

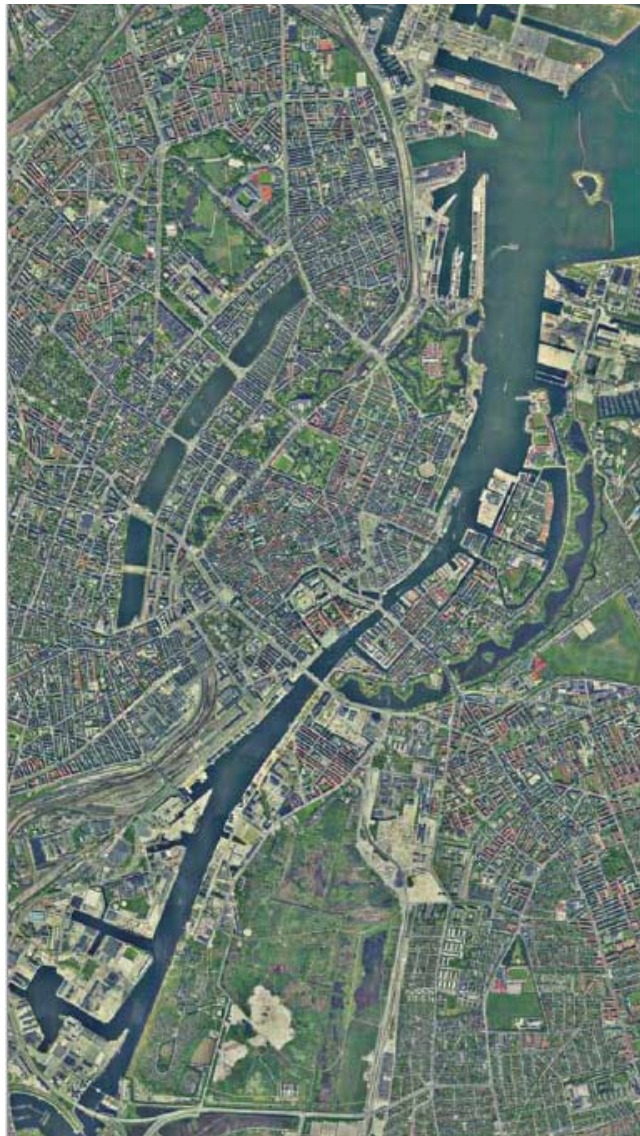
# Livable Copenhagen: The Design of a Bicycle City



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Map on the left from City of Copenhagen's Traffic Environmental Plan, 2004

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In Copenhagen, it is typical to park bicycles outside of your home instead of a car.

This document would not be possible without the help of these people: First and foremost, my partner in crime, Jason Nelson deserves more than just a mention here. He has ventured out on the streets of Copenhagen, risking life and limb measuring travel lanes and shunning Danes with angry stares to get “the” picture. I only hope that I someday can repay him during his journey through architecture school!

The Valle Scholarship and Scandinavian Exchange Program made my five months abroad possible, and for that I am forever grateful.

Rob Adams, guest professor with the Center for Public Space Research and the Director of Design and Culture for the City of Melbourne, Australia, for advising me during my Copenhagen stay. Without

the meetings and conversations, I would have been lost to craft the document that I wanted within five months. And here it is!

The staff at the Center for Public Space Research at the Royal Danish Academy of Fine Arts in Copenhagen for providing me with a Danish home from which I could research and for countless conversations, meetings, and feedback.

Lars Gemzøe for his information and advice, and for going above and beyond to provide me guidance as I finished this project.

My life-long friend and mother, Karen Farris, who not only has spent many hours as my proofreading assistant on this project, but has also managed all of my United States affairs during my time abroad, not a small task. However, her time spent helping me during the past five months cannot compare with all she has done for me over my lifetime.

My thesis advisor, Ron Kasprisin, who has not directly influenced this project, but has inspired me to continue to practice expressing my ideas visually.

Finally, I would like to thank my son, Orien Nelson, who may only be nearing two, but has changed my life in more ways than any other person on this Earth. I thank him for being a good sport through the past five months, reminding us to put on his “helmet” before going out on our bikes, and helping me really understand the job of planners - to make accessible, livable, beautiful, sustainable cities for him, his children, and his grandchildren.



Mobility on three wheels: A young mom transports her child in the popular Christiania bicycle. People do not only use these front carriers for transporting their children, but also for hauling musical instruments, furniture, and other bulky items. Postal workers use cycles such as these for package delivery.

## introduction

*"In Copenhagen, there's more bike traffic than car traffic at rush hour. You see people out there looking like my mom and grandmas just riding to work or riding errands around town. It's clearly a standard and acceptable mode of transportation. In Seattle, it's still unusual if someone rides a bike around the city."*

Zach Triesman, quoted in Bock, 2006



A landmark of Copenhagen is the large temperature gauge that climbs up the above building. It leads to two women, one on a bicycle and one with an umbrella, who appear to show the day's expected weather conditions.

the culture of cycling

I've learned a lot being a short-term resident of Copenhagen. For one, you can ride a bike with a cello on your back. I played cello for years growing up, and one of my preconditions for buying my first car was that my cello must fit in the trunk. Otherwise, how would I transport my bulky instrument? In Copenhagen, I saw two friends riding bikes side-by-side with cellos on their backs. I stand corrected.

I find this true about a lot of things. You CAN be a parent and bicycle, as the Christiana-style bicycles full of children with a young (and fit) mom or dad shows. To tell how many children a dad has, just look at his calves – as it is a sign of bicycling with your kids in tow. You CAN transport many items on a bike. As it nears Christmas, I saw a man bicycling with a small Christmas tree. I saw a man with an armoire making his way onto a cycle path. I've seen couples holding hands riding side-by-side, men in business suits, and women in mini skirts and stilettos – even in winter. Children can ride safely on their own and with friends – what independence this offers for both parents and kids.

The bicycle is a socially acceptable mode of transport in Denmark. Many remark that Copenhagen's success at maintaining such a high percentage of bicycle traffic in the modal split is thanks to the presence of a bicycle culture. I do not wish to deny the importance of social acceptance or a bicycle tradition in creating a bicycle city. But there is evidence that the bicycle was on its way out in Copenhagen during the 1960s and early 1970s. That the bicycle is still a viable



Above, a man struggles to see around a recently purchased armoire along Amagerbrogade.

mode of transport today is thanks to 1980s policies and planning efforts that were able to once again foster the everyday use of the bicycle.

The Danish culture values modesty, doesn't so much appreciate displays of wealth. Bicycling is seen as a modest mode of transport. The Danes have a word, *hygge*, which cannot be directly translated to the English language. If one tries, the closest you might get is "cozy". During an interview, two young women declared bicycling to be "hyggelig", saying that the ability to feel the weather and see the city evoked feelings of being *hygge* (Copenhagen, 2002). Thus, with the values and infrastructure in place, Copenhageners most often choose their bicycle for short trips (Copenhagen, 2005a). Ninety percent of Copenhageners own a bicycle. In Denmark, the average household owns 0.7 cars and 2 bicycles (Brewer, 2001). Fifty-eight

percent of Copenhageners use a cycle on a daily basis (International, 2004).

Out in the city doing field research, I comfortably rode on many streets, but knew that I would not want to ride on similar streets in the United States. Why, one might ask, would it matter? The critical mass of bicyclists that Copenhagen has means less cars and also more motorists are aware of bicycles and look out for them. As Executive Director of Seattle's Cascade Bicycle Club Chuck Ayers states, "To change the culture of transportation, you need a critical mass" (qtd in Bock, 2006). To create a critical mass in a US city will require providing a bicycling environment that is safe, secure, comfortable, and even enjoyable for everyone, including children, older adults, and commuters. The goal of this project is to give the details of the design of Copenhagen's bicycle network so that cities that wish to promote cycling as a mode of transport might learn from it. One part campaigns and education, one part infrastructure – who knows? Perhaps even United States cities will find an emergent culture of bicycling all of their own.

It is necessary to note that times are changing in Copenhagen. The livability of the city is leading to vast increases in property values, with many home owners finding that the money made off the increase in property value each year is greater than their yearly income. Lars Gemzøe notes that for the first time, he is seeing Hummers and SUVs in the city, with no apparent need for them with the topography of Denmark (Interview). The amount of



A helmet-clad mother and son make their way through an Amagerbrogade intersection. It is not typical for adults to wear helmets in Copenhagen.

automobile traffic has increased 16 percent since 1995, and although bicycle traffic is still increasing faster, Copenhagen is at a crossroads (Copenhagen, 2005a). Will the city once again succumb to the automobile in policies and planning, or will it hold its ground and fight for the bicycle?

#### Rules of the Road

- Cyclists are thought of as "soft cars" in Denmark, and must follow the same rules as vehicles
- No right turns are allowed on red lights for either cars or bicycles
- Cyclists are permitted to ride two-ways on one-way streets where signage is posted
- Children can cycle on the footpath until the age of six
- Children over five cannot be a passenger on a bicycle
- Cycling side-by-side is permitted unless someone wishes to pass
- Mopeds must travel 30 kilometers per hour or less on the cycle paths
- One hand must be on the handlebars at all times
- Left turns are allowed only indirectly, by first crossing the intersection and then crossing again
- Cyclists must use hand signals to indicate turns
- At areas with a separate bus island, bus patrons must wait for bicyclists to pass; in areas where patrons exit and enter directly onto the cycle tracks, bicyclists must yield the right-of-way
- It is not permitted to ride on pedestrian-only streets, crosswalks, or on the sidewalk
- Lights must be used at night

## making the case for a bicycle city

*"The kind of behavior changes we need are not so much individual as collective. It's the rule changes: the building codes, transportation infrastructure, transit, urban form – nobody makes those decisions as individuals. That's why we need to support these collective policies – they are more important than, say, buying a smaller vehicle. If we just focus on the individual behavior, we miss all the big items."* John Robinson, quoted in Glave, 2006



As night falls in Copenhagen, bicyclists use lights to increase their visibility. A rain puddle has formed along this Amagerbrogade cycle track, which makes the usable space much smaller for cyclists.

reasons to promote a bicycle city  
In Seattle, fifty percent of all trips are less than 8 kilometers (5 miles). Overall, twenty-five percent of all car trips in America are less than 1.6 kilometers (1 mile) (Durning, 2006). Trips that fall within these ranges are readily bicycled within many European cities, including Copenhagen. In The Netherlands, thirty percent of all trips less than 5 km are made by bicycle. Surveys of US residents have shown that they rate trips less than 3 km as "bicycle-worthy" (Gardner, 1998). This shows a latent demand for bicycling in many United States cities.

There are a variety of reasons to promote more bicycling, both for individuals and the overall society. The burdens of car driving are numerous. The average US commute totals 55 minutes per day, during which blood pressure and mood can be altered depending upon congestion levels. In addition, motorists are exposed to air pollutants from car traffic, especially if their commute involves freeway driving. Add to this the 42,000 deaths and 3 million injuries that occurred on US highways in 2002 (Handy, 2006).

There are also less obvious burdens from a car-oriented city design. In this context, equity is an important component, as up to thirty percent of the population does not or can not drive, including the elderly, children, poor, or disabled (Wilkinson, 1997). The cost of car ownership and use in 2002 was estimated to be on average \$7,825 (in 2000 dollars), which is a substantial portion of many incomes. In addition, driving has been linked to obesity, as an



In Copenhagen, one finds that mobility is available to anyone, regardless of age or income, since bicycling is a feasible alternative to the car. Along the bridge that connects Nørrebrogade with the central city, one can find bicyclists of all different stages of life. Free bicycles are even available via the City Bikes program.

Atlanta study discovered (Handy, 2006). These more obscure burdens to driving mostly go unnoticed.

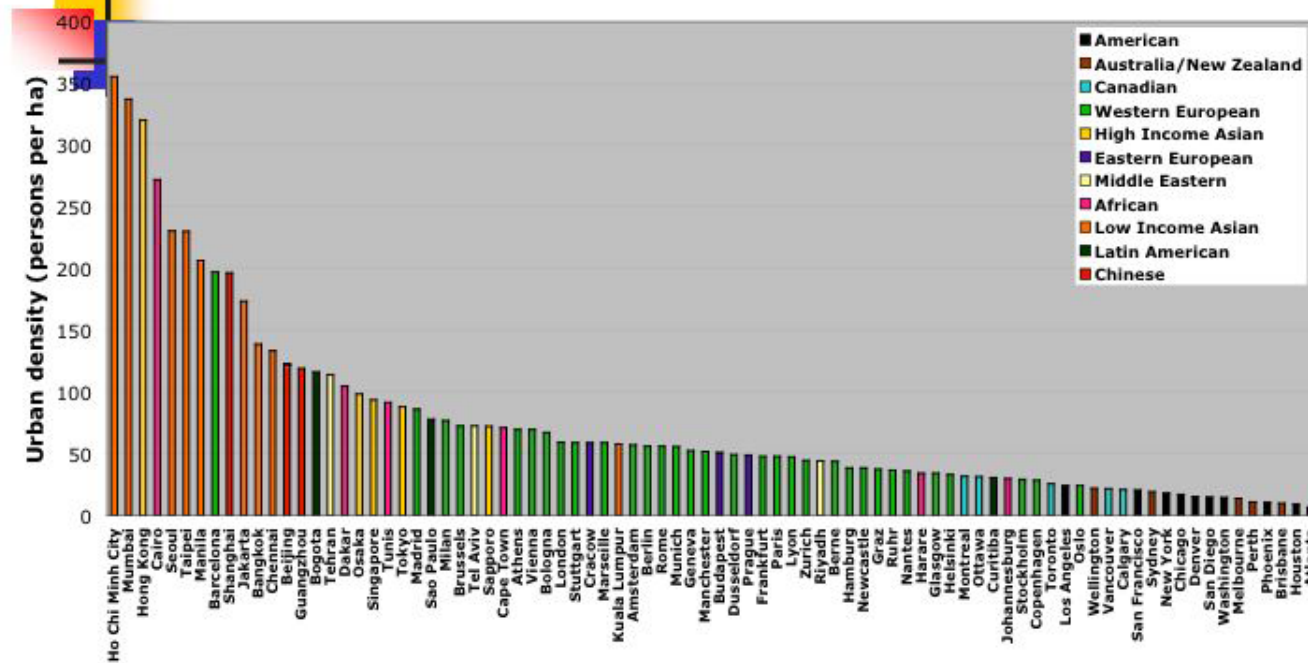
Other burdens that people do not often consider are those which are collective in nature. In 1999, the US consumption of oil was at 19.5 million barrels per day, accounting for nearly thirty percent of the world's consumption. Two-thirds of this oil is used for transportation. In 2000, transportation accounted for 513 million metric tons of carbon dioxide that entered the atmosphere. One third of US counties still fail to meet federal Clean Air standards, meaning that 85 million people are living in areas without adequate air quality (Handy, 2006).

Economist Todd Litman has estimated the "full cost" of driving, including individual and societal

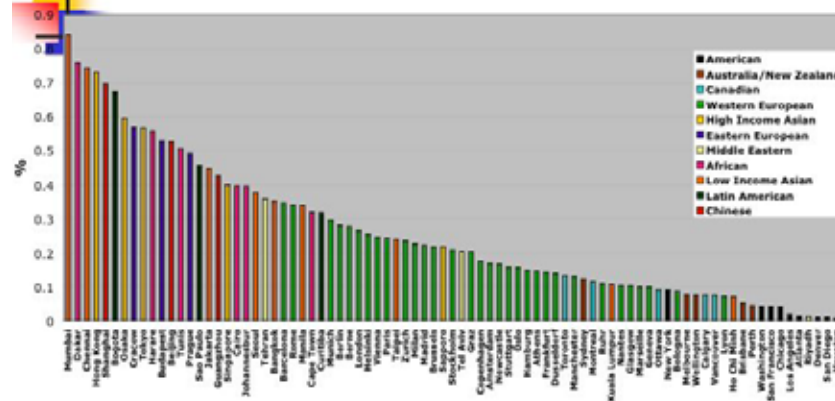
burdens and estimates that a transition to a bicycle-oriented transportation infrastructure would provide significant benefits to the population. If five percent of the vehicle miles traveled during non-peak hours were shifted to bicycle, the savings would be greater than \$100 billion, not including health or aesthetic benefits. That is just during non-peak hours, too. A California study found that ninety percent of the emissions during an 11-kilometer trip are released during the first 1.6 kilometers (Gardner, 1998). Litman determined that every one percent of car trips replaced by bicycling will reduce the amount of air pollution from vehicles by 2 to 4 percent, since bicycling seems to reduce the most polluting car trips, when the engine is not yet warm.

The graphics on the right show that European cities have greater densities and greater transit ridership than their American counterparts. This is due in part to a recognition that it is necessary to promote strategies that reduces the convenience of a driving a car, such as maintaining a transit-supportive density. A difficulty in American transportation planning has not been that planners and politicians are unwilling to support plans aimed at a reduction in driving, instead they have yet to realize that they cannot also make it easier or more convenient to drive, as is the traditional approach (Handy, 2006). Efforts must be taken to prioritize people over cars, not only through funding and infrastructure, but also through education and marketing. Public transit and non-motorized transportation will only compete when America correctly balances the burdens and benefits of the private automobile.

**Urban Density, 1995 (Persons/Ha)**



**Proportion of Total Motorised Passenger Kilometres on Public Transport, 1995**



European cities tend to have medium densities when compared to Asian cities, but still much higher densities than US or Australian cities (above, Newman 2006). Greater densities partially contribute to the success of public transportation systems in Asia and Europe (Newman 2006). The viability of cycling as a mode of transport also depends greatly upon density. In American cities, cycling cannot be increased without a focus on increasing density as well.

## making the case for a bicycle city



Below, a child and an adult make their way across Amagerbrogade. Notice the traffic calming exit conditions of the side street, with the pedestrian crossing continuing across the junction. Amagerbrogade is one of the main connector streets into Copenhagen and features cycle tracks on both sides of the street.

Travel behavior studies find that people choose their transport mode based on what provides them with the greatest utility (Handy, 2006). Most people choose to drive most of the time since it is convenient, fast, and comfortable. If public transport or non-motorized modes such as bicycling are to compete, the utility of these modes must have a greater utility than driving. In order to balance the system between cars, bikes, and public transit, driving must become both more expensive and infrastructure should make it possible to choose other modes instead of driving.

Measures such as supporting density, mixed uses, transit-oriented development, and jobs/housing

balance will make it easier for people to drive less. One survey found that eighty-percent of participants drove more than they wanted (Handy, 2006). These land use strategies must also incorporate pedestrian and bicycle facilities, as cities with more bicycling infrastructure have higher levels of bicycle commuters (Clarke, 1998).

If driving is also made “more expensive” (or just closer to the actual cost of driving), it will become less attractive and other modes will become more competitive. Measures such as pay-as-you drive insurance or toll roads might be politically viable, but road pricing has proven effective in many European cities and might one day be supported in the United States, especially once other modes of transport provide feasible alternatives. Then road prices will represent less of an equity issue. The key is ensuring that transportation investments no longer counteract the success of measures to increase bicycling or public transit use.

Urban planning can help reduce driving by developing compactly and promoting a more sustainable transport pattern. The top reasons why people did not cycle in the US included safety concerns and excessive distances (Gardner, 1998). Urban designers and planners can create positive changes in these areas by providing a comprehensive network of bicycle facilities and promoting a compact urban form. Most cities in America have embraced the need for greater densities within center cities, so now its time to turn to bicycle networks.



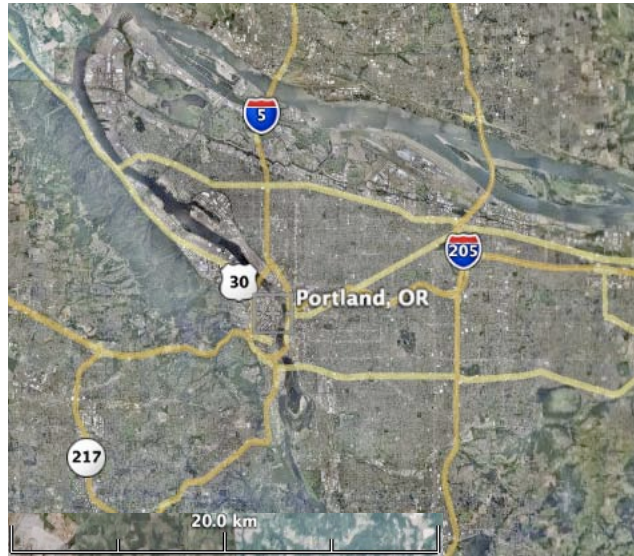
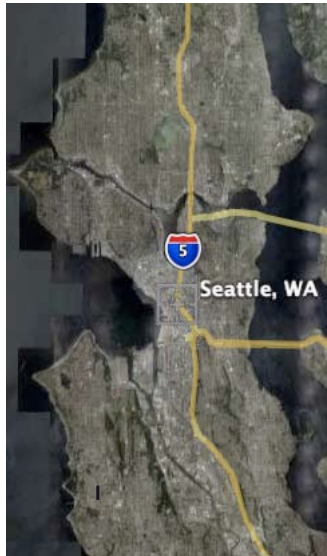
A new development in the Østerbro neighborhood features a large inner courtyard, basketball courts, children's playground, and indoor secured bicycle parking. In America, creating a bicycle city will not just entail adding bicycle lanes or off-street paths, but a comprehensive solution that includes incentives for developers to provide facilities for bicyclists.



Along a quiet residential street in Copenhagen, one finds more parked bicycles than cars and a streetscape that is for social activities as much as for transportation purposes.



comparing copenhagen  
with cities of the pacific northwest



All maps are to the same scale.  
Source: Google Earth

Copenhagen is a mere 88 square kilometers in size, whereas Seattle's land mass comprises 217 kilometers<sup>2</sup> and Portland totals 348 kilometers<sup>2</sup>. The cities' respective numbers of bicycle facilities must be considered in this light.

Modal Split							
Mode	Seattle 2000	Seattle 2005	Portland 2000	Portland 2005	United States 2000	United States 2005	Copenhagen
Car	67.7%	67.6%	75.5%	72.8%	87.9%	87.7%	27%
Public Transit	17.6%	17.0%	12.3%	13.3%	4.7%	4.7%	33%
Bicycle	1.9%	2.3%	1.8%	3.5%	0.4%	0.4%	36%
Walk	7.4%	6.9%	5.2%	4.3%	2.9%	2.5%	5%
Data source	Census 2000, SF 3 QT-P23	American Community Survey, 2005	Census 2000, SF 3 QT-P23	American Community Survey, 2005	Census 2000, SF 3 QT-P23	American Community Survey, 2005	Bicycle Account, 2004

Statistics for commuting show that bicycling to work is gaining support in Seattle and Portland, but both cities have a way to go to reach Copenhagen's modal split. One can see the upward progression of bicycling as a mode of transport even within the five years between 2000 and 2005. United States modal split statistics are included in order to give a sense of the typical commuting transport pattern in America versus cities in the Pacific Northwest.

Bicycle Facilities			
Type	Seattle, WA	Portland, OR	Copenhagen
Off-street bike path	0.28 km/km <sup>2</sup>	0.32 km/km <sup>2</sup>	1.25 km/km <sup>2</sup> existing and planned
Bike lanes	0.19 km/km <sup>2</sup>	0.69 km/km <sup>2</sup>	4.53 km/km <sup>2</sup> existing and planned
Data source	Bock, 2006	Bock, 2006	Jensen, 2006a

Comparing bicycle facilities for Seattle, Portland, and Copenhagen shows that Portland stands out with regard to bicycle infrastructure in the US context.

Since the mid-1990s, Oregon State law has made it necessary to spend one percent of statewide transportation revenue on pedestrian and bicycle facilities. In addition, new road construction and rebuilds are required to have cycling facilities. Subsequent statistics show that there has been a 300 percent increase in bicycle commuting, with a negligible increase in bicycle accidents. This is proof that a critical mass of bicyclists makes it safer.

Copenhagen has found that the individual risk has gone down even as the kilometers traveled have increased since more people bicycle. The risk of fatal injury on a bicycle in the United States is four times greater than in The Netherlands, even though they do not have a helmet law and have a high proportion of children and elderly who ride. Between 1978 and 1992, The Netherlands doubled the length of its bicycle network and found fatality rates dropped by one third while kilometers traveled increased by one third (Gardner, 1998). It seems that more bicycling "transforms the culture of the street" (qtd in Bock, 2006).

## urban planning in copenhagen

*"We don't think about the fact that we have cycle tracks – and that our politicians make sure we have a bicycle friendly town. We just take it for granted. It shows that it is not just about having a popular bicycle culture. It is also political."*

*Young woman interviewed in Copenhagen, 2002*



At one of the busiest intersections in Copenhagen, where H.C. Andersens Boulevard meets Vesterbrogade, cars wait behind a wide blue bicycle lane, there to provide a safe route for cyclists crossing the junction.

In Copenhagen, thirty-six percent of all home-to-work trips are by bicycle. Over one million kilometers are cycled each day. Within the past six years, there has been a twenty-one percent increase of cycling traffic, while vehicular traffic has increased only by six percent. Since 1995, car traffic has increased a total of sixteen percent, which is significant when one considers that before this time it had been stagnant at 1970s levels. There are 100,000 bicyclists who enter the city each day, and at peak hours there are more bicycles entering the city than cars. Even during the winter, with average temperatures in January and February at zero degrees Celsius with fresh winds, 70 percent of bicycle commuters continue by bicycle (Jensen, 2006a).

The bicycle is not a forgotten mode in urban and transportation planning in Copenhagen, as it is in many United States cities. There seems to be a clear understanding that the remarkable statistics the city has achieved with regard to transportation is a direct result of the fact that so many Copenhageners choose to bicycle. As Mayor of Building and Construction Administration Søren Pind stated regarding bicycle planning, "You have to make it comfortable, you have to make it secure, you have to create a climate where people would want to go on bike. And there's been for the past 30 years a political will to do this" (Copenhagen, 2002).

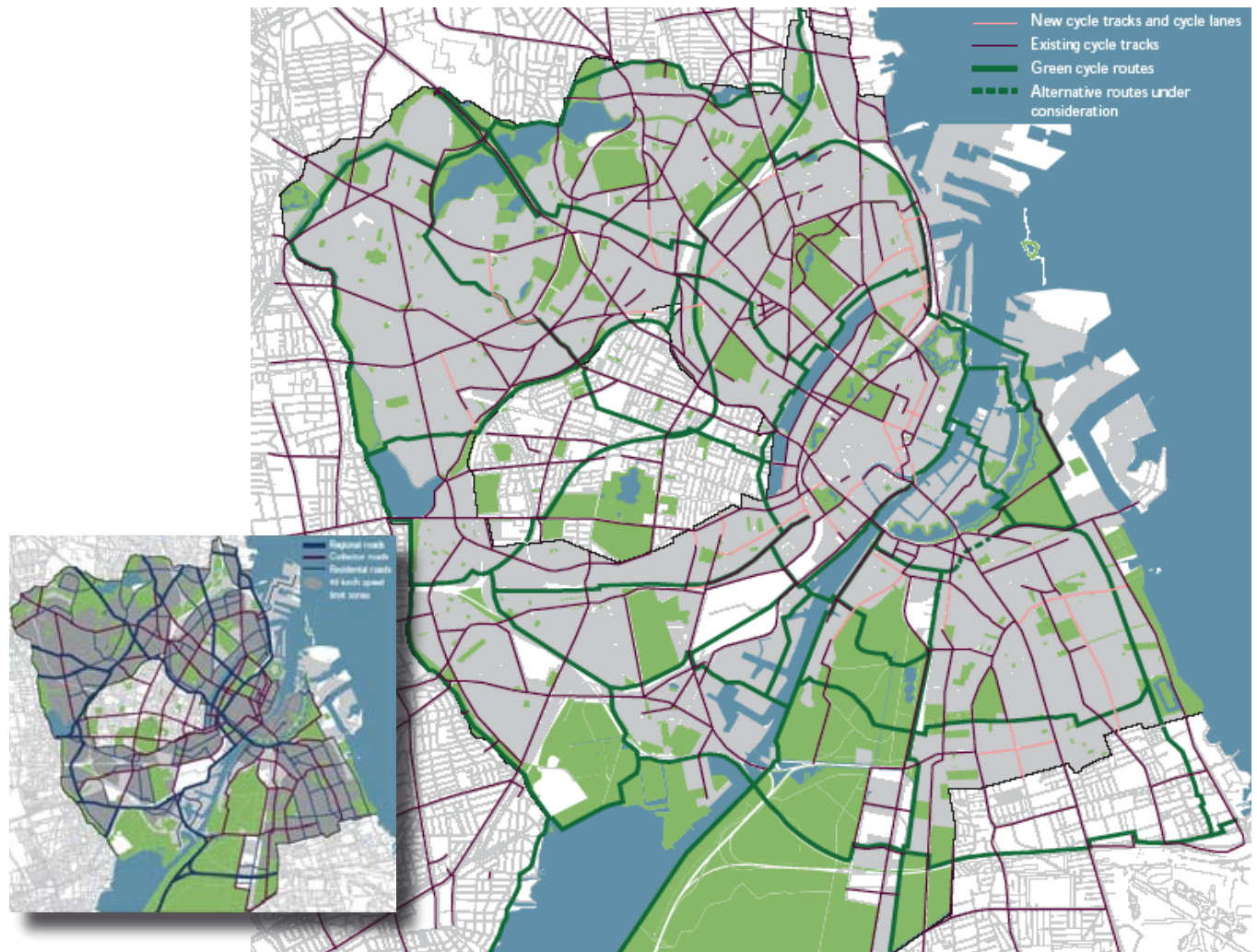
However, Copenhagen politicians and planners of past decades did not always share in this recognition of the critical role of cycling in creating a more livable and sustainable city. Copenhagen has a long

bicycle tradition, with cycle tracks dating back 100 years to a time when they were once horse riding paths that slowly evolved into cycle tracks. In spite of this, cyclists began to lose out to the automobile during the 1960s and 1970s, when Copenhagen saw a change in policy direction towards an emphasis on automotive transport efficiency, often at the expense of bicycling. While no cycle tracks were removed, many new roads were created without cycle facilities and bicycle tracks were often shortened at intersections to provide additional capacity for vehicles.

In the early 1980s, The Danish Cyclist Foundation and close to 40,000 citizens demonstrated in order to provoke politicians to see the value that Copenhageners placed on bicycling (Jensen, 2000). Politicians began to respect the role of the bicycle, and new laws came about that ensured planning efforts would take bicycling into account as a viable mode of transport. In 1983, the Danish Road Traffic Act was passed and provided the groundwork for legislation that promoted streets as livable spaces for all users, specifically children, pedestrians, and cyclists (Lawlor, 1992). Current planning efforts are still promoting cycling as a sustainable transport form, and work continues to make the city more attractive for cyclists. In this section, I will highlight some of the key planning principles that makes cycling so effective in Copenhagen.

### General Urban Planning Principles

- In local and regional planning in Copenhagen, **sustainable urban development** is key. Centralizing housing and jobs around transit hubs increases the competitiveness of public transportation. The location of workplaces, especially those with a high level of employees or visitors, is most critical. Since most residents of Copenhagen also work within the city, the location of housing is less essential as many choose to bicycle or walk to their jobs. Allowing additional density around transit hubs promotes the development of such areas (Copenhagen Municipal Plan, 2001). Linking bicycling with public transit is also an important component of planning for transit hubs.
- Instead of changing the city in order to better accommodate increased vehicular traffic, transportation planning in Copenhagen focuses instead on regulations that can create a **sustainable traffic pattern** that lessens energy consumption and environmental impact. This pattern promotes reducing automobile traffic as much as possible while providing mobility for all Copenhageners via public transit and bicycling (Copenhagen Traffic and Environmental Plan, 2005a).
- There is a high value placed on maintaining and improving the **quality of life** for Copenhagen residents. Bicycling helps create a more livable city by minimizing street-level air and noise pollution, giving more mobility to children and teens, and minimizing car congestion (Copenhagen Urban Space Action Plan).



The Traffic and Environmental Plan of 2004, includes the inset map, which shows areas with 40 kph speed limits in grey with main roads as thick blue lines and collector roads in magenta. The above map shows existing cycle tracks, planned additions to the cycle network, and green cycle routes. A comparison of the two maps highlights how Copenhagen has thought about bicycle planning, because most of the bicycle routes follow the main collector roads. Only now that they have a critical mass of cyclists are they turning to green routes as an alternative, since the original goal was to provide cyclists with the quickest and most direct route, typically found along the main streets. Green routes are advantageous to encourage long-distance commuting and recreational bicycling.

## bicycle planning

“...many city plans have created specialized cycle lanes which serve as recreational ‘rivers’ but these do not in any way comprehensively address commuters’ needs. Gehl describes this as the ‘river vs. irrigation’ approach to traffic planning and that as important as rivers are there needs to be irrigation on the street (cycle lanes and sidewalks) if the cycling network can have fertile conditions in which to grow. Seattle’s Burke Gilman Trail is a great river for the city but there is not full potential in using it as a complete commuting system.”

Mary Patricia Lawlor, 1992



Along most one-way streets in the central city, bicyclists can travel two ways. This has been an effective method to increase the competitiveness of cycling over cars for decades in Copenhagen.



During peak hours, there are more bicycles and mopeds entering the city from the Copenhagen Lakes (western part of the city) than cars. Counts have been done each year since 1970, when bicycle traffic was at its lowest levels (Gehl, et al, 2006).

Copenhagen transportation planners are effective at promoting cycling through dual techniques. Soft policies, such as campaigns and education, are an important component of cycle planning since they can encourage new bicyclists and influence changes in transportation behavior. Hard policies, such as creating new bicycling infrastructure, have the greatest impact when combined with campaigns and education (Jensen, 2000).

Another essential strategy is to ensure that new traffic improvements do not nullify efforts to increase cycling in the city. Restrictions to car driving, such as road pricing, taxes, and parking fees, are necessary in order to promote cycling. In order to make cycling more viable, it must have advantages over driving a car. Being faster, cheaper, and more convenient

to park are some of the most common responses to why one cycles in Copenhagen. Policies such as allowing cyclists to travel two-ways on one-way streets or providing advanced stop lines for bicycles to give them priority at intersections improve the competitiveness of cycling over the automobile.

Finally, bicycle planning in Copenhagen focuses on the importance of mobility for everyone. While in the United States efforts that restrict vehicular flow or impose new costs to driving are found to be inequitable, in Copenhagen similar efforts would be found to increase the equality across modes. By prioritizing bicycles and pedestrians in downtown planning while reducing access for vehicles or increasing the costs to park a car, Copenhagen has made its inner city accessible to all: bus riders, bicyclists, pedestrians, and cars.

Equitable mobility necessitates restrictions on the reign of the private automobile in order to provide enough room on the street for others. The streets are public spaces, and as such they deserve to be places that function for all users, not only motorists. This equity transfers to financing, and in Copenhagen, one-third of the total road budget goes towards bicycle planning and infrastructure.

Planning for bicycling in Copenhagen necessitates thinking about different users and providing them with conditions that can make bicycling a viable mode of transportation in their daily lives. Children, the elderly, commuters, and tourists all have very different needs with regard to cycling infrastructure

and require a diversity of solutions. Transportation quality is essential to maintaining and increasing the number who cycle. Improving transportation quality is a main priority of the Cycle Policy.

### Bicycle Planning Principles

The main principles of Copenhagen's bicycle planning are simple and straightforward:

- Create bicycle tracks on main streets to connect cyclists to major destinations along the most direct route. This has been the main aim of bicycle planning in Copenhagen since the 1980s.
- Reduce traffic on local and residential streets via traffic calming to ensure adequate cycling conditions. This will create livable neighborhoods that function best for bicyclists and pedestrians. It is particularly important to focus on where local streets join major roads with cycle tracks and to provide entry and exit conditions that make car drivers aware of the presence of cyclists.
- Provide alternatives to cycling on urban streets in the form of green routes to promote recreational cycling and greater commute distances. Green routes are a new planning concept for bicycling in Copenhagen. They will appeal to residents and tourists who may not cycle currently because the distance of their commute or a dislike of busy main streets that makes them feel less comfortable on the cycle tracks. Cyclists will be able to travel at much faster speeds since there will be fewer signalized intersections or bus stops.

Measures to Increase Bicycling	
Plan for Bicyclists	<ul style="list-style-type: none"> <li>• Direct cycle routes</li> <li>• Coherent networks</li> <li>• Cycle audits of plans</li> <li>• Cycle plans</li> <li>• Green routes to link schools, parks, and workplaces</li> <li>• Cyclist facilities at workplaces</li> <li>• Dense, mixed-use development pattern</li> <li>• Two-way cycling on one-way streets</li> </ul>
Information, Campaigns, and Events	<ul style="list-style-type: none"> <li>• Safety and enforcement campaigns</li> <li>• Cycle to work campaigns</li> <li>• Cycling for health campaigns</li> <li>• Education on the societal costs of cars</li> <li>• Campaigns targeted at children</li> </ul>
Restrictions on Car Driving	<ul style="list-style-type: none"> <li>• Remove surface and on-street car parking</li> <li>• Reduce speed limits on residential roads</li> <li>• Create parking fees</li> <li>• Ticket illegally parked or stopped cars blocking cycle areas</li> </ul>
Road Safety	<ul style="list-style-type: none"> <li>• Integrate road safety planning with bicycle planning</li> <li>• Perform road safety audits</li> <li>• Redesign black spot areas</li> </ul>
Competence Development	<ul style="list-style-type: none"> <li>• Hold conferences about cycle planning</li> <li>• Research and development</li> <li>• Offer data for specialists</li> </ul>
Bicycle Schemes	<ul style="list-style-type: none"> <li>• City Bikes or other free bicycle program</li> <li>• Company bikes campaigns</li> <li>• Bicycle couriers</li> <li>• Cycle basket/trailer deposit zone in shops</li> </ul>
Safer Road Layout	<ul style="list-style-type: none"> <li>• Traffic calming, particularly at intersections</li> <li>• Cycle crossings, advanced stops, pre-green lights</li> <li>• Focus on barrier areas, such as bridges</li> </ul>
Link Bicycles and Public Transit	<ul style="list-style-type: none"> <li>• Allow bicycles on trains or busses</li> <li>• Provide adequate parking at transit hubs</li> </ul>
Enhance Road Maintenance	<ul style="list-style-type: none"> <li>• Smooth surfaces</li> <li>• Better sweeping</li> <li>• Adequate winter-time maintenance</li> </ul>
Increase Bicycle Parking	<ul style="list-style-type: none"> <li>• Bicycle parking funds</li> <li>• Provide bicycle racks to meet different needs, including covered and locked areas</li> </ul>
Economic Incentives	<ul style="list-style-type: none"> <li>• Tax deductions for cyclists</li> <li>• Deductions for workplaces which provide cycle facilities</li> </ul>
Source: Jensen, 2000	

## copenhagen's cycle policy

*"A piecemeal approach will not restore bicycles to cities any more than peppering the Columbia River with fish food will bring back salmon. Thus, many cities build bike paths, or promote bike-and-ride commuting, or put police on bikes. But few take all of these initiatives, and fewer still coordinate these with other urban policies that affect cycling. Only when transportation is planned comprehensively - with attention to all options for managing transportation demand - will the natural place of the bicycle become evident, and the obstacles to biking be removed."*

Gary Gardner



Two friends ride towards the center city along Torvegade, a main shopping street and Metro hub.

The Cycle Policy 2002-2012 published by the City of Copenhagen lists six areas of transportation quality:

- A sense of security. The perception of safety is essential. When cyclists feel unsafe, the full potential of cycling as a mode of transport will never be realized. Campaigns and education can be important mechanisms to increase a sense of security by encouraging new or infrequent cyclists to try bicycling in order to change their perception of cycling as unsafe.
- Safety. This measure is objective, the number of cyclist casualties per cycled kilometer. As more people cycle, there are actually fewer cyclist accidents. A critical mass of cyclists decreases accident risk because motorists become more aware of cyclists, but also because more cyclists are indicative of a well-developed cycling network and more cyclists also mean less car drivers (Jensen, 2000). Providing cyclists with their own space on the road increases the safety of cycling, but it is important to focus on the design at intersections where cars and cyclists meet.
- Traveling speed. Cyclist speed is a critical element in ensuring the competitiveness of the bicycle over the car. Cycle tracks can help increase speeds for cyclists since they do not get held up in car congestion. In addition, cycle tracks must be wide enough to allow for cyclists to overtake one another, since most adults travel an average of 16-18 km/hour but children and the elderly travel 6-8 km/hour



Vindebrogade near Stormgade features one of the nicer bus island designs in Copenhagen, as it has enough room for entering and exiting bus patrons to safely and comfortably wait for bicyclists to pass.

- (Jensen, 2000). Other mechanisms such as pre-green bicycle lights or advanced stop lines at intersections, allowing two-way bicycling down one-way streets, providing bus islands so that cyclists do not have to wait for entering and exiting bus patrons, and developing a network of green routes where cyclists will have priority will promote increased traveling speed.
- Health. Promoting daily exercise has societal benefits. Studies have found that the exercise from cycling for a half hour daily increases mean life expectancy one to two years, and outweighs the additional cycling accident risk by a factor of twenty (Jensen, 2000). As David Hiller, advocacy director of the Bicycle Alliance of Washington put it, "Riding bikes is not killing

people. Heart disease is killing people. If everybody rode their bikes you'd see a startling decline in the rate of cycling fatalities, and you'd probably look at a startling decline in heart disease, too" (qtd in Bock, 2006).

- Experiencing the city and its life. The bicycle infrastructure was originally added to main shopping streets because it gave the cyclist a sense of the urban life of the city and made it easy to shop on the way home from work. Recreational cycling, or being able to commute in a more peaceful setting on a green route now provides Copenhagengers with an alternative. On bicycle, a person directly connects with the seasons and the city, something that most Danes enjoy greatly. As a former Valle Scholar to Copenhagen aptly put it, "By traveling on foot or by bike I felt that I really 'existed' in the city and that I was very connected to the seasons, the weather, the people and the city itself...instead of just passing through from one destination to another. I was a participant



Along Amagerbroagde, a bicyclist must ride very close to the edge of the cycle track in order to pass a cyclist on a three-wheeled bicycle. This can feel quite uncomfortable, but so does traveling at a slower than desired speed.

instead of a spectator. This was, and still is, an undeniably good feeling" (Lawlor, 1992).

- Comfort. Cycle track and street surfaces must be even in order to create a pleasant cycling experience. Potholes and inadequate grate design can diminish the desirability of bicycling. Cleaning and maintenance are vitally important to maintain and increase the number of cyclists in Copenhagen. Two full-time City of Copenhagen workers cycle throughout the city and record inadequate cycle tracks and lanes (Hart, 2005). While the Cycle Policy only speaks of comfort in terms of street surface, I believe that the level of cyclist comfort or enjoyment



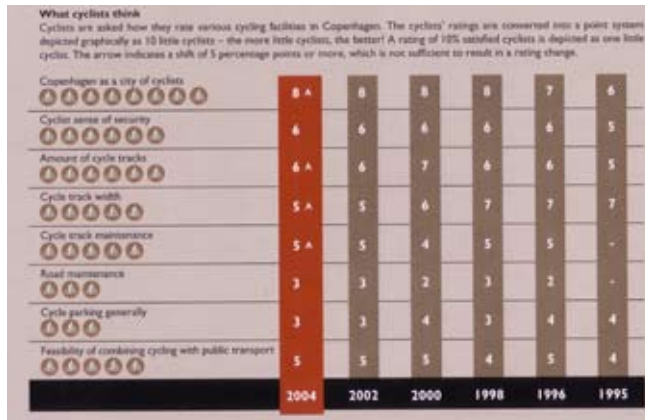
Copenhagen's grate design causes cyclists to weave to avoid grates, especially when they have sunk into the ground (above, left). An Amsterdam cycle route highlights an effective alternative grate design (above, right).

relates to the ease in riding with a friend or with your child. Can you go slowly and have others pass you easily, or do you worry about slowing down others? In the future if cycling is to maintain its diverse demographic base, it may be necessary to provide even larger cycle tracks, up to 3 meters, which would correspond with a three-lane capacity. With the increasing numbers of Christiania-style cycles, elderly cyclists on three-wheeled bicycles, and a prevalence of mopeds that share the cycle lanes with bicycles, it may be necessary to consider social comfort as well as the physical condition of the road.



Near H.C. Andersens Boulevard, this area along Copenhagen's harbor will be a future green route.

# cycle policy goals and evaluation



This is a page from the Bicycle Account from 2004. Ratings are given with a cyclist graphic, with ten “little cyclists” being a perfect score. A single page provides information regarding ten years of cyclists’ perceptions regarding issues such as the links with public transport, the amount of bicycle parking, and cleaning and maintenance.

The goals of the Cycle Policy directly relate to transportation quality. The goals are quantitative in nature to allow for easy evaluation. Assessment of goal realization occurs on a biannual basis through the Bicycle Account, discussed in more detail below. The main goals are:

- Increase proportion of commuters cycling to work to 40%,
- Reduce cyclists’ risk of being seriously injured by 50%,
- Increase the proportion of cyclists feeling secure in traffic to 80% satisfied,
- Increase cyclists’ traveling speed by 10% for trips greater than 5 kilometers,
- Increase cycling comfort by having less than 5% of surfaces unsatisfactory.

The Cycle Policy focuses on increasing transport quality for bicyclists through efforts in nine focus areas, which will be discussed in detail in the following section. These focus areas each have funding and detailed plans in order to realize the above transport quality goals. The Bicycle Account acts to measure the success of the City at meeting the goals with regard to the focus areas. Additionally, some focus areas have come about because of past Bicycle Accounts, such as the desire for green routes and the importance of cleaning and maintenance.

Evaluation and public accountability are essential components to an effective bicycle strategy. The Bicycle Account is a biannual evaluative tool used by the City of Copenhagen’s Roads and Parks since 1995. The Account incorporates two main elements: a survey of over 400 frequent cyclists and important statistics that affect cycling conditions (Hart, 2005).

Surveys include questions about the satisfaction with cycling conditions in Copenhagen, quantity and quality of cycle tracks, cyclists’ sense of security, bicycle parking conditions, and the link between cycling and public transport. Key statistics include the proportion of cyclists, amount of kilometers cycled, cycle track and lane length, amount of money for cycle track maintenance, and safety figures. Survey questions and figures collected are the same for each account to allow for comparison, but new questions and figures are also collected. For example, the 2004 Account measured the amount of on-street bicycle parking spaces and cyclists’

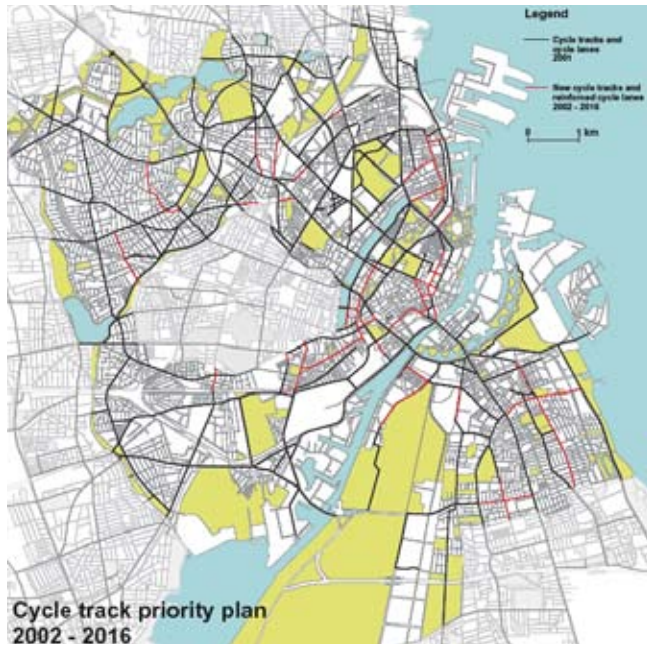


An elderly couple rides along the new Nørrebro green route as it nears Frederiksberg’s Metro station. Surveys collected from the public showed the desire for bicycle routes in a more natural setting.

traveling speed, and cyclists were asked if they wore a helmet (Copenhagen, 2005b).

The Bicycle Account then can be used to measure the success in meeting the goals set forth in the Cycle Policy. The results of the survey and statistics have an impact in determining where to allocate future funding. After the 2002 Account determined that cyclists were dissatisfied with narrower cycle track standards, the City changed the standards and began efforts to widen cycle tracks in many areas. The Bicycle Account is an important tool with regard to public accountability and policy evaluation.





**Cycle track priority plan 2002 - 2016**

Red lines indicate where cycle tracks or lanes will be added to complete the bicycle network of Copenhagen.

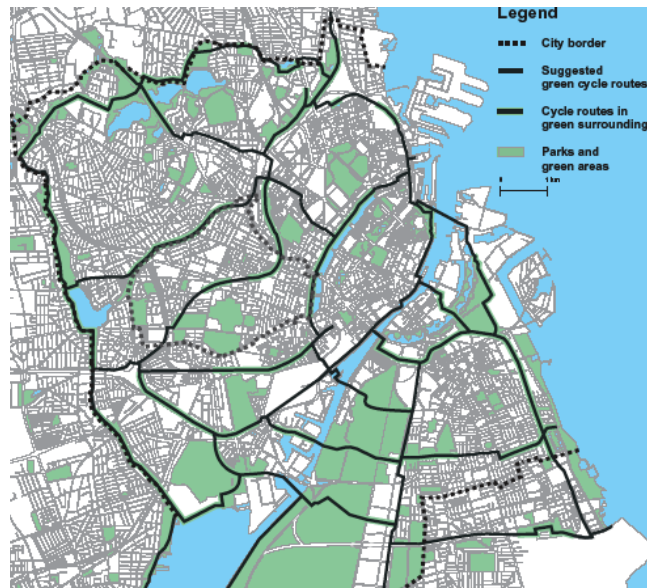
### Cycle Tracks and Reinforced Cycle Lanes

A Cycle Track Priority Plan has been established in order to finish the cycle track network in the City of Copenhagen, where there is approximately 65 kilometers missing from the network. Painted cycle lanes can be used as a temporary measure, and places that form link-ups in the network or carry a high level of bicycle traffic will be prioritized. Cycle track width will be 2.5 meters.

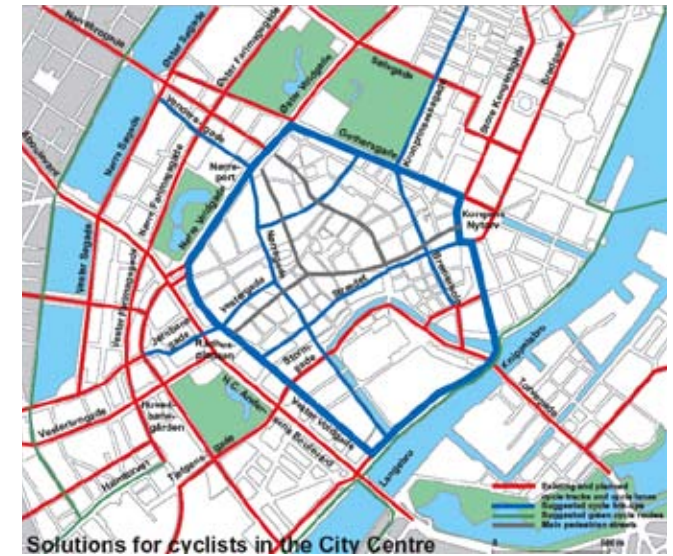
### Green Cycle Routes

A plan for green cycling routes was adopted in 2000 and updated in 2006. The network will total 110

kilometers when complete, with 21 routes ranging between 2 and 8 kilometers. They will incorporate separate pedestrian and cycle paths. Thirty-seven kilometers of green routes already exist throughout the city, although many will be upgraded. The routes along the lakes that ring the inner city and along the harbor will be key elements. The Lake route is also controversial, as Copenhageners are concerned that it will reduce space for pedestrians. This highlights the need for a pedestrian plan in order to ensure that bicycle and pedestrian facilities are complementary. Green routes will be for recreation and commuting. The development of commuter routes will be prioritized, particularly if they offer short cuts through the city or provide links with areas not currently connected by the existing bicycle network.



The Green cycle route plan map from 2000.



The map of proposed cycle improvements in the inner city.

### Improved Cycling Conditions in the City Center

Efforts such as removing one-way restrictions for cyclists, establishing 40 km/hour speed zones, and developing cycling link-ups are important elements to create better cycling conditions in inner Copenhagen. In 1999, six streets in the inner city had painted cycle lanes installed as temporary measures in order to improve conditions for cyclists. Link-ups that will be established within the historic center of Copenhagen will be designed to ensure that pedestrians are still prioritized. Important links include:

- Nørregade
- Straedet
- Vesterbrogade
- Bremerholm
- Cycle ring around the historic city center

## cycle policy goals and evaluation



The City of Copenhagen now routinely allows residential apartments to remove parking in areas along the street in order to set up bicycle parking facilities.



The city also allows shops along main streets to set up cycle racks, so long as there is still adequate space to walk. In practice, bicycle parking, even where racks are provided, overflows and makes walking uncomfortable.

### Bicycle Parking

A plan for bicycle parking will be developed in order to determine the need for more parking facilities in the city. Regulations are needed to ensure adequate bicycle parking for new developments, similar to car parking requirements. The demand for bicycle parking should shape the requirements, since more cycle parking is needed at employee-intensive workplaces, at entertainment and shopping hubs, transit stations, and at residences (Jensen, 2000).

### Improved Signal Intersections

While typical cycle tracks were designed up to the intersection, the 1960s and 1970s was a time of removal of cycle tracks at the junction in order to add capacity for cars. Now this shared lane for cycles and turning cars has been found to be safer, since both motorists and cyclists are more aware of one another. A disadvantage of the design is that right-turning cars often block the intersection and force cyclists going straight to wait or weave into car traffic in order to cross the junction. A variant of this design that will be used for new or redesigned intersections in Copenhagen will be a cycle track until 20-30 meters before the junction, then a narrow cycle lane up to the pedestrian crossing so that cars leave room for bicyclists. This will also allow for cyclists to have an advanced stop line, which along with blue-marked crossings are important tools to improve the safety at intersections.



The new standard design for intersections in Copenhagen, will incorporate a painted cycle lane up to the junction.



A shared intersection design popularized in the 60s and 70s forces cyclists and cars to mix more closely.



At Malmö's central train station, like Copenhagen's main train terminus, bicycle parking is of great importance.

### Combined Cycling and Public Transport

Public transit and bicycles together provide a viable alternative to travel via private automobiles for long-distance commuters. Allowing bicycles on the Metro and suburban commuter trains are of vital importance, and 5,000 cyclists bring a bicycle on board trains each day (Jensen, 2006a). Additionally, secure bicycle parking at train stations is important so that people feel safe riding to the station and leaving their bicycle. Copenhagen's central train station offers locked and covered parking for ten DKK for the first day and five thereafter, or you can subscribe for a monthly rate. A repair and rental shop is located next to the parking, which provides surveillance as well as a place to service your bicycle. At this time, only fifty percent of cyclists surveyed in the Bicycle Account are satisfied with the feasibility of combining public transport and bicycling.

### Better Cycle Track Maintenance

Maintenance for cycle tracks has the same standard as intersection maintenance. Approximately €1 million is spent on cycle infrastructure maintenance each year in Copenhagen (Copenhagen, 2002). In addition, any maintenance work which disturbs cyclist flow is well marked with signage.

### Better Cycle Track Cleaning

Daily cleaning, especially along shopping streets, is essential. During the weekends when there is no street cleaning, garbage is present on the tracks. Snow clearance is also important, and cycle routes have the same priority as major roads.

### Campaigns and Information

Campaigns are inexpensive and can be effective at promoting cycling. There are three main types of campaigns, (1) to raise public awareness, (2) targeted to specific groups and settings, and (3) targeted to individuals and households. Public awareness campaigns are a good first step and will increase the effectiveness of later, targeted campaigns (Jensen, 2000).

In 1995, Copenhagen initiated a company bicycle campaign, where fifty companies were provided with a free bicycle for use by the employees around the city in order to promote short trips by bicycle instead of by car. Odense, Denmark uses a website with a bicycle route planner for cyclists. They receive a map, directions, distance, and expected travel time. You can also get a route map via mobile phone ("Cykelruteplan"). Copenhagen is continuously



Double-decker parking outside of Copenhagen's train station is a simple solution to add capacity.

finding new ways to promote bicycling in the city. Bicycling lessons for immigrants, campaigns to promote cycling among older men and women, and the City Bikes program all showcase innovative ways Copenhagen encourages cycling.

## city bikes



A City Bike at a rack in inner Copenhagen. A deposit of 20 DKK unlocks the bicycle, which you get back upon returning it to any rack within the city.

City Bikes began in 1995 as a public-private partnership to provide free bicycles for tourists and residents to use in the inner city. It was the first program of its nature, although other cities have now adapted the City Bike model to their situation. City Bikes has now become part of the identity of the city, and helps promote the image of Copenhagen as an environmentally-aware and bicycle-friendly city. You can get information about the program at tourist offices, but it is also easy to find a City Bike on a rack and get a sense for the system.

City Bikes began with 700 bicycles at 120 cycle racks, and there are now over 2,000 total cycles. The City of Copenhagen provided the space (by removing a car parking spot) and bicycle racks to help promote the success of the program. Private corporations “buy” a City Bike and promote their companies with bright advertising, giving the bikes a

unique look that discourages theft.

A Danish newspaper reported that a City Bike it tracked for twelve hours only spent eight minutes at a bike rack throughout the time period. Within the first year of the program, bicycle theft decreased 18 percent and by 26 percent in the second year (Gardner, 1998).

Downsides of the City Bikes are in its popularity, because it is often difficult to find a bicycle when you are looking for one. The program was meant to be used by commuters, who could get of a train in the morning and ride to work, depositing the bicycle at a rack near the office, and then do the same to get back to the station. Unfortunately, there were not enough bicycles to guarantee that one would be available, thus limiting its effectiveness for commuters. The bicycles cannot be used at night, since they do not have lights. For a time, the bikes featured baskets but they no longer do, which makes it difficult to transport items while using a City Bike. Another detriment is that the cycles are not available during the winter.

Other cities have developed new models based on Copenhagen’s system. JCDecaux recently launched Cyclocity in Belgium, where 250 bicycles at 23 bike racks throughout the inner city are available to rent. The bikes cost €0.50 for the first hour, then €0.50 to €1.00 for each hour thereafter depending upon the type of ticket. A membership costs €10 for the year. In Lyon, France where Cyclocity debuted in 2005, the bikes are used extensively during morning,



Cyclocity debuted in Brussels in 2006, the fourth city outside of France to join the system. In France, Cyclocity currently has 60,000 members, who travel an average of 40,000 kilometers each day.

lunch, and evening rush hours, with 28,000 bicycle trips daily. Cyclocity is proving effective at providing a link with public transit, by giving commuters the ability to quickly get around the inner city during their workday. Bikes include a lock and basket (JCDecaux, 2006).

## cycle design guidelines

A successful cycle route network should be based upon the following principles (adapted from Jensen, 2000):

### Accessible and Coherent

A network of routes should be no more than 500 to 800 meters apart, and can be much denser in city centers where there are many destinations. The routes should link main destinations, connecting residential areas with schools, universities, workplaces, shops, transport hubs, places of entertainment, and other residential neighborhoods. The routes should occur on main streets. An increase in the number of cycle routes increases the unity of the overall network, as cyclists have more potential routes to choose from for any given trip. Consideration of the cycling population will necessitate different solutions in order to maximize the diversity of users; children, commuters, and tourists all have different needs.

### Direct and Easy

The cycle network should be easy to navigate and follow. As Lars Gemzøe aptly stated, the cyclists' space on the street in Copenhagen is always found in the same place with regard to the position of cars and pedestrians. Cyclists most often prefer to take the most direct route to a location; so providing bicycle facilities on major streets maximizes the level of service for cyclists.

### Safe and Secure

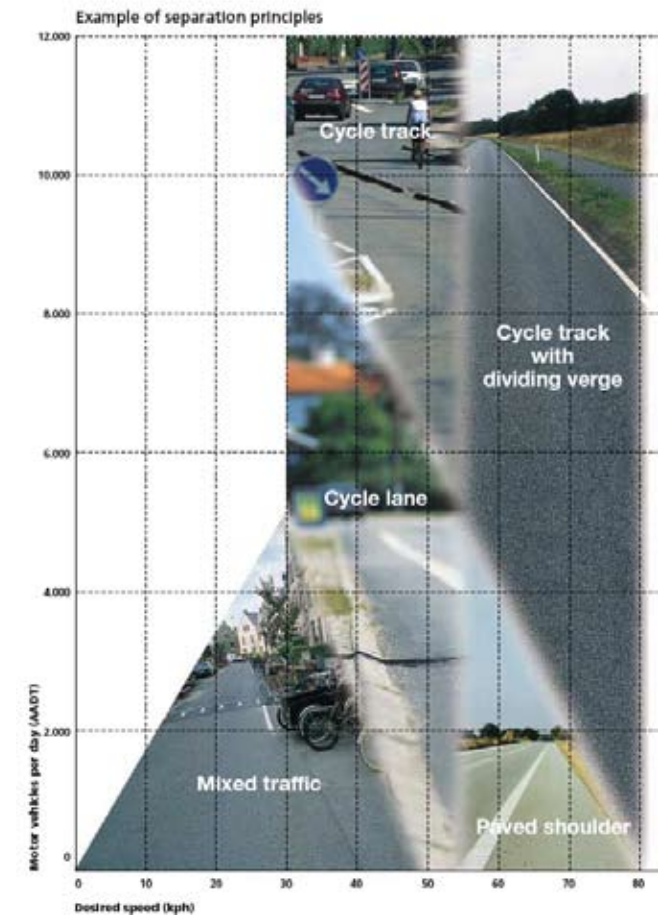
Vehicular speed must inform decisions regarding cycling facilities provided on the street. Determining whether to provide cycle lanes, tracks, or to mix cycle and car traffic will depend upon the circumstance. The image here highlights different circumstances and the best solution. Typically separating cars and bicycles will be more expensive to construct and maintain, but will also be more comfortable for cyclists, and can increase road safety. Separation can be detrimental, especially where there is low traffic volume or speed, but effort must be taken to ensure car speeds are adequately low.

### Self-Explanatory Design

It is important that cyclists can form a mental map of the bicycle network. This is easiest when the cycle routes follow major roads. Uniformity in the design of the bicycle network is an important component, because it gives cyclists a good idea of what any particular route will look like.

### Comfortable and Attractive

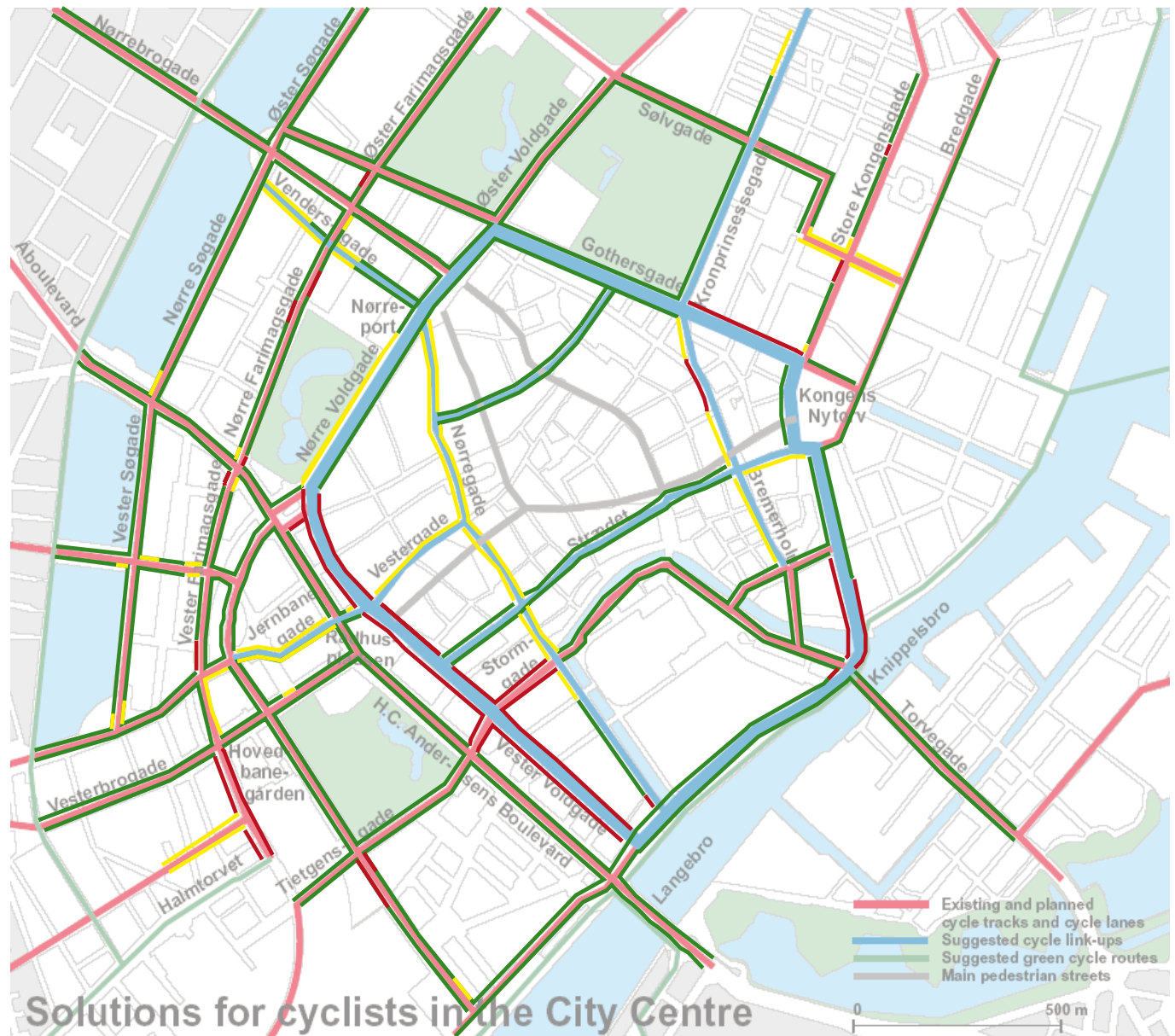
When paving is well maintained, cyclists' comfort is increased because they do not have to look down at the pavement to avoid problem areas. This enhances the ability for a cyclist to observe the actions of vehicles and pedestrians, as well as to enjoy the sights along the route. Cycle track maintenance during the winter must also be prioritized. Planting trees and vegetation can mitigate the effect of wind on cycle routes. Where cycle routes are not along main streets, safety concerns may result.



Above is a graphic representing the best cycle facility depending upon traffic volume and speed (Jensen, 2000).

# typology of streets in the inner city

Type	Street Characteristic
A	Cycle track with separated median between bicycle and car space
B	Cycle track separated from moving traffic, with or without adjacent parking
C	Painted cycle lanes between sidewalk and traffic lanes, with or without parking
D	Slow mixed street with traffic calming design
E	Open street design, parking on left or right side
F	Mixed street without traffic calming elements but slow speeds and/or low traffic volume
G	Open street design, parking on both sides or right-turning traffic entering from roadway
H	Bus priority streets
I	Mixed street without traffic calming elements and with high speeds and/or high traffic volumes



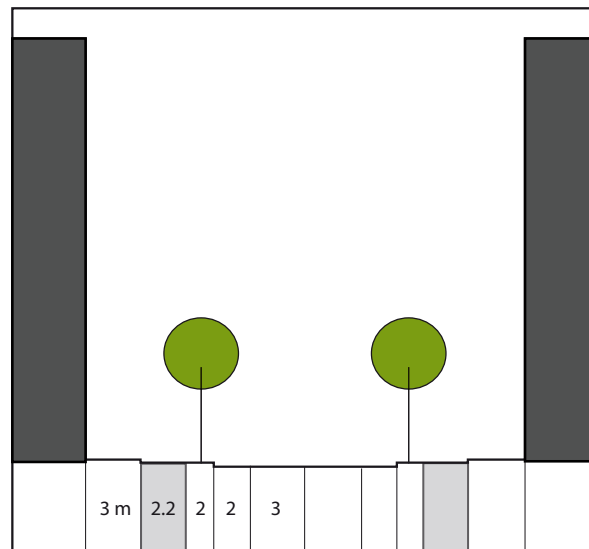
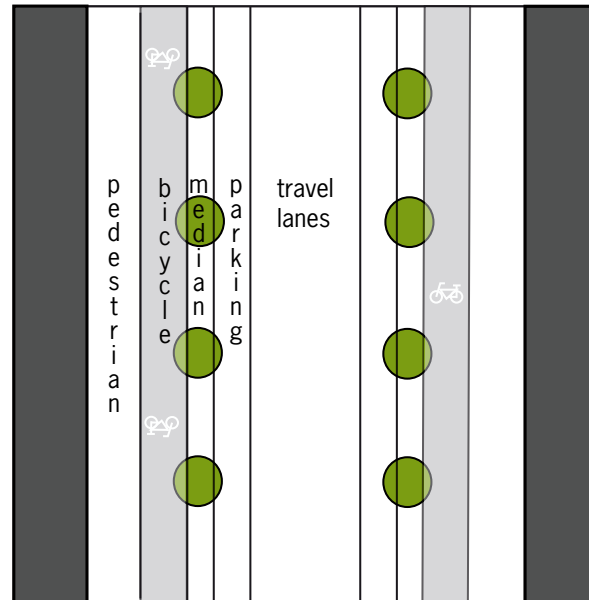
## Type A

Cycle track with separated median between bicycle and car space:

- Provides extra protection for bicyclists from moving traffic or parked cars;
- Offers a waiting place for pedestrians to cross the road, making the street easier to cross;
- Creates space for temporary loading and unloading;
- Functions as a bus island for passengers to enter and exit the bus without interrupting bicycle flow (for this purpose, the median should be at least 1.5 m and 2.5 m will provide enough space for wheelchair-bound passengers and mothers with strollers to load and unload comfortably);
- Provides a space for street trees, bicycle parking, meters, and signage that will not disrupt pedestrian movement.



At Kongens Nytorv, a door swing zone is provided to prevent cyclists from having to swerve to avoid doors. This zone should be level with the track, at least one meter wide, and can be distinguished from the cycle track by a different paving material (Jensen, 2000).



Typical plan and section of a Type A street.



At Nørre Voldgade near Nørreport Station, the median strip is being used as a temporary loading zone. Temporary parking in bicycle lanes or tracks is a common problem where no median is provided, even though it is illegal.



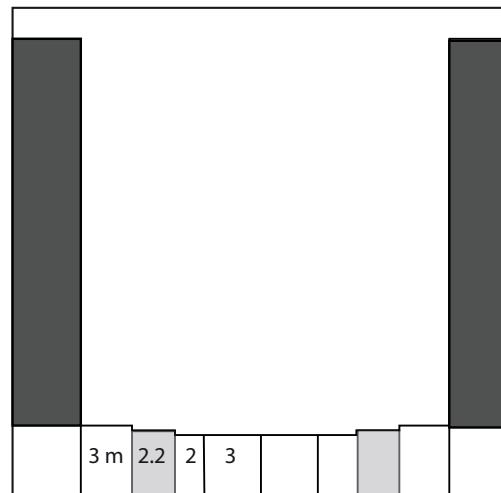
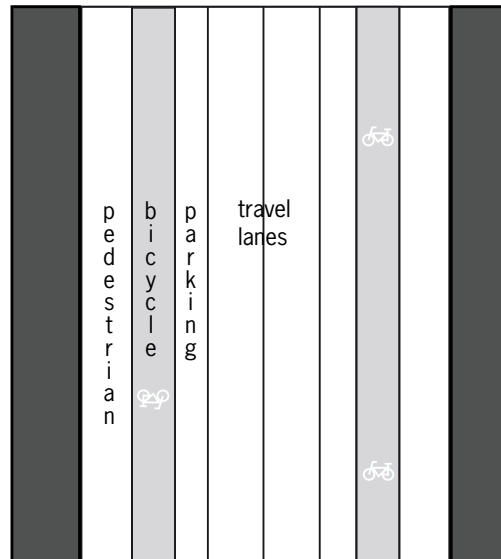
Along Frederiksborggade, the bicycle path is adjoined by a planted median that accommodates street trees, bicycle parking, and parking meters, which separates bicyclists and pedestrians from moving and parked cars.

# typology of streets in the inner city

## Type B

Cycle track separated from moving traffic, with or without parking:

- Cycle track is wide enough to accommodate open car doors, although it is less desirable than having a median;
- Bus stops can be an area of conflict as passengers load and unload onto the cycle track, often with limited visibility;
- Passing on the left can be less comfortable as you near the edge of the cycle track curb;
- The raised curb between the travel lanes and the foot path help motorists and pedestrians to understand that the cycle track is for bicyclists only. Curb heights between the sidewalk and the cycle track should range between 5-9 cm. Between the travel lanes and the bicycle path, a curb between 7-12 cm is recommended (Jensen, 2000);
- The curb reduces the speed of cars coming from side roads and ensures that most motorists will not park on the track;
- When cars travel at speeds greater than 50 kph (30 mph), cycle tracks can reduce the severity of bicycle accidents (Jensen, 2000);
- The cycle tracks in Copenhagen are typically 2.2 meters, and will be 2.5 meters in the future. This will make it possible to avoid car doors, which take up nearly 1 meter of space; pass slow traveling cyclists, which is important as the elderly and children travel up to 10 km slower than the average adult; and to pass three-wheeled cycles.



Typical plan and section of a Type B street. This example has parking on both sides of the street, but the area can also function as another travel lane or a bus priority lane.



Along Nørre Voldgade, a bus stop is adjacent to the cycle track. Where cycle tracks are provided, most accidents occur between bus patrons and cyclists. When the bus delivers passengers directly onto the cycle track, cyclists must yield the right-of-way, which can slow down travel time. Painting zebra crossings on the cycle track can be effective at reducing the traveling speed of cyclists.



The typical Copenhagen cycle track with adjacent parking, here along Gothersgade.



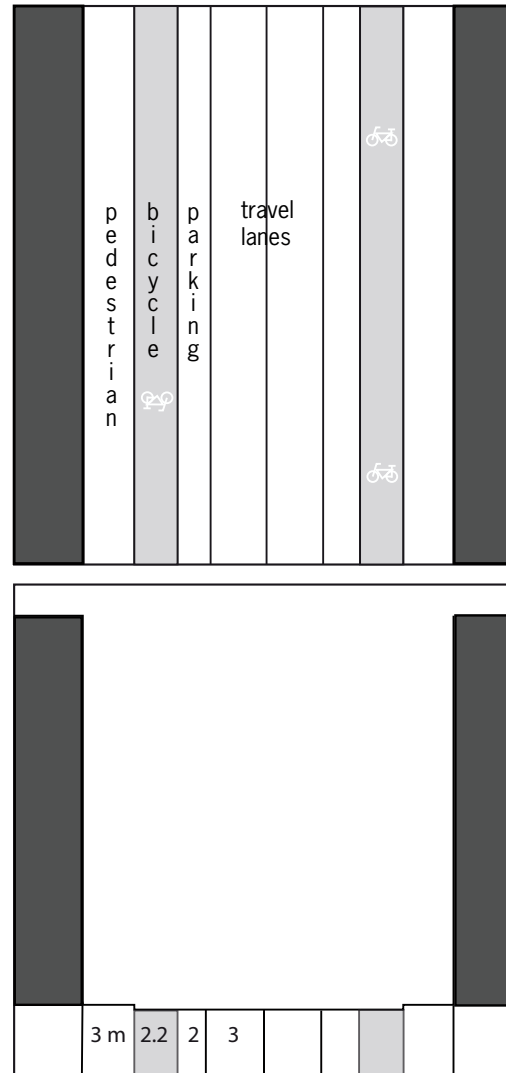
## Type C

Painted cycle lanes between sidewalk and travel lanes, with or without parking:

- Ensures cyclists have their own space within the street section;
- Where parking is allowed and marked with paint, cars tend to follow the rules and keep out of the cycle lane;
- Is an inexpensive solution that still feels comfortable to ride;
- Can easily accommodate additional capacity by moving the white stripe over if necessary;
- Can be painted or paved to differentiate cycle areas from the roadway, give added awareness to motorists, and to add to the cyclists' understanding of the overall cycle network;
- If cycle lanes are not wide enough, they can be less safe than mixed traffic situations.



At Vendersgade, a contra-flow lane has been installed along the one-way street, which has two white lines and bicycle symbols to distinguish it as a bicycle path.



Typical plan and section of a Type C street. This example has parking on both sides of the street, but the area can also function as another travel lane or a bus priority lane.



Nørre Farimagsgade near Frederiksborggade incorporates parking with painted spaces so cars know where they belong. The painted lanes are typically the same width as a cycle track, at 2.2 meters. The white stripe is 0.3 meters wide and continuous, except for junctions with side roads, where it is broken to indicate the presence of cars. Bicycle symbols should be placed every 100 m and after junctions (Jensen, 2000).

# typology of streets in the inner city

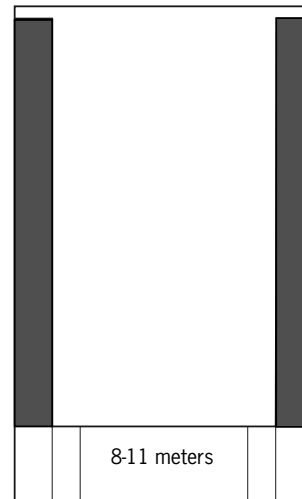
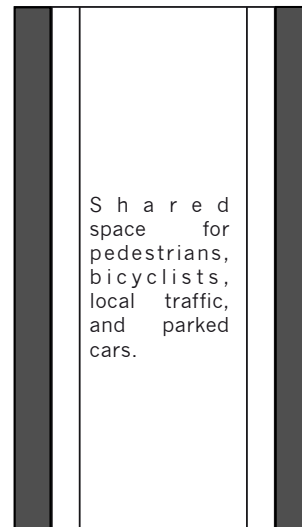
## Type D

Slow mixed street with traffic calming design:

- This design can be safer on streets that carry a low volume of traffic, but must be designed to slow down traffic so bicyclists feel secure;
- Junctions are critical and should feature traffic calming elements such as a different paving, traffic humps, or raised intersections;
- Short bicycle facilities at intersections can increase motorists' awareness of bicyclists and ensure a place for bicyclists at the junction;
- On shared streets, the rules of the road should be clear as to who is to be prioritized, bicyclists and cars should not be allowed to detract from the pedestrians' experience.



Along Frederisholms Kanal, part of the Nørregade link through the city center, is a quaint road that has slow speeds because of its narrow travel space and road paving.



A typical plan and section of a shared design Type D street, where there are no designated lanes or areas for vehicles, bicyclists, or pedestrians.



Streets of this nature are either designed to be traffic calmed streets or are that way by default, usually because they are narrow or carry little traffic. Blågårdsgade, which runs perpendicular to Nørrebrogade, is an example of a commercial shared street. Along such a street, you find a mix of bicyclists, pedestrians, local traffic, and parked cars. The area is typically paved uniformly across the street and features no curbs or differences in level. Also, no through car traffic is allowed. Bicycles are expected to move with the speed of pedestrians, although in practice they weave around pedestrians slowly to make their way through the street. Parking spaces are typically marked by special paving stones so that cars know where parking is and is not allowed. Along these slow, low-volume streets, traffic calming at intersections is essential, especially when they cross busier streets and do not have traffic signals.

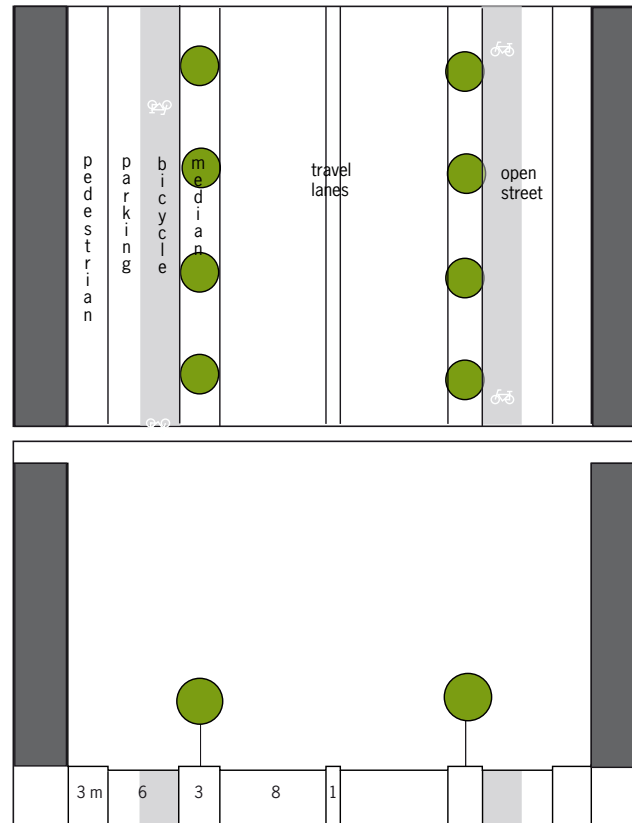
## Type E

Open street design, parking on either the left or right side:

- This design includes a wide area for cyclists, with enough room to safely maneuver around a car going in or out of a parking space;
- Cyclists must be more aware of the presence of cars, particularly watching out for opening car doors in areas with parallel parking on the right side of the cycle area;
- In order to be comfortable, cars must travel slow in the open street, temporary loading and unloading should not be allowed, and parking turnover should not be high.



Near the intersection of Niels Jules Gade and Holbergsgade, this open street combines parallel parking against the sidewalk and a wide cycle area. It is wide enough that cyclists can avoid opening car doors, but they must be aware of that possibility. In addition, cars waiting for a parking space to open can block much of the cycle area.



Typical plan and section of a Type E street. Cars typically park diagonally against the median, with cyclists still riding closest to the sidewalk. Alternatively, the cars park parallel to the sidewalk with bicyclists using the space to the left.



Hans Christians Andersen Boulevard near Rysensteensgade incorporates a wide cycle area that is shared with diagonal parked cars, which is comfortable so long as the volume of cars and turnover of parking spaces is limited.



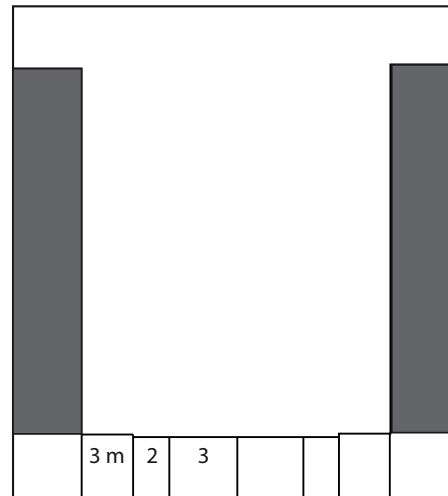
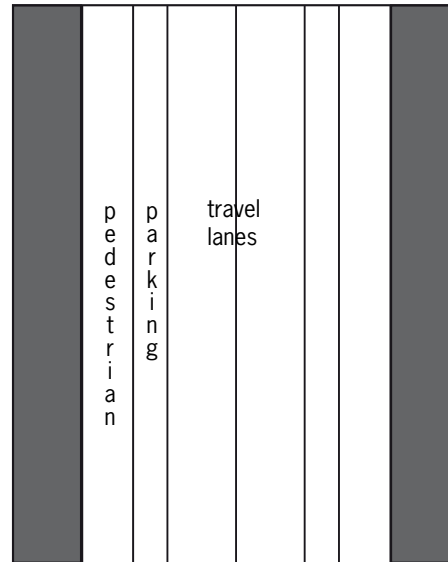
When H.C. Andersen Boulevard nears City Hall Square transitions from an open street design to an area with separated cycle facilities via a blue crossing that guides cyclists back to the main roadway.

# typology of streets in the inner city

## Type F

Mixed street without traffic calming elements but slow speeds and/or low traffic volume:

- One-way streets that are sufficiently wide do not necessarily need separate contra-flow lanes (Jensen, 2000). Two-way cycling signage should be posted and short cycle lanes should be provided. This has been the typical Copenhagen design for decades;
- Contra-flow lanes will become the standard solution for two-way cycle traffic on one way streets. This benefits cyclists as they can travel at faster speeds within their designated space. These lanes should be no less than 1.5 m wide. Niels Jensen, a City of Copenhagen bicycle planner, saw this as a disappointing development, since a lane of parking must be removed and the short cycle facilities and signage method had worked well (2006b);
- Mixed traffic is comfortable to ride in areas where the streets are wide enough to fit cyclists and moving vehicles and it can be safer than separating bicyclists from cars on streets with low vehicular speeds and traffic volume;
- Determining whether or not mixed traffic is an adequate solution will depend upon vehicle traffic volume and speed, amount and turnover of parking spaces, roadway width, presence of bus traffic, and the volume of bicycle traffic. The behavior of vehicles will affect the sense of security and safety of cyclists on the route. Traffic calming can alleviate many conflicts between road users, particularly at junctions.



Typical plan and section of a Type F street. One-way streets may feature parking on only one side of the street, with the other side having a contra-flow lane.



A contra-flow lane on the Strædet route near Vester Voldgade provides space for cyclists traveling against cars.

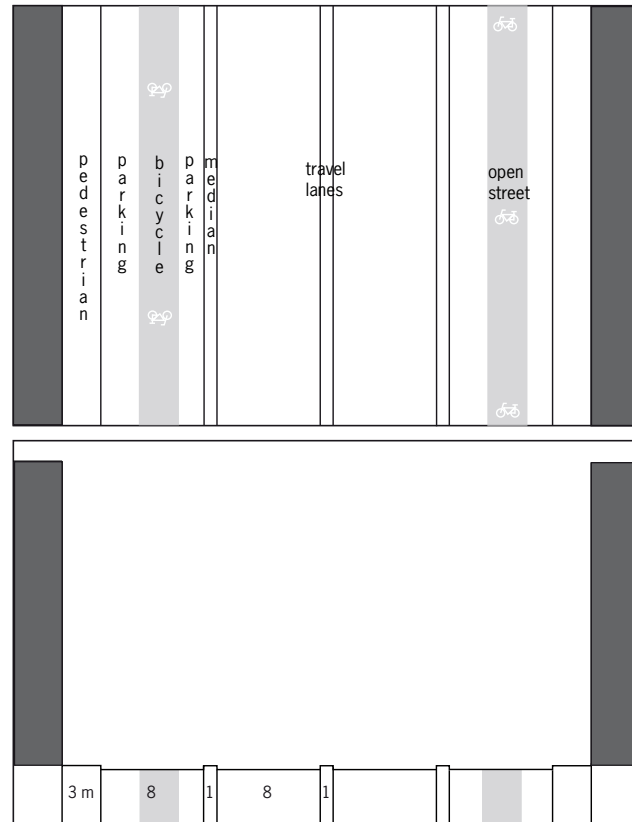


Along Vestergade, traffic travels in one direction but bicycles are allowed to go either way.

## Type G

Open street design, parking on both sides or right-turning traffic entering from roadway:

- In situations where cyclists have either parked cars on both sides of them, or where moving cars are entering an area at faster speeds, the level of comfort is significantly reduced;
- It is important to provide signage when an open street allows turning cars to enter the area; this ensures that cyclists and drivers are both more aware and give the route adequate attention;
- Cyclists prefer to have parking only on the left side of the cycling area, as found during a recent Bicycle Account;
- Such areas should be marked with signage or painted bicycle symbols in order to remind cars of the presence of bicyclists;
- Blue marked crossings can help cyclists follow difficult routes as well as indicate to cars when they are passing over a bicycle area. This is particularly important when right-turning vehicles are entering an open street, especially when the cycle lane shifts from its traditional place next to the sidewalk.



Typical plan and section of a Type G street. Parallel parking is typically provided adjacent to the foot path and diagonal parking is found nearest the median. When right-turning traffic enters, it usually takes the place of parallel parked cars along the sidewalk, with a break in the median where they are allowed to enter.



Along Nørre Voldgade, near Ørsteds Parken, there is an open street with both diagonal and parallel parking. Niels Jensen stated that this area would be redesigned so that the parallel parking was removed and replaced with a cycle track in order to increase cyclist comfort.



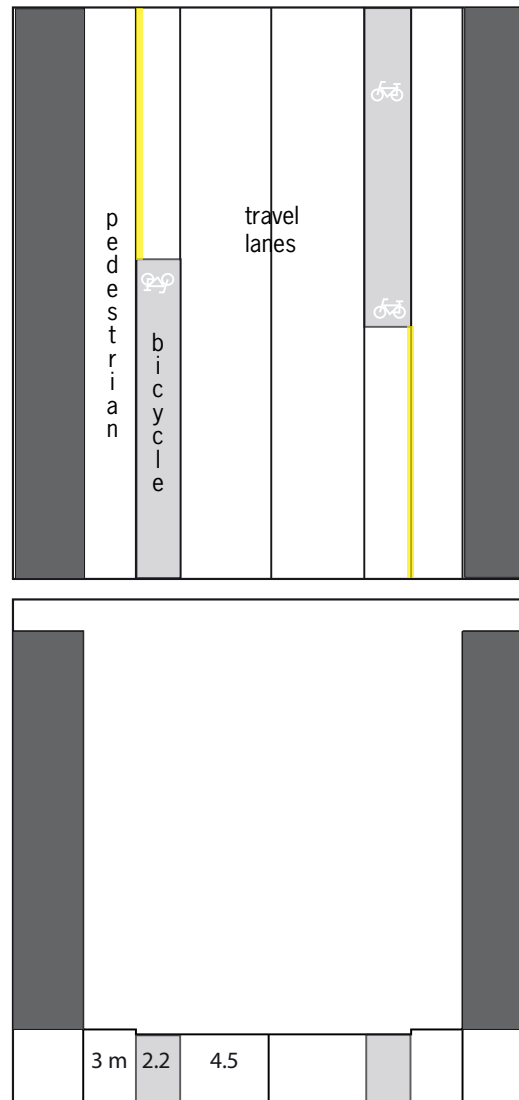
At Vesterbrogade at Axeltorv (Across from Tivoli Gardens), the open street allows right-turning traffic to enter from the main roadway and bikes must weave around to get back to their painted lane.

# typology of streets in the inner city

## Type H

Bus priority streets or street segments:

- Conflict between bicyclists and busses occur on all streets in Copenhagen, but particularly along streets with mixed traffic or streets that have been designed to prioritize busses;
- For instance, bus stops may occur too close to junctions. It is recommended that bus stops not be within 20 meters of an intersection, as it reduces the visibility of cyclists;
- In addition, bus signals have been installed that give busses a head start at the intersection. In such places, bicyclists do not necessarily understand that busses have priority over bicycles and try to go with the bus light;
- Some streets with cycle lanes have removed the lane for some distance in order to allow busses to pull directly up to the sidewalk. However, this forces cyclists to decide whether to wait for the bus to merge back into traffic or to weave into traffic and back to the designated cycle lane;
- Finally, bus priority projects have changed the design of intersections along such streets to prioritize motorist flow over cyclists. Along Store Kongensgade, the design has been altered from giving bicycles a lane up with the intersection with a withdrawn stop line for cars to a design featuring a shared right-turn and bicycle area that causes many conflicts for cyclists going straight through the junction.



Typical plan and section of a Type H street. The bus loading area can be up to a full block in length along some streets in Copenhagen.



At Nørre Farimagsgade right after the junction with Ahlefeldtsgade, