pedestrians descent to the roadway sends a signal to drivers they are on space designed for pedestrians. This can also be done with paint, design features, and markings.

e. ***Physically protect pedestrian facilities from incursions by motor vehicles***

Placing bollards to protect curbs at intersections prevents trucks and motorists from jumping curbs and hurting pedestrians. Bollards also are used to prevent motorists from parking across sidewalks.

f. ***Traffic crossing signals***

In developing countries, it is quite common to have very large unsignalised intersections. These large unsignalised intersections are extremely dangerous for pedestrians and NMVs. Other traffic calming measures are more important when there is no traffic signal. Where signals do exist, not allowing right turn on red signals can help pedestrians cross safely. An increasing number of municipalities are using a phase in the traffic signal sequence only for pedestrians and cyclists to cross, allowing pedestrians and cyclists to clear the intersection before the turning motor vehicle traffic. In the Netherlands, there are entirely separate traffic signals for bicyclists, motorists, pedestrians, and trams. While this allows tram and bicycle prioritisation, it is also visually confusing to some people.

4. Advice on how to achieve implementation

4.1 POLITICAL COMMITMENT

Politically, it is often easier to implement an extremely expensive metro or highway project than even the simple improvement of a sidewalk. This is because any large construction project has large interests which stand to make a lot of money if the project is implemented, and therefore are willing to push government officials on a regular basis to ensure it is implemented. Politicians also stand to gain by being identified with the completion of public works. Even though basic improvements like the construction of sidewalks may do more to alleviate traffic congestion and road accidents than other projects costing hundreds of times more, the very low cost nature of these improvements makes it difficult to find a political constituency to ensure their implementation.

Historically, these sorts of projects have come about because someone with political power, money, and perseverance made them happen. The most recent large-scale non-motorised transport improvement was done in the city of Bogotá. In Bogotá, improving the city's transportation system in this way was a major campaign promise of Mayor Enrique Penalosa who was personally convinced of the importance of such measures. In the city of Bogotá, the Mayor also has enormous power, unlike in some other cities where the mayor is less powerful. Support for the NMT improvements from the NGO community existed, but it was clearly the Mayor's office which pushed it forward. Similarly, the pedestrianisation of downtown Curitiba, Brazil, was also pushed through by an enlightened Mayor (see Module 1: *The Role of Transport in Urban Development Policy*). The prioritisation of bicycle use in China was a decision by the highest levels of the national government and party, just as today the restrictions against bike use are being pushed through national level political pressure.

In other locations, pressure from bicyclists, NGOs, and international funding agencies has proven critical. The bike facilities in most large US cities, in Western Europe, in Central Europe

(Krakow, Budapest, etc), in Bangkok, and the dramatic improvement in pedestrian facilities in Seoul clearly resulted from pressure applied to governments by NGOs and cycling federations. In Accra and Tamale (Ghana), in Tanzania, in Marakina, Manila (Philippines), Lima (Peru), Gdansk (Poland), Yogyakarta (Indonesia), and Santiago de Chile, new bike and other NMV facilities were given a strong push by international organisations such as the World Bank or UNDP, and often more specifically committed individuals within these institutions.

Other factors critical to ensuring implementation are good public education efforts through the media. If the Mayor fully supports the plans, he can use his access to media to push them forward. NGOs can also make clever use of the media to win popular support for NMT improvements.

Involving all the relevant stakeholders both inside and outside the government in the planning process from the outset, and letting them take ownership of the plans, is also likely to reduce significant obstacles to implementation.

4.2 COST, AND TIME FRAME FOR IMPLEMENTATION

While it can cost tens of millions of dollars to properly reconstruct a single major public transit hub or intersection to ensure safe non-motorised travel integration, many measures to improve conditions for non-motorised transport can be done for the cost of basic roadway paint. Construction costs vary from country to country. Most measures can also be implemented rapidly, in less than a year. Physical construction for pilot projects will take weeks rather than months.

Developing cities should start by forming a non-motorised transport task force, which can initiate a planning process. This task force can then begin to develop and implement measures, beginning with isolated improvements, and in a relatively short period laying the foundation for a city-wide network of non-motorised transport routes.

5. Resources and key contacts

5.1 WEB-BASED RESOURCES

- www.aashto.org (to order *Guide to the Development of Bicycle Facilities*)
- www.crow.nl ("publications" "records" to order *Sign Up for the Bike*)
- http://www.nottingham.ac.uk/sbe/planbiblios/bibs/sustrav/refs/ST05.html Numerous British traffic calming references.
- www.saferoutestoschool.org (the New York City Safe Routes to Schools Program)
- www.transalt.org (New York City bike-related information, including links to bike regulations in the US)
- www.cycling.nl (rich in information on best practices, with a European focus)
- www.itdp.org (numerous resources on NMT-related issues)
- www.transact.org (Lots of advocacy resources for NMT focused on the US)
- www.worldbank.org (To order World Bank publications listed below)
- www.adb.org (to order "Vulnerable Road Users in the Asia and Pacific Region," Stock No. 010499)
- www.walkinginfo.org (Pedestrian and Bicycle Information Centre, US DOT)

5.2 OTHER REFERENCES

- De Langen, M. 1999. *Liveable African Cities: A Guideline for Urban Pedestrian and Bicycle Traffic in Africa*. (IHE Delft University, Delft, the Netherlands)
- Gallagher, D. 1992. *The Rickshaws of Bangladesh*. (Dhaka: University Press).
- *Guide for the Development of Bicycle Facilities*, 1999. American Association of State Highway and Transportation Officials. Washington DC.
- GTZ & ITDP 2000, *Improving Conditions for Non-motorised Transport in Surabaya: A Pilot Project in Two Neighbourhoods*, GTZ Sustainable Urban Transport Project, www.sutp.org
- Kuranami, 1994. *Non-Motorised Transport in Ten Asian Cities*. (Washington D.C.: The World Bank)
- Replogle, 1992. *Non-Motorised Transport in Asian Cities*. (Washington D.C.: The World Bank)

- *Sign Up for the Bike: Design Manual for a Cycle-Friendly Infrastructure*. 1994. (The Netherlands: Centre for Research and Contract Standardisation in Civil and Traffic Engineering).
- *Traffic Calming in Practice: An Authoritative Sourcebook with 85 Illustrated Case Studies*. 1994. (Landor Publishing: London)

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