INTEGRATION OR SEGREGATION – RECOMMENDATIONS OF THE PRINCIPLES OF URBAN ROAD NETWORK DESIGN FOR THE SUSTAINABLE CITY

Gustav Nielsen
Civitas Consultants AS, Oslo

1 INTRODUCTION

1.1 A study of traffic integration or segregation

This paper presents main conclusions from a study the author has carried out for the TRAST (‘Traffic for an attractive city’) project of the Swedish Road Administration and other national bodies responsible for urban planning and transport in Sweden1. The study is a review of literature related to the current international debate about the principles of road and transport network design in urban areas (Nielsen 2006). This includes a discussion of urbanists’ critique of the conventional approach in the tradition of the famous Buchanan report (Traffic in Towns 1963) and of the influential Scandinavian traffic safety principles of SCAFT (1967) for road network design. The study looks at the competing concepts of:

- Traffic integration and traffic calming with filtering of car traffic on traditional, mixed use urban streets as the main object of interest, versus
- Differentiation and segregation of different types of traffic, with the hierarchical road system as a main system solution, which tends to result in urban structures that are characteristic of the modernistic, car-based city.

The merits and disadvantages of the two different planning paradigms have been discussed in relation to the goal of sustainable development. The study looked at existing evidence of the environmental, safety and accessibility effects of the various types of solutions recommended by the main schools of thought. In conclusion the study proposed a set of planning and urban road network principles that might be recommended to cities that have a sustainable transport system as a major objective of city transport and development.

1.2 Policy principles and design solutions for a sustainable city

In most urban regions in the developed world, a major concern of transport policy is to contribute to a significantly more sustainable and environment friendly region on a long-term basis. The study interprets this to imply that the political authorities are seeking for solutions for the transport systems that are able to make walking, cycling and travel by public transport a competitive alternative to the motor car for urban travel. This is a far-reaching ambition, which means that it is difficult to find practical examples that fully live up to the expected level of quality for all components of the urban transport system. In
order to fund the qualities needed, the transport system must also be cost-efficient.

So, high quality alternatives to the car are required and the use of resources to achieve this must be efficient. This implies that restrictions and disincentives to car use must be included in the policy package. I also take up some transport and land-use policy aspects that are outside the scope of the literature study. This is because the principles of network planning and design must be seen and understood in the context of an urban and land-use policy with the sustainable city as the main goal.

Some will probably find the recommendations too radical in relation to current urban and transport planning. However, in Scandinavia as in the rest of Europe current practice has failed to deliver sustainable transport. Already in 1975 the OECD countries declared that they wanted ‘Better towns with less traffic’. For several decades politicians and planners at international, national and local levels have been declaring that the growth of urban car traffic should be halted or even reversed, and that more sustainable, environment friendly transport solutions should be found.

So, if one really wants to turn around the strong forces of the still growing car traffic on urban roads and streets at the level of the urban region, and not only very locally, some radical changes are needed. One must also make policy and planning adjustments over a wide range of fields.

Others might perhaps find that the recommendations are rather conventional, mainstream thinking of classical urban traffic planning. However, I believe that the way cities deal with urban development and transport policy could change if they really stick to the goal of more sustainable urban transport and make full use of existing knowledge about traffic consequences and the effects of different measures. Results from more than 30 years’ research and practical experience is available but still not properly integrated into the mainstream political debate, transport policy analysis and practical planning in our cities.

1.3 This paper

This paper presents the main conclusions from the study in the form of sixteen policy recommendations for a small or medium sized city region in Europe or elsewhere in the so-called developed world.

The recommendations should be seen as qualified hypotheses about how the traffic system of urban areas – in particular the design of the road network – should be developed in order to contribute significantly to the future sustainability of cities. I do not pretend to have the final answers, but believe that we have some good points for further discussion and more thorough analysis and empirical testing.

Many planners are well aware of this type of recommendations. But often decision-makers and other participants in the planning and design process do not fully recognize the importance of the principles, the required quality of solutions, and the strength of implementation force which is demanded.
2 RECOMMENDATIONS FOR URBAN NETWORK DESIGN FOR THE SUSTAINABLE CITY

2.1 Create an urban land use and transport policy package to achieve the required traffic volumes and environmental qualities

Existing knowledge about the connections between local environmental factors and car traffic, and the effects of traffic and accessibility on urban place qualities should be used to define the environmental capacities for car traffic in all relevant parts of the road network of the city. This analysis will indicate the need to influence car traffic in different parts of the road network, depending on the level of ambition for the urban environment and other relevant indicators that have been politically determined.

