Planning of traffic areas

This chapter describes good networks and principles for cyclists' traffic areas. The chapter also discusses implementation processes.

In a number of Danish urban areas there are sensibly designed and coherent cycle networks. But there is a need for more cycle routes and for traffic calming. The quality of cycle networks can often be improved, with respect both to their coherence and to individual routes.

PHOTO: Linda Hansen

PHOTO: Lars Bahl

PHOTO: Linda Hansen

PHOTO: Linda Hansen

Contents

PHOTO: Road Directorate

Physical conditions for cyclists can often be improved in relation to cables, pipes, mains and road works.

Plan & process

Planning in this chapter should be understood in two ways, namely as plan and process. The plan can consist of network planning and draft design, while the process is a matter of getting the projects implemented, often as cheaply as possible and in the right sequence.

Network planning for bicycle traffic deals with, among other things, choice of corridor, desired speed, standard, number and type of junctions. Here decisions are made concerning whether, for example, the traffic area should be a field track or a cycle track with asphalt, street lighting and winter maintenance. And whether junctions should be eg signal-controlled or roundabouts.

Network planning for bicycle traffic is often seen as part of municipal planning and other traffic planning. At the draft design stage decisions are made regarding, eg alignment, cross section and junction design.

In general planning it is advisable for road administrations to lay down principles for draft design in order to achieve a uniform level of service. Such principles can form the basis for quality control of completed projects.

The principles set the level for, among other things, road safety, costs and the experience of road users and neighbours of and in the traffic. For example, an urban street with cycle tracks will often be more expensive with respect to maintenance than without cycle tracks, while cyclists will experience a higher level of service.

The Road Standards and Guidelines are a set of principles. As culture, traffic, technology and economy are in a state of constant development, the possible and desired levels of road safety, service etc, are also constantly changing. This makes periodic revision necessary.

A cycle path directly to the school – and the bicycle racks.

PHOTO: Road Directorate

The process revolves around two factors. The first is better utilisation of the resources that are already being spent on construction and maintenance of roads, cables etc, so road safety and the level of service for cyclists can be improved. The second is a focus on the general public's wish for better traffic conditions for cyclists and information regarding experiences and accidents on cyclists' traffic areas. This focus will hopefully lead to more funds being allocated to the process.

Terminology:
The cycle network is a coherent system of cycle routes. A cycle route goes from A to B, and is planned for bicycle traffic with a high level of safety and service. On the main routes there are many cyclists for a long time. Local routes are for few cyclists for a short time. In practice, cyclists should be able to detect when they are on a cycle route, and when they are leaving one.

Good planning for cyclists

The functional demands that a successful road and path network must fulfil are banal: Mrs Jensen needs to get from A to B, and the trip must be a good and safe experience. At the same time as the surroundings must not suffer from Mrs Jensen's transport.

The philosophy behind cycle networks and routes is often to get more people to cycle by making a better offer to cyclists, rather than by making life difficult for motorists. But in residential areas and shopping streets, for instance, there is often a wish to avoid through-going motor traffic. It is

PHOTO: Road Directorate

An interrupted cycle route.

important to incorporate these wishes in traffic planning so that the cycle network provides a higher level of safety and service.

Accessible and coherent

The cycle network should run directly from residential areas to the most important destinations for cyclists, such as schools, other educational institutions and workplaces. Shops, sports arenas, places of entertainment, transport terminals are also important destinations. Similarly the cycle network should connect residential areas.

A coherent cycle network, in which the main routes have priority over side roads and local routes, can attract a major part of the bicycle traffic. Coherence can be interrupted by, for instance, the absence of cycle tracks and street lighting, barriers, too many traffic lights or poor maintenance. These interruptions reduce use of the cycle network.

More cycle routes enhance the coherence of the cycle network, as cyclists have more possibilities of adapting their trips to the network. There are different kinds of cyclist. A direct but very busy road is interesting for adults but not for schoolchildren, who need a sense of security. Tourists want new experiences.

Meshes of 500-800 m in breadth in the networks of main routes are acceptable in urban areas, except in areas with many destinations, eg town centres, where breadth should be halved. Main routes can run along very busy roads with a number of junctions, which gives children a sense of perceived risk. In such cases there should be coherent alternative cycle routes.

In rural districts broader meshes of perhaps 3-5 km are acceptable as there are fewer destinations. Because of high car speeds on rural roads a network of cycle paths and tracks is necessary. The cycle network should include schools, larger towns and tourist attractions as destinations.

Direct and easy

A feature common to towns where bicycle traffic has increased as the result of physical measures is the construction of direct main routes with a high level of service for cyclists. If the cycle network is not direct, logical and easy to use, some cyclists will choose roads not planned for bicycle traffic.

Most cyclists will immediately choose the shortest/quickest route. Cycle paths and tracks attract cyclists from roads with mixed traffic. Large volumes of motor vehicles and poor pavement quality repel cyclists. The surroundings and traffic calming play little part in cyclists' choice of routes. Cyclists

PHOTO: Lars Bahl

A main route on the outskirts of the town.

PHOTO: Road Directorate

Cyclists ride on roads despite good cycle paths.

PHOTO: Road Directorate

PHOTO: Linda Hansen

Wide paths give more possibilities.

on their way to and from work, shops and places of education hardly ever choose a detour [13].

Delays for cyclists at junctions, access barriers etc, should be minimised, especially on main routes. Stops, half-stops, upward grades and uneven pavements require a greater consumption of energy from cyclists, and this contributes to reducing the number of cyclists [73].

Safe and secure

The number of conflicts between cyclists and motorists can be minimised by traffic planning. In existing urban districts it will often be quite impossible to completely separate cyclists and motorists. It is possible to obtain direct cycle routes with fewer cars by having few roads with through-going car traffic, eg by closing some roads and use traffic calming on others. Remember – it is rarely feasible to move cyclists to other routes.

The road administration has a choice: either car speeds must be adapted to the conditions, or conditions must be adapted to car speeds. On cycle routes where cyclists and cars use the same traffic area, a desired speed for cars of up to 40 kph is suitable. The speed level should also depend on the volume of crossing pedestrians. If car speeds are higher than 40 kph, traffic calming or separation of the types of traffic is advisable.

Cyclists on very busy roads often experience a perceived risk even though speeds are low. Here, too, visual or physical separation is a good idea if the road is part of a cycle route. The design and maintenance of cycle tracks and lanes should always ensure that cyclists are kept off the carriageway.

Adequate visibility and curve radii should make it possible for cyclists

The desired speed, V_D, is the speed that the road administration wishes the drivers of private cars to observe out of regard for road safety and the environment. The desired speed, which must be less than or equal to the speed limit in force, forms the basis for the detailed design of individual road sections.

In connection with new road construction 20 kph is added to the desired speed when determining the elements that are important for road safety, eg visibility at junctions, stopping sight and distance to fixed objects. On existing roads calculations are based on the measured V_{85}, ie the speed that 85% of road users do not exceed in wet conditions. If V_{85} is greater than V_D, the two factors should be equalised through the use of visual and/or physical measures [134].

PHOTO: Lars Bahl

Speed adapted to conditions.

PHOTO: Lars Bahl

Conditions adapted to speed.

PHOTO: Road Directorate

The dividing verge reduces cyclist visibility.

PHOTO: Linda Hansen

The town is a landmark.

to travel safely at a minimum of 25 kph. Design speed increases with 2 kph for every 1% fall, which means that cyclists should be able to travel at a minimum of 35 kph down a hill with a 5% gradient.

The visibility of cyclists in traffic is an important pre-condition for road safety. Parked cars, dividing verges, curves, vegetation, noise barriers etc, can result in poor or reduced visibility. Where necessary, awareness of the presence of cyclists can be heightened by signing and road marking.

Accidents between cars and bicycles occur mainly at junctions. Signalised junctions and roundabouts are in general fairly safe for cyclists, while priority junctions are far less safe. To obtain better road safety for cyclists much attention must be devoted to junction design.

PHOTO: Linda Hansen

Large junction, but easy to grasp.

Self-explanatory design

Cyclists must be able to form a map of the cycle network. The alignment and design of main roads is often more logical and easier to understand than that of cycle path networks or of routes on local roads. Cyclists can lose orientation as a result of changes of direction along a cycle route. With a view of landmarks it is possible for cyclists to know where they are going.

Edge lines, bicycle symbols, coloured cycle tracks and lanes and channelisation of bicycle traffic make it easy to understand where cyclists should place themselves. Uniformity of design over long stretches is an important component in the design of cycle routes. When road and path elements are easily identifiable, eg a one-way cycle track, there is less need of signing.

Comfortable and attractive

Even and uniform road and path pavements help cyclists to maintain their speed without having to look at the pavement all the time. This makes cycling more comfortable and makes it easier for cyclists to observe other road users and sights of interest along the route.

In view of the number of cyclists and out of consideration for their safety, perceived risk and comfort, cycle tracks and paths should be kept negotiable in winter to at least the same extent as roads. The main routes for bicycle traffic can be regarded as being on a level with the regional road system.

Strong headwinds reduce cycling speed. On some stretches comfort can be enhanced by the use of wind-breaking elements such as trees and hedges. Canopies, trees etc, can be used for, among other things, shelter from short and intensive showers. If the cycle track is placed lower than the road, cyclists can be dazzled by the lights of approaching cars.

PHOTO: Linda Hansen

Canopy as shelter from rain.

Cycle routes that are visible from the road – indeed, human activity of all sorts improves the sense of social safety. When cycle routes are hidden away from other road users, there is an increased fear of assault. Cycle path networks are used less because people perceive social risk on them, a reaction that can to a certain extent be countered by lighting.

Speed and cross section

Separating cars and bicycles costs more in construction and maintenance. On the other hand, it can improve road safety and comfort and reduce perceived risk. If it is not possible or desirable to separate these types of traffic, car speeds can be reduced.

How much space do the individual solutions require? The table adduces recommended widths for cycle tracks, paths and lanes. If a cyclist without a trailer is to overtake another cyclist without a trailer in reasonable safety and comfort, a width of 1.7 m is necessary. A cycle lane of 1.5 m in width means that overtaking cyclists have to ride on the carriageway. A cyclist with a trailer blocks a 1.7 m wide cycle track almost completely. Although prohibited from doing so, roller skaters use cyclists' traffic areas, and if this is to be taken into account in the cross section, the recommended width of a one-way cycle track will be 2.6 m.