In addition to this rather detailed study of the road and street network some indicators of the total traffic volume, modal split and total use of energy for the transport operations are needed for the environmental assessment of the total traffic system and transport policy. This problem analysis will help to define which parts of the network that need different types of improvements to reach the objectives, including the required reductions in traffic volume and particular types of disturbances from car traffic.

Based on this information, planners and politicians should define the need for policy measures to improve the goal achievement of the traffic system. These measures could be taken from a very large pool of possible policy instruments, such as new road building, traffic and parking management, vehicle detection and control, urban redevelopment and changes in street use, influencing transport demand directly by economic or other measures, or developing alternative means of transport. The main basis for such an analysis is to have good understanding and data about existing and future transport demand within the urban region in question. This includes knowledge about urban activities and their geographical distribution in the region.

Within limits, in theory it is possible for a city to have the amount of traffic and traffic related problems that one finds acceptable. The main professional challenge is to compose optimal packages of combined policy measures to achieve the desired results. Three main types of measures are required, and they should be designed to strengthen the effects of each other:

Transport system design: The physical design and operation of the transport system should fully reflect the objectives of the sustainable city both in principles and in detailed design. We will soon return to this topic.

Incentive and financing system: There should be clear incentives for all actors to choose the most sustainable alternatives to meet their demand for transport and activities. A comprehensive pricing and financing policy for the use of parking places, roads and public transport should be designed to reflect the social and environmental costs of different modes of transport. An efficient and long term system for the financing of the investments and operations of the different parts of the urban transport system is also required.

Land-use planning development: Land-use policies are important in the long term perspective that is needed to change current trends and move towards
the sustainable city. These policies should include the intensification of urban land use, transformation of former industrial areas and derelict land, and the concentration of development in public transport corridors. The location of specialized types of workplaces, regionally oriented services and cultural facilities, and large traffic generating services, close to important public transport interchanges should also be part of the land-use planning policy.

The political and institutional obstacles are usually greater than the difficulties of a professional, analytical nature. But they are easier to overcome if the planners' advice can be based on thorough and independent analysis as well as cooperation between different professional fields and groups of interest.

This study does not deal with all these aspects of transport policy, only the most important principles of the physical design of the road transport network. But the design principles depend strongly on the policy context outlined here.

2.2 Make use of information technology to control traffic volume, speed and character

With the fast development of information technology and increased use of this in the traffic system, it is possible to control and manage vehicle traffic in much greater detail than before. Such technology is already in use for the control and payment of road tolls and access to parking sites or garages, and to control automatic barriers and traffic signals on bus and tram routes.

In goods transport electronic identification systems are used to track containers' and parcels' location continuously through the delivery process. Similarly, through the introduction of electronic vehicle identification systems, it will be possible to distinguish between individual vehicles in car traffic without having to rely on visual observation of licensing plates.

This technology could be used to control the number and types of vehicles that are allowed to pass a certain screening line, or to diversify road tolls or other local charges, e.g. for car parking. Then priority could be given to environment friendly vehicles when driving into certain urban zones or environmentally sensitive areas. Differentiation over time of road or parking charges or access controls would be simple, and even dynamic pricing in relation to the actual level of congestion or local air pollution will be rather simple to implement in terms of technology and operational costs. In the future, it will also be possible to have the speed limits automatically sent to the cars depending on which section of road they are running on. This information might also be used to restrict maximum possible driving speeds of the cars.

These systems must be developed with due consideration for the critical concerns of privacy and public control, and they must be designed and implemented on a national level, or even better through international standardization. But then they will have the potential to become a very efficient tool of traffic management in order to reach very specific and local requirements concerning traffic volume, character, speed, and noise and air pollution.
2.3 Create a transit-oriented network designed to support sustainability and urban life

To a large extent traditional urban traffic planning has concentrated on the planning for car traffic and parking. In addition, traffic safety has been a major concern, and some measures against traffic noise and local air pollution have been studied and implemented. When politicians and planners want a more sustainable city and transport system, they must focus much more on improvements for users of environment friendly modes of transport.

The design requirements for urban road systems well suited for public transport, cycling and walking are different from those of car traffic. Road and street space is scarce, and usually a number of compromises must be made between the space demands of different street users. The priorities between users should affect the overall design of the road and street network, traffic signals and other traffic regulations.

By giving priority to the environment friendly modes in the overall and detailed design of the road system, traffic system designers can significantly influence the competition between the car and other modes of transport in urban areas. Direct routes in attractive transport corridors for pedestrians, cyclists and public transport, with priority at junctions and crossings with car traffic, is probably the most important requirement. Letting public transport vehicles run straight through roundabouts, straight public transport stops, and low driving speeds for car traffic, are other examples of design solutions that should be preferred. Creating cycle lanes wide enough for cyclists to drive past each other, and giving cyclists extra space and priority time at traffic junctions are other examples of the type of priority needed.

An environment oriented transport system design for a city could follow a planning process like this:

- Analyze overall transport demand patterns of today and in the future of the urban region in question.
- Define the major local areas that attract heavy volumes of passenger and goods transport, and the most important urban activity places and environmental areas that need both good access and protection from heavy car traffic.
- Draw up the major elements of an efficient and attractive public transport system that could cater for a very significant part of this demand. This must include the main public transport corridors and lines operated undisturbed by car traffic, major public transport interchanges, the typical service frequency levels, travel speed requirements, desirable walking distances, important quality factors for system design, etc.
- Locate as many public transport interchanges and stops as possible in car free areas, but in locations close to important places of travel origin and destination. This will improve safety and comfort for public transport passengers.
- Design safe, attractive and efficient pedestrian and cycle routes to provide good access to all public transport stops and interchanges, and connect them to a continuous, high quality network of pedestrian and cycle roads and streets for the whole city and surrounding area.
- Direct and regulate car traffic away from environmentally sensitive areas and roads where they create significant nuisances for public transport, pedestrians and cyclists.
- In the urban car road system, give priority to access traffic, goods delivery, service and emergency vehicles, and vehicles for disabled persons. Do this at the cost of through traffic by car when these considerations are in conflict.
• Concentrate car parking to fewer and larger sites with normal walking distances not shorter than what is considered acceptable for public transport users.

By doing this and adjusting down the traditional space and speed requirements of car traffic, the competitiveness of the car for intra-urban travel will be reduced. Environment friendly modes of transport will become more attractive alternatives for larger parts of the transport demand of the urban area. The principles of how to plan and design the network of high quality public transport are discussed in another paper of the conference (Nielsen et al. 2006).

2.4 Segregate heavy and fast car traffic from urban life

The recommended network strategy for the most environment friendly modes incorporates the principle of traffic segregation. This is a reflection of the harsh reality of motorized traffic: High quality public transport, pedestrian and cycling cannot be operated at high levels of safety, travel quality and comfort in the same roads and streets as heavy and/or fast car traffic.

Today, a compromise is attempted in many cities in order to accommodate high levels of car use. But if the city has some ambitions of creating an attractive and competitive environment friendly transport system, these low quality solutions must be replaced through the means of traffic management or the building of new bypass roads or tunnels for the through traffic by cars.

2.5 Create a two-tier car network: Highways and traffic calmed urban roads and streets

A fundamental idea behind the traditional approach to traffic separation and road classification is to determine which roads can take larger volumes and higher speed levels than others. The concept of environmental capacity is a tool to assist in the process of defining the most vulnerable parts of the urban network.

There is no reason to believe that the idea of a road transport network hierarchy should be completely departed, as some of the critics of traditional road planning seem to indicate. There will always be a need for collectors and highways as well as high speed public transport links and separate high quality bicycle routes. The principle of separating large volumes of high-speed traffic from other modes and from densely populated neighborhoods is thoroughly supported by indicators of environmental factors such as barriers, noise and pollution, and from statistics on traffic accidents. Also the cities’ need for safe and fast regional and inter-regional road connections makes it easy to confirm that a high quality road system for car traffic should be provided at the top level of the road hierarchy.

However, for more and more urban areas, the traditional traffic planning solutions do not answer our current challenges sufficiently. Before the ‘car revolution’ the traditional urban streets and roads could very nicely cater for a wide range of urban place and access functions by all modes of transport.

With the explosive growth in car ownership and use since the 1960’s, these older streets have been gradually transformed in order to accommodate often rather heavy through traffic in the middle of the streets, and dense car parking along the curbs. In attempts to reduce traffic congestion, traffic signals and
other traffic management techniques have been used to improve the flow of car traffic, very often at the cost of slowing down public transport and reduced attractiveness of the street for other activities and transport modes.

Today, more and more cities and national governments are coming to the conclusion that the balance of use of urban roads and streets should be redressed, with less emphasis on car traffic volume and speed, and more space and higher environmental quality for other transport modes and urban place activities. The second main level of the car system hierarchy should therefore be the traffic calmed urban road or street.

The idea of using traffic calming in a broader perspective than on link level is a tempting approach, as it does not require the expensive need for new space for cars and does not include the physical undertaking of constructing new arterials. However, the strategy of traffic calming is unlikely to be a success if not followed by other means to reduce the overall traffic in an area, and to concentrate the larger volumes of motorized traffic to some main arterials.

2.6 Distinguish clearly between the town and the highway
The recommendation to limit the hierarchy of the car road system to only two levels does not mean that only two road design standards are applicable.

Outside urban areas there will be still be different types of highways with single or dual lanes where other road users are allowed, as well as motorways from which slow and non-motorized vehicles are excluded. There will also be main urban highways and motorways with no or very restricted access between major junctions. The fast, safe and efficient operation of car traffic, sometimes very heavy flows of traffic, are the main objectives determining the design of this top level of the simple road hierarchy.

Within urban areas the roads and streets will have different designs and functions and speed restrictions, but the car traffic solutions should always be adjusted to the needs of other road user categories and the local, urban place activities.

The basic idea of the simple two-level hierarchy is to make the distinction between urban driving and highway driving as clear as possible, in theory almost similar to the classical distinction between town and country in the medieval, walled town:

- On the highways, car drivers can expect that other users respect their high speed of travel and right of way. The highways are designed to provide reasonably safe transport at a given, regulated travel speed with as few disturbances as possible on the main legs of all car journeys outside local urban districts. There should not be any doubt about the fact that these roads are transport arteries.

- At the urban level of the road hierarchy the road design is determined by urban planning considerations, and should encourage car drivers to take great care of the environment and safety of other road and street users. There should be no doubt that these roads and streets are urban places where vehicle access is allowed only to the extent that this may be combined with the urban functions that also take place there.

All design elements of the roads and streets, including road and traffic signs, lighting, pavements, and greenery, should be used to define the type of road the car driver – and other road users – are operating on.
2.7 Design urban roads for low speeds
The two levels should correspond with the distinctions between the standard urban and rural speed limits, which will probably require some adjustments in current practice for the determination of the urban speed zones. In order to avoid confusion, the number of road and street sections with speed limits that differ from the 'default values' of highway and urban traffic should be limited.

After the widespread introduction of low speed zones in residential areas, for a very large part of the urban road network in Scandinavia 30 km/h has become the most common speed limit. Also in many city centers and traffic calmed streets elsewhere, this is the speed limit.

Traffic safety, especially for children, has been the main motivation for this development. But it has also been documented that the best-designed schemes have reduced traffic noise and even air pollution, and in combination with physical measures, stimulated the use of streets for urban activities.

The later effects seem to be strongest in cities with large areas of 30 km/h roads, and are good arguments for making 30 km/h the general speed limit for urban areas. The explanation is that when 30 km/h becomes the most common speed limit in the city, car drivers tend to adjust to a slower and more careful mode of driving over a wider area. The 30 km/h limit will only work well if the whole road system is physically designed to encourage slow driving. The principles of such road design are now well understood from widespread research and practical experience in many countries.

Furthermore, with reduced design speed of motor vehicles the width of the car lanes and the carriageway can be minimized. This creates more street space for cyclists and pedestrians. This can help to facilitate fast, undisturbed and comfortable cycling on major cycle routes.

2.8 Create an urban street system that improves the competitive advantages of environment friendly modes
Low car speed should be seen as one of the means to alter the balance in travel time and attractiveness for short urban journeys from the car towards the more environment friendly modes of travel.

By combining driving speed reductions and more space for environment friendly transport with restrictions on through traffic, the advantages of the more direct routes for walking and cycling will reduce the use of cars for the many short journeys that are common in existing urban networks.

Similar effects can be achieved for longer journeys by giving full priority to high quality bus routes in all significant transport corridors in the city. This will require street design measures such as separate buss lanes and high quality bus stops with straight and fast curb stopping and extra space for waiting passengers and shelters. The location of stops will be optimized according to the need of public transport users, which normally will mean very close to road and street junctions. This is rather different from the traditional traffic solutions where the concern for car traffic flow often is the key factor that determines the location and design of bus and tram facilities.

Traffic junction design and regulation is a key factor in improving the quality of environment friendly modes in relation to the motor car. At signalized junctions
more green time can be given for pedestrians, cyclists and public transport vehicles. Extra advantages and increased safety can be achieved through separate lanes and waiting areas that are clearly visible in front of car drivers behind set back stopping lines and signals.

Taken separately, all these measures are well known and used in many cities and urban areas. The new thing in an environmentally oriented traffic system design policy is to make the combination of all relevant measures the standard design solution for the whole network of all urban roads.

2.9 Give suburban and industrial areas more urban elements

The techniques of urban street design and traffic calming are now well understood and practiced in dense inner city areas and in residential districts. They are practiced both in areas that have a traditional street pattern and in many of the housing areas and satellite towns that have been built on the principles of segregation and differentiation. So the recommendations above are meant for these types of urban area. They are also applicable to smaller settlements and villages of an urban character.

However, in the more dispersed outer parts of the cities, and in industrial areas, the character of development and the road system is very different. Most of these areas have been designed and developed in the car age. They very often have a functionalistic urban layout (if any significant urban planning has taken place) and a hierarchical road network with all the implications of this that are so heavily criticized by the new urbanists.

A long term strategy for these areas as part of the sustainable city should have three significant elements:

- Intensify the dispersed land use by the development of new buildings on wasted land between existing buildings, roads and other heavy infrastructure, much of which might be characterized as ‘SLOPE’, i.e. ‘space left over after planning’. The highest densities should be aimed at in areas close to existing or potential future high quality public transport corridors and services.

- Restructure and redesign the road system in order to use less land for roads, to create shorter routes for all types of traffic, and to give the roads and adjacent land a more urban character. Connecting existing sections of pedestrians and cycle paths and shortening times for walking and cycling to public transport stops are key elements in this strategy. Also improvements in public transport efficiency and service levels can be made by connecting bus services of neighboring areas through new bus only road sections or similar means.

- Improve gradually high quality public transport services as the increase in land use density and the improvements in structure of the road network makes this possible. The changes in the design of the road network recommended above will encourage car owners to make more journeys by public transport, thus contributing to the financing of higher qualities of service.

2.10 Define environmental areas

The negative environmental effects of heavy through traffic by cars in residential, recreational and other sensitive areas are well known. Simply speeding down the traffic by traffic calming measures will often be insufficient to reach the environmental qualities that are needed in the sustainable city.

In many urban areas high urban environmental standards can only be achieved if significant volumes of car traffic are taken away from certain
streets and local through roads. This may be done by using general transport policy measures and/or a selection of traffic management techniques, which sometimes will include the full closure of road or street sections for car traffic. It should be noted that the creation of so-called cul-de-sac roads, normally does not mean full closure for pedestrians and cyclists, as often implied by the critics of such road networks.

For practical planning purposes, it is useful to define environmental areas within the city. They should be conceived as areas where heavy through traffic by car should be discouraged, and surrounded by a combination of natural or man-made barriers, parts of the highway network, and/or by urban streets that have greater environmental capacity for motorized traffic. These roads will very often be different from those that to-day are classified as major through routes.

We stress that the environmental area is only a practical urban planning tool. No assumptions about local travel activity patterns to be confined inside the ‘borders’ of environmental areas are made, and there is no attempt to make the borders follow any social groupings of residents or particular types of land use functions. Neither is the environmental area concept connected to the classical urban planning ideals of the neighborhood unit.

From this follows the conclusion that the size of environmental areas will vary a lot, depending on the local situation and the strength of policy aiming for the sustainable city.

2.11 Have a place and high quality transit oriented strategy for the old urban arterial streets

Many of the old through roads and streets in cities, towns and villages are the most intensively used urban places, with shopping, local services, often served by bus or tram lines and also with dense housing along one or both sides of the street. Because of this, the low environmental capacity of these streets will often be the most critical part of the traffic system, so a consistent strategy is needed for these streets.

In most cases these streets will need significant reductions in through traffic by cars. Also reduced speed and removal of heavy traffic in particular is often required. This must be done through a combination of city-wide measures and local measures as already described.

Usually these streets are important public transport corridors, connecting many significant destinations along a potentially high frequency route. They are also among the most important destinations for pedestrian and bicycle traffic. The development of these routes into high quality streets for environmental friendly modes should become a key element of the new urban transport strategy.

This strategy will have a significant impact on traffic and travel patterns – similar to what has happened in city centers that gradually have restricted the use of cars through traffic calming and pedestrianisation of former heavy trafficked streets:

- Some car users will switch to public transport, cycling or walking.
• Some car drivers will find a bypass route, chosen under influence of the traffic calming measures and environmental areas in the rest of the urban area.

• Some car journeys will be moved to a different time of the day or week.

• Some car journeys will be moved to new destinations with fewer restrictions for car usage, because these places are less sensitive to car traffic and therefore have some spare capacity without exceeding the wanted environmental quality standards.

• Some journeys will simply disappear.

The main counter argument one meets against such a policy is also the same that has been forwarded by the opposition to the car traffic regulations in city centers: Businesses and city life will move out of the city if access by car is restricted. More than 30 years’ experience tell the opposite story: By giving priority to public transit, pedestrians and cyclists, more visitors come to the shops and other functions, business activity grow and property values increase more than the city average. By reducing somewhat car traffic, new qualities and more space and transport capacity is created for the users of the much more space-efficient environment friendly modes of transport.

2.12 Create continuous routes if not in conflict with urban environment objectives

Even if heavy through traffic is to be kept out of an environmental area, the local street network should as far as possible allow for local motorized traffic to run directly between neighboring environmental areas. This will allow for efficient local goods delivery, refuse collection, emergency vehicles etc, and also simplify local car users’ orientation and driving in the local street network.

However, the stronger preferences one wants to give to walking and cycling as opposed to car use for short journeys, the more restricted the local car network should be. By closing short, direct routes for car driving, some car owners will be encouraged to switch to walking or cycling instead of a far longer round trip to the local school, shop or other local destinations.

2.13 Selective filtering of motorized traffic

By the use of information technology and traffic system design the choice between an ‘open’ or ‘closed’ local street can be flexible. Through automatic vehicle detection, or even differentiated pricing for local road use, the traffic and roads authorities can decide which individual or group of motorized vehicles that will pass a certain control point in the traffic network.

2.14 A parking policy that improves the environmental areas and support environment friendly transport

The location, number, regulations and charges of car parking determine the volume and pattern of car traffic starting and ending in an area. When reduction of car traffic is an important policy goal, as it will be in the sustainable city, the concentration of car parking to the outskirts of environmental areas is a good solution.

This will reduce car traffic and car parking on local streets and roads, and give environment friendly modes an advantage in travel time and convenience. The extra walking distance to the car park will reduce the car owners’ more or
less automatic choice of the car as the only mode of transport for almost all journeys, even for very short trips.

Then more urban traffic space, 25-30 square meters per place moved to a central car park, can be allocated to other uses. In congested areas this space might be used to improve accessibility for disabled drivers, for short term parking for visitors and shoppers, or for goods and service delivery by car. In other cases it will be better to use it to improve the space and quality for public transport users, cyclists or pedestrians. One car parking place removed, can give room for a shelter for bus users or a bicycle parking place for 15-20 bicycles.

The concentration of car parking and concurrent restrictions on local parking (on and off street), will also support the efficient building of underground parking and simplify parking control and the charging of parking fees.

The financing of car parking investments and operations should be organized so as to ensure that all costs are paid by the actual car users. This means that car parking should be seen as an integral part of the road traffic system, and not as a responsibility for the owners of buildings or properties, which to a large extent is the case today. Residents should not be forced to pay for car parking they do not need or want, and hidden subsidies of parking at work places should be taxed as part of the employees’ salary.

2.15 Create more and bigger car-free zones

The most advanced solution for an environmental area is to create a ‘car free zone’. Like other types of environmental areas, the size of such zones may vary a lot. Such zones usually have one or more car parks on the edge of the car free area, under ground, or in buildings.

This response to the challenges of the car is much more common than we tend to think. These examples show in practice that car free zones should have a very significant place in the transport strategies for the sustainable city:

A few European towns and villages are true car free cities (Venice, Zermatt, Wengen etc), but they are still often considered as exotic places well suited only for tourism and recreation. Nevertheless, they also have significant numbers of working places, residential areas and they usually serve well as cultural and business meeting places.

Most large and medium sized European cities, and also many smaller towns and villages have car free zones in their city centers. Some cities also have car free shopping streets outside the central pedestrian zones. Other cities have chosen to have more flexible car free zone restrictions, some only during the summer, and others only on certain market or celebration days, and some for specific hours or days in the week.

Furthermore, many local and regional centers have been built as car-free precincts, often served by railway, underground, tram or advanced bus systems; usually a combination of several modes and lines. People also seem to forget that almost all shopping centers are built around internal shopping precincts, in the inner city, in the suburbs or at external locations along the main road system.

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Large car free housing areas exist in many cities. In Scandinavia one of the main attractions of many housing estates built in the period 1965 - 1990 still is their segregated traffic system, conceived as an ideal place for families with children and others who prefer the radically improved traffic safety, peace and quiet from car traffic these estates provide, and the fine opportunities they offer for walking and cycling in natural surroundings undisturbed by car traffic.

Also many modern urban housing areas are today being built as car free estates, usually with car parking stuck under the ground or in the basements. Some of these areas are former industrial zones that have been transformed into car free residential or mixed use areas.

Many areas also have strict restrictions on the number of parking places allowed, and even projects for ‘car free housing’ have been built in several European cities.

Even urban parks and large institutional areas, such as hospitals, universities or other higher education campuses are often designed as car free zones, with access only by foot, on bicycle and for specifically authorized vehicles.

It is interesting to note that the principle of the car free zone is an urban planning element that is growing in popularity. For the sustainable city the difference will be that these areas will be even more common and larger in size.

2.16 Upgrade significantly the role of park & ride and bike & ride

In the sustainable city where access by car will be significantly more restricted than common today, park and ride and bike and ride will have a much greater role.

Some areas in the urban region will not be sufficiently heavy developed to be serviced by public transport. Local distribution and access to the public transport system in these areas will to a large extent be provided by cars and bicycles.

The upgrading of park and ride and bike and ride should include direct and short access roads, high quality and safe parking facilities, combined ticketing with public transport, service functions, car and bike hire, etc.

3 CONCLUSION

To achieve the transport and environment objectives of the sustainable city, the key is to develop an integrated land-use and transport policy which includes an appropriate strategy for the planning and design of the road and transport network. The overall policy priority of environment friendly forms of urban transport must be reflected in all details of design and traffic regulation. Some sixteen recommendations are proposed to reflect the current state of knowledge about the potential and effects of different urban transport measures.

In order to verify the validity of this advice, I propose that further work on this topic should be to document best possible practice for each of the recommendations mentioned. Also examples of the opposite solution, which should be considered bad practice in relation to the recommendations, will be useful to document.
This will help to clarify the principles, and give more inspiration to how the principles may be set out in practice. The work may also uncover important aspects that need further study, or lead to a revision of one or more of the recommendations.

BIBLIOGRAPHY


NOTES

1. The study has been made as part of the revision of the Swedish design guides for urban road transport system design under the development programme called TRAST (‘Traffic for an attractive city’). This is a joint venture of the Swedish Road Administration, the Swedish Rail Administration, the Swedish Association of Local Authorities and Regions and the National Board of Housing, Building and Planning. More information about TRAST on the project website (in Swedish): http://www10.vv.se/vag_traf/vgu-trast/trast/index.htm