	Along roads	In separate layout
Cycle track (one-way)	2.2 m (1.7 m)	
Cycle path (two-way)	2.5 m (2.5 m)	2.5 m (1.7 m)
Cycle track (one-way, at footway level)	1.7 m (1.5 m)	
Shareed-use path	3.0 m (3.0 m)	3.0 m (1.7 m)
Cycle lane (incl. 0.3 m edge line)	1.5 m (1.2 m)	

Recommended widths (and minimum widths) for cycle track, path and lane [122].

The following example of principles for separation on road sections places a strong emphasis on road safety, but the separation of motor traffic and bicycles has been taken a couple of steps further in order to give cyclists greater comfort and to minimise perceived risk. The example is illustrated on page 53.

Some of the documentation supporting the example is described in the chapter on the design of traffic areas. It is, of course, possible to choose cheaper principles – this is only an example – but less separation means a lower level of service for cyclists.

Mixed traffic

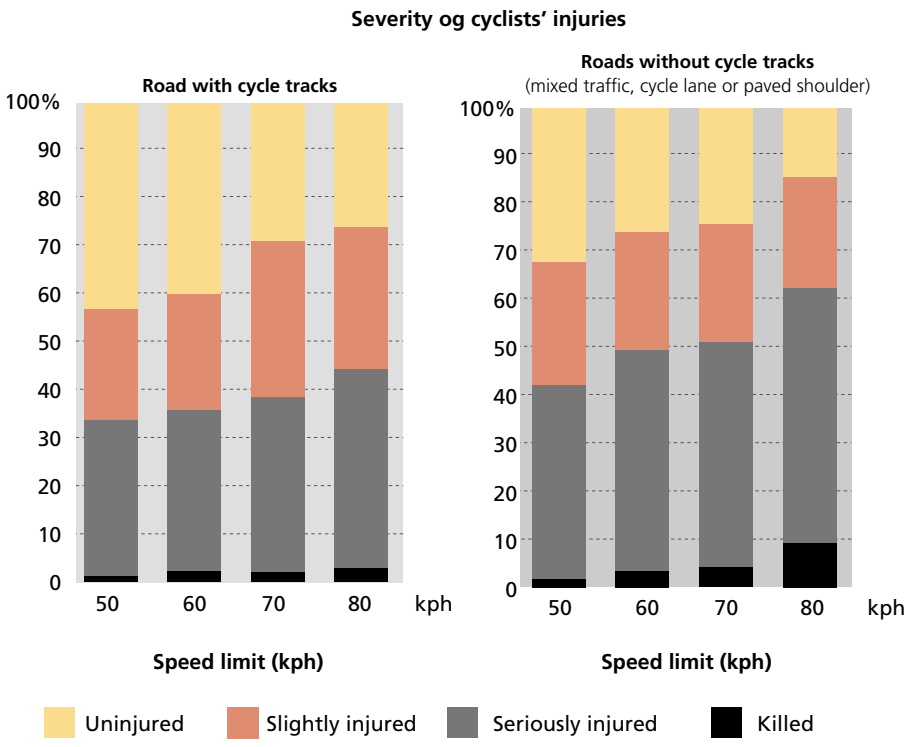
At low car speeds and low volumes of motor vehicles, separation rarely results in safety benefits for cyclists. In fact, separation on roads with many junctions will often result in more bicycle accidents. Separation can be undesirable if one wishes to avoid having a wide road. Nevertheless the establishment of cycle tracks or lanes may be considered with a view to achieving coherence in a cycle route. Traffic calming is often necessary to obtain suitably low desired speeds in mixed traffic.

Cycle lane

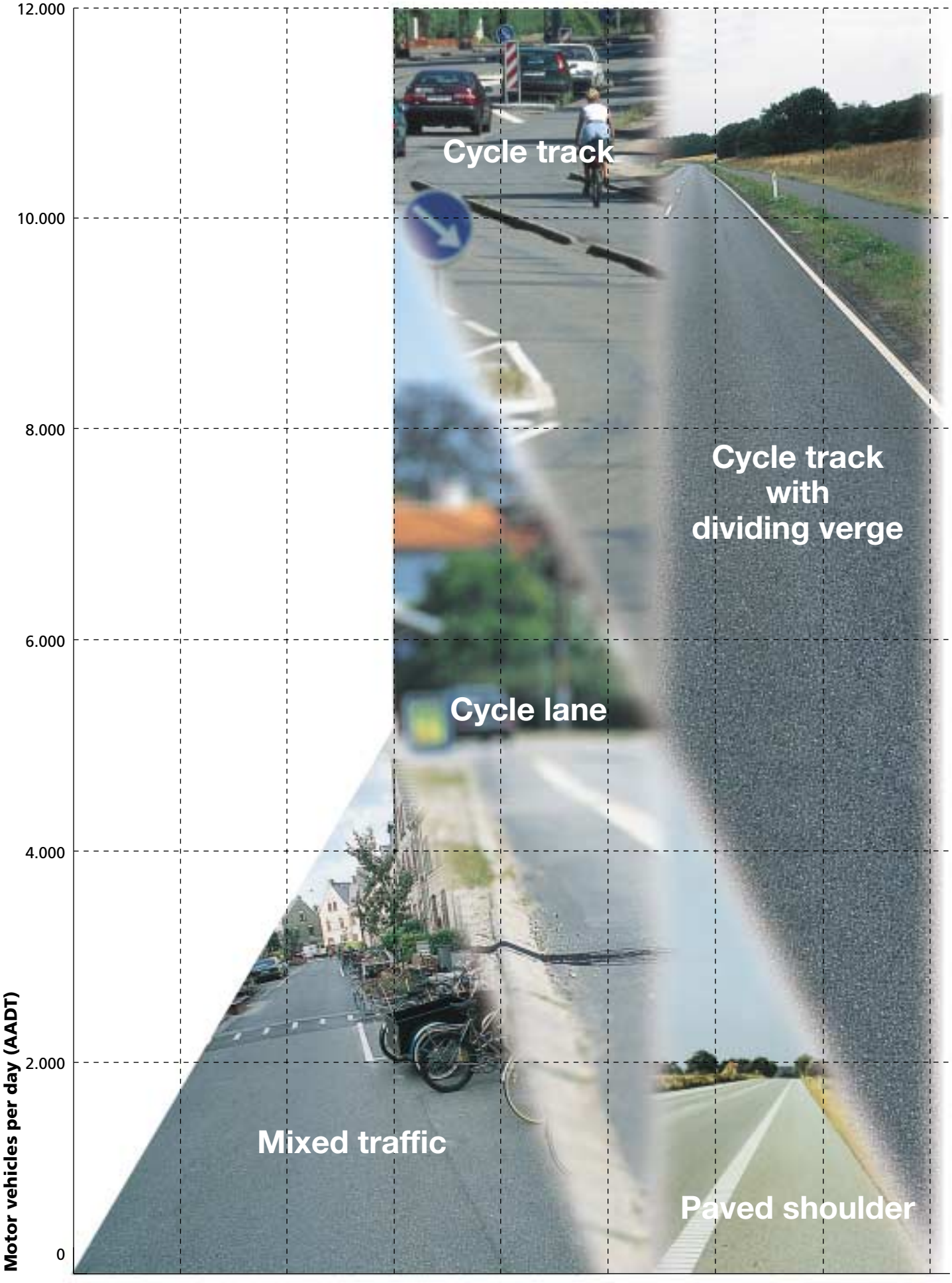
With speeds of 50 kph and less and moderate traffic volumes cycle lanes may be a solution. Cycle lanes are cheap and enhance the level of service experienced by cyclists, though not to the same extent as cycle tracks. Cycle lanes can be recommended on urban roads without shops and with few junctions. Cycle lanes do not solve the safety problems caused by parked cars. Like cycle tracks, cycle lanes can result in more bicycle accidents at junctions. Cycle lanes are marked with broad continuous white lines and bicycle symbols. It is prohibited to park motor vehicles on cycle lanes.

Paved shoulder

In small towns with through-traffic and few cyclists and on highways



Example of separation principles



with limited motor traffic, broad paved shoulders can be a good solution, provided the paved shoulder can be established without widening the road. If it is necessary to widen the road in order to establish paved shoulders, the construction of cycle tracks should be considered. Paved shoulders function best at a width of 0.9 m including the edge line or wider. Traffic calming is often required in towns to meet the needs of the inhabitants and of vulnerable road users. Broad paved shoulders reduce the severity of bicycle accidents considerably less than cycle tracks at high-speed levels.

Cycle track

A kerb or the like between cars and bicycles is beneficial even at moderate speeds and traffic volumes. Cycle tracks improve safety, comfort and lower perceived risk. Cycle tracks enhance the level of service experienced by cyclists twice as much as cycle lanes and can lead to more bicycle traffic.

Road safety problems in connection with parked cars are almost completely solved by the construction of cycle tracks. Parking closer than 20 m from junctions will give rise to visibility problems.

Cycle tracks lose many of their advantages with respect to safety and comfort on roads where there are many major and closely spaced priority junctions. On the other hand, cycle tracks function well on roads with signalised junctions and minor side roads, as the entering side roads can be given speed reducing exit constructions, and signalised junctions lights can be quite safe even with cycle tracks in entry roads.

Cycle track with dividing verge

On roads with high speeds distances between junctions are often greater than on roads where speeds are lower. The extra comfort and reduction in perceived risk afforded by a dividing verge are arguments in favour of this solution. From a road safety perspective, however, dividing verges are a bad solution at junctions. Roads with many junctions – basically all roads with a desired speed below 60 kph – should, therefore, not have a dividing verge. Dividing verges should always be avoided on the approaches to signalised junctions.

Two-way path along road sections with many junctions can't be recommended.

PHOTO: Road Directorate

Junction design

The following section presents an example of principles for junction design. Junctions involving cycle paths, junctions where traffic coming from the right has priority and grade-separated junctions are not included in the example. Junctions where traffic coming from the right has priority cannot be recommended. To give cyclists greater safety corner radii should be as small as possible in order to make the junction as undynamic as possible for turning vehicles. Parked cars and stopped buses alongside cycle tracks and lanes should not occur closer than 20 m before a junction. Not all road design elements are shown, as the example only illustrates the general design of some few of the many possible ways of designing junctions. For example, junctions where left and right turns are forbidden have not been included.

Signalised junctions

Pedestrian and cyclist safety will benefit if the stop line for motor vehicles in all lanes is drawn back some 5 m in relation to the pedestrian crossing. This makes cyclists more visible and reduces the number of potential conflicts at the beginning of the green stage.

Cycle tracks and lanes can be brought up to the stop line and continued as a blue cycle crossing provided that there is a right-turn lane for motorists, and cyclists ride at a normal or low speed. This solution reduces perceived risk and will especially benefit children, as they cycle slowly and can easily feel at risk.

Cyclists get up high speeds downhill. Here the primary solution is to

truncate the cycle track and let cyclists and motorists merge. A truncated cycle track can be a good solution, if space for the right-turn lane cannot be obtained in other ways. If the cycle track is truncated, the right-turn lane must be about 4 m wide to facilitate safe merging manoeuvres. Another possibility is to insert a cycle lane between the right-turn lane and the straight-on traffic lane.

A narrow cycle lane approaching the junction can give the necessary meter for a right-turn lane and, as opposed to a truncated cycle track, has the effect that cyclists avoid merging with motorists and move into the crossing before cars at the beginning of the green stage. The narrow cycle lane can cause capacity problems for cyclists. Exits and entries for motor vehicles should not occur across truncated cycle tracks, nor on cycle lanes that continue up to the traffic lights.

In mixed traffic the choice is between a short cycle lane just before the stop line, where cyclists can move ahead of motorists and take advantage of a cycle crossing, or simply to recess the stop line.

Priority junctions

For side roads with less than 1,500 motor vehicles per day in urban districts speed reducing exit constructions are as a rule a safe, reassuring and comfortable solution for cyclists. Footways, cycle tracks and lanes should be continued through crossing at minor side roads. As an exception, the cycle track can be recessed 5-7 m from the crossing and cross the side road on a flat-topped hump. This solution is particularly relevant when the primary road is very busy, possibly with 4 lanes, as in such cases the side road motorist is liable to drive right up to the nearest lane. The flat-topped hump is necessary for cyclist safety. If trucks use the side road, recessing the cycle track is not a good solution.

Poor visibility conditions because of parked cars, vegetation etc, can lead to cars waiting on the cycle track at a junction, but here recessing the track is not a good solution. Instead visibility conditions should be improved in other ways.

On major side roads and highways the cycle track may be interrupted. Cycle tracks and lanes may also be continued as cycle crossings marked with bicycle symbols. Cycle tracks and lanes can be inter-

PHOTO: Road Directorate

Staggered stop lines.

PHOTO: Road Directorate

Staggered stop lines and blue cycle crossing.

PHOTO: Road Directorate

Downhill - truncated cycle track.

PHOTO: Road Directorate

Cycle lane between the right-turn and straight-on traffic lane.

PHOTO: Danish Cyclists Federation

Narrow cycle lane after truncated cycle track.

PHOTO: Road Directorate

Short cycle lane.

PHOTO: Road Directorate

Speed reducing exit construction and continued cycle track.

PHOTO: Road Directorate

Interrupted cycle track and cycle crossing.

PHOTO: Road Directorate

Recessed cycle track.

rupted about 30 m before a side road if cyclists are riding at high speeds downhill. Right-turn lanes should be avoided, however, at priority junctions with two-way traffic on side roads. If there are more than 2,000 motor vehicles per day on the side road, it may be a good idea to reconstruct the junction as a roundabout or as a signalised junction.

Roundabouts

With fewer than 6,000-8,000 motor vehicles per day in roundabouts or mini-roundabouts it is unnecessary to separate cyclists and motorists. In this situation separation does not lead to greater road safety – in fact, it can reduce road safety. Similarly, cyclists can get through the roundabout faster with mixed traffic.

In roundabouts with more motor traffic, which have one circulating lane and one lane for each entry, cyclists can be separated from the motor traffic. In roundabouts designed for low speeds the cyclist can be led round on a cycle track about 5 m from the circulatory carriageway, possibly on a raised surface. In dynamic roundabouts the cyclist can be led round on a cycle path about 30 m from the circulatory carriageway with a duty to give-way to entry and exit roads. This large distance is necessary if cyclists are to be able to manoeuvre in respect of cars leaving the roundabout.

In roundabouts with more than one circulating lane and possibly also more than one lane for each entry, cyclists should be led outside the roundabout via bridges, tunnels or as in dynamic roundabouts on a cycle path about 30 metres from the circulatory carriageway.

Mini-roundabout.

PHOTO: Road Directorate

Large roundabout with a blue circulating cycle lane.

PHOTO: Road Directorate

Materials, construction and aesthetics

If a town's streets and roads are to be more than mere traffic arteries, but also attractive spaces that it is pleasant to pass through and spend time in, it is necessary to work with total concepts. In order to achieve a harmonious result, specialists such as architects, engineers and landscape designers must co-operate closely, co-ordinate their efforts and acquire insight into one another's specialist fields [122].

PHOTO: Road Directorate

Clear perception of cyclists' traffic area.

Signal value

The various groups of road users experience pavements very differently. For example, granite paving stones signal that pedestrians can walk here without regard for other types of traffic. Granite paving stones should only be used on cyclists' traffic areas where there is a clear difference of pavement or level in relation to the footway. A cyclist's eyes will naturally be directed somewhat downwards, and for cyclists the pavement plays an important role in their total experience of the space [44].

Choice of pavement and colour can make it clear what road users should be where. These choices should always be made in such a way that road users do not misunderstand how and by whom the space is to be used, and who has an obligation to give-way. By using a colour that is different from the rest of the surroundings certain traffic areas can be made to stand out, thereby helping to emphasise give-way conditions. Blue cycle crossings are an example of this. Changes of pavement, eg using sett or concrete block paving at junctions can help to make road users more aware of one another.

A poor construction narrows the cycle track and path.

PHOTO: Road Directorate

Cycle tracks and paths

For the comfort and safety of cyclists all tracks and paths carrying daily bicycle traffic should be constructed with a smooth pavement with sufficient friction to prevent skidding. The construction of the track and path should be able to withstand the pressure of the vehicles that use it, eg of maintenance equipment and illegally parked trucks. It is a good idea to continue the road foundation beneath cycle tracks along roads where there is no dividing verge. Unfortunately crack formation is all too often encountered in the half meter of the cycle track closest to the carriageway. On paths the base etc, should be constructed in such a way that maintenance equipment does not cause crack formation on the sides of the path.

Hot-mixed asphalt of hot soft bitumen and small stones (< 16 mm) forms a suitable wearing course for cycle tracks and has a normal lifetime of 15-20 years 100. Its fine surface makes it easy and pleasant to cycle on, provides good friction and can be produced in many colours. Asphalt should always be machine-poured.

Granite

A natural material like granite is a popular type of pavement, which

appears in many forms, for instance as cobblestones, sett paving, cut kerbstones, ordinary flagstones and special oblong granite flagstones.

Granite is an almost imperishable material, which becomes more beautiful with the passing of time. Its disadvantages are its price and the amount of processing it has to undergo before it is a suitable pavement for cyclist areas. Thus, cobblestones are unsuitable for bicycle traffic, because they are uncomfortable, slippery when wet and baggage tends to fall off. Nor can uncut sett paving be recommended for cyclists' traffic areas, while cut, rounded or polished flagstones can be used.

Concrete pavements

Concrete blocks and flags can be used for both heavy and light traffic. The flags should be laid correctly with the right filler to avoid frost bursts and the like. Concrete blocks and flags can be obtained in various shades of colour, shapes and surfaces. A large part of stone pavements available today can be laid by machine. By using different kinds of stone and pattern, moreover, it is possible to change the sound picture in a car and thereby heighten the driver's awareness. The various shades of colour may be used to express a further signal value for road users.

PHOTO: Road Directorate

Smoother sett paving on cyclists' part of the road.

PHOTO: Road Directorate

Concrete flags are more pleasant to cycle on than sett paving.

Provided that the road is designed for the actual traffic load, the functional life time of concrete will normally be in excess of 20 years. Flagstones and concrete blocks can today be produced from a special strong kind of concrete, which gives high durability and resistance to frost and salt [123].

Coloured cycle crossings

When establishing coloured cycle crossings at junctions, one can choose among different kinds of material. Blue cycle crossings are often laid in thermoplastic, which is cheap and visible, but not especially durable. An alternative to thermoplastic is blue asphalt. Asphalt is more durable and, with respect to friction, a good alternative to thermoplastic, though considerably more expensive. Blue asphalt is not as strongly coloured as thermoplastic. On the other hand, the asphalt preserves a uniform colour throughout its lifetime. The lifetime of blue asphalt is expected to be the same as that for ordinary asphalt [50].

PHOTO: Road Directorate

Blue thermoplastic improves safety at this spot.

Gravel etc

On minor recreational routes and short sections where there are few cyclists gravel, slag etc, can be accepted as pavement material on condition that the gravel is tampered and rolled so that the pave-

PHOTO: Lars Bahl

PHOTO: Road Directorate

Roads without asphalt can be beautiful.

ment is not too uneven and the gravel remains on the road.

Comfort

Cyclist comfort on different types of pavement has been investigated. Ten different test sections were ridden over. For each section a peak value was measured for the vertical acceleration over 8 m, and the test persons gave an assessment of the comfort of the pavement. The results are adduced in the table below [116].

Other studies of the importance of pavement for cyclist comfort have shown similar results. If it is a service goal that at least 80% of cyclists should be satisfied with pavement quality on main routes, these routes must be asphalted and without noteworthy patches, cracks etc.

The process

The first step is to determine the structure of the cycle network. Then the cycle network can be implemented. It is important to determine the structure, as many persons are actively involved in the process of changing road and path systems. The plan for the cycle network is part of the basis for mutual understanding and co-operation and, in addition, a good checklist.

Formulating the plan

The final product should be a visionary plan for the cycle network. A large part of the resources for the implementation of the cycle network will not be earmarked for bicycle projects, but for maintenance of roads, cables etc, urban development and other projects. The plan will have to take into account how these resources are used so that the cycle network can be implemented.

Pavement	Share of satisfied cyclists	Measuren peak value
Asphalt pavement	100%	0.12
Asphalt pavement	98%	0.17
Patched asphalt	44%	0.33
Rough surface-treated asphalt	44%	0.55
Depression in cracked asphalt	33%	0.68
Concrete blocks	43%	0.73
Uneven asphalt due to trees, frost etc.	28%	1.05
Manhole covers in asphalt pavement	15%	1.23
Set paving, neatly laid	2%	1.81
Ramp, asphalt pavement	2%	2.28

For example, there may be a 50% discount for the construction of a path in connection with the laying of a new natural gas system, so that the price for the path falls from DKK 1 million to DKK 0,5 million per km. Nevertheless the remaining DKK 0,5 million must be procured, otherwise the cycle network will not be implemented. It is a good idea to budget the DKK 0,5 million for the cycle network plan rather than elsewhere. Part of the plan for the cycle network can contain new construction of cycle paths, tracks and lanes and improvement projects for existing cycle routes with signs, road marking, contra-flow cycling etc. These projects should be included in a long-term investment plan.

Bicycle traffic in Virtual City.

Background knowledge
- Existing traffic structure
- Present destinations for all road users
- Future destinations (urban development and renewal)
- Route choices for all road users (traffic flows)
- Motor vehicle speeds
- Parking of cars, vans and trucks

Check list – main routes
- Mesh width adapted to the number of destinations
- Collect motor traffic on few roads with separation
- Traffic calm or separate
- Few stops – give priority to the main route
- Few hills and easiest route
- Good lighting and maintenance
- Least possible car parking

Quality requirements

The purpose of identifying a physical cycle network is so that the road administration can meet a number of specified quality requirements. It is a question about the offer that politicians wish to give cyclists. The quality requirements could include:

- Road safety
- Level of service, including perceived risk and comfort
- Mesh size for main routes.

The requirements to be made of the cycle network are therefore not just a matter of the cross section – the presence and width of cycle paths, tracks and lanes – but also of such factors as road lighting, number of stops per km, maintenance etc.

Background knowledge

Once again the point of departure for functional requirements is banal: Mrs Jensen has to get from A to B. Therefore we have to know where Mrs Jensen comes from and where she wants to go – her destination. We must also know the routes road users choose, that is, the traffic flows. This knowledge is necessary in order to be able to offer the greatest possible number of cyclists the best quality, ie the main routes, at the lowest possible price.

The volume, speed and parking of cars also influence the ways in which the quality requirements can be met. Why? The volume and speed of motor traffic exerts a decisive influence on the choice between cycle track, cycle lane and mixed traffic. If cars are to be allowed to park on the road, it may be impossible to find space for a cycle track or lane.

Determining the cycle network

Before the fateful lines are drawn on the map, it is important to consider previous ideas and plans regarding the volume, speed and parking of vehicles. Thus, a planned road closure may mean that it is more appropriate to traffic calm a road than to construct cycle tracks. An upcoming car park may create space for contra-flow cycling in one-way streets or for cycle tracks. It is best for these ideas to be collected in an overall traffic plan.

Many studies have shown that it is particularly difficult to move cyclists from one route to another without prohibiting cycling on a given route. In fact, the alternative route has to be more direct or logical (ie few stops) and perhaps also have a higher level of service, if cyclists are going to be prepared to change routes. Together with the difficulty of acquiring land, this fact sets a limit on how many local roads and paths can form part of the network of main routes both in the rural and urban areas. A quite different possibility is to move motor traffic away from main routes in order to improve road safety and level of service on these routes for cyclists.

The safety of cyclists will undoubtedly be one of the main requirements, and here junction design is important. The road administration will have to take the consequences of having chosen one road as the main route for cyclists. In towns this may mean that a number of junctions will have to be redesigned with shorter corner radii, speed reducing exit constructions at minor side roads and roundabouts/signal-control at larger side roads.

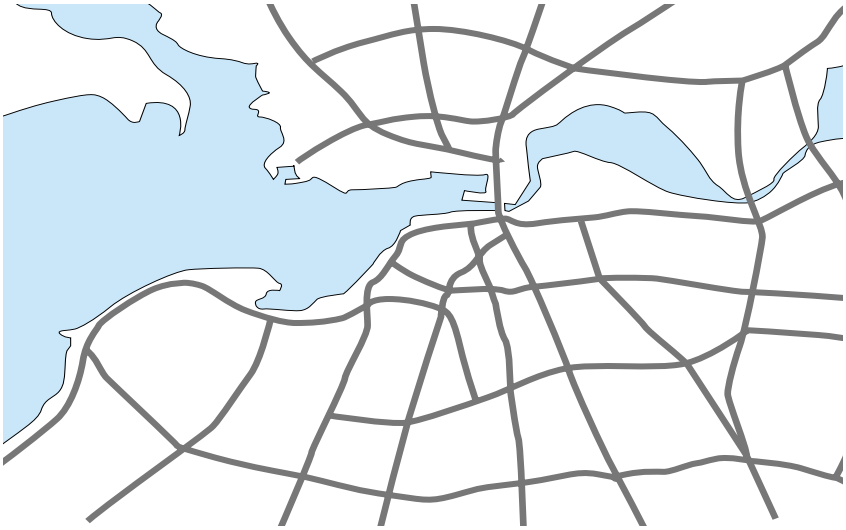
The local routes must also be safe. Their safety is mainly the product of traffic calming and a modest amount of car traffic. On local and recreational routes a high level of service for cyclists is not so important, as they spend only short periods on them. But remember that eg cycle tourists may constitute the majority of users of a main route.

Accumulate knowledge and experience - and keep motivation high

To create something is basically a matter of knowledge, experience and motivation – and funds. The cycle network plan will presumably have been thought up by one or more traffic planners. And it is the planners who have the knowledge, experience and motivation to improve the offers made to cyclists. But they dispose over only a small portion of the funds needed to build up the cycle network.

Part of the implementation process therefore consists of inculcating the plan in road maintenance personnel, town planners, owners of mains, sewers, cables etc, utilities and contractors.

The road administration may require that as early as possible an audit should be carried out of various tasks and projects where there is a possibility of implementing parts of the cycle network. Thus, it is natural that the funds the road



Draft structure of main routes in Virtual City.

administration receives from independent user-financed utilities in connection with the re-establishment of roads should be incorporated in the plan for the cycle network.

The general public wishes and needs should be an important part of the reason for changing the traffic system. These wishes and needs can be obtained by questionnaires and debate and can form basis for service targets.

A purpose of such questionnaires is partly to give the public clear information about the administration's traffic services. The replies can be used as an argument for the allocation of greater funds, but more importantly, they can motivate co-operation partners – the owners of utilities, road maintenance personnel etc.

3 types of project

The following section presents a brief overview of the different kinds of project and the possibilities for linking up the cycle network plan with other projects.

Today a lot of funds are spent on the maintenance of roads, cables, mains, sewers and railways. It is important that the cycle network plan is seated at the table when decisions are made as to where the funds are to be spent. It is often a question of acting swiftly – of more or less having a draft design ready for all parts of the cycle network. By being visionary new possibilities of more and safer cycling can be obtained by already allocated funds.

A cycle audit should be carried out in connection with new construction, reconstruction and repaving

Roadworks in Virtual City year 20??

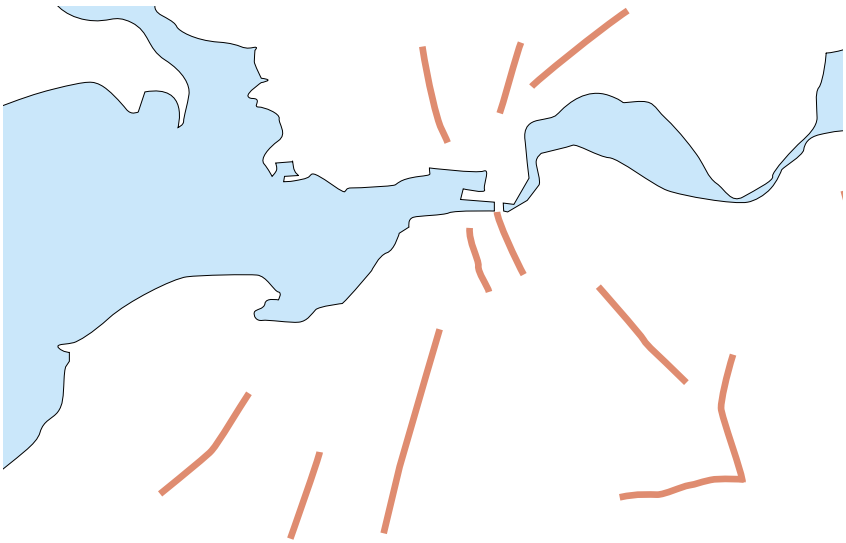


ILLUSTRATION: Philip Rasmussen

Cycle route established in connection with district heating pipes.

Maintenance	Roads and paths
	Cables, district heating, mains, railways etc
New construction,	Roads and paths
reconstruction and repaving	Cables, district heating, mains, railways etc
	Urban development and renewal
Bicycle projects	New construction, reconstruction and repaving
	Options
	Minor improvements

projects that are based on other factors than bicycle traffic. A political demand might be that those parts of the cycle network that can be implemented must be implemented in connection with new construction, reconstruction and repaving. However, it is not a good idea to place all cables, district heating pipes, sewer mains etc, beneath the cycle track, as the track will become uncomfortable to cycle on after it has been dug up sufficiently often. Try the footway.

The main objective of bicycle projects is to improve the traffic situation for cyclists. Projects for new construction, reconstruction and repaving can be implemented individually, ie one cycle route at a time. There can be advantages with respect to costs and information activities in implementing minor improvements, such as signs, road marking etc, as mass initiatives, ie on a large number of cycle routes simultaneously. Finally, there are option projects, where areas are physically reserved for cyclists, but where one does not have the funds or it is not the right time to implement the cycle network plan. Such an option might be the construction of cycle lanes along a road with the intention of constructing cycle tracks at a later date.

Price examples

Construction costs for the cycle network are one thing, maintenance costs another. Here are a few figures for construction in year 2000 prices.

The prices depend on the volume of work to be done. The prices are based on ordinary new construction, reconstruction and improvement projects, which is not part of maintenance.

	Approx. year 2000 prices
4.5 m wide cycle path incl. excavations and 3 m asphalt pavement (on virgin land) and excl. drainage	DKK 1,000 per meter
2 x 2.2 m cycle tracks on existing urban road incl. asphalt pavement and drainage	DKK 2,000-5,000 per meter
Comprehensive traffic calming	DKK 4,000-8,000 per meter
0.3 m broad edge line in thermoplastic	DKK 20 per meter
0.1 m broad edge line in thermoplastic	DKK 10 per meter
10 bicycle symbols	DKK 5,000
Signing of cycle routes with symbols, signs, stopping and parking prohibited signs etc	DKK 50-100 per meter
2.2 m broad blue cycle crossing in thermoplastic	DKK 300 per meter
Road closure	DKK 3,000-25,000
1 hump on existing carriageway – kerb-to-kerb – including road marking	DKK 10,000
1 mini-roundabout	DKK 100,000-350,000
1 roundabout with 1 circulating lane and deflection islands in all branches	DKK 1.5-2.5 million
30 m truncation of cycle track	DKK 50,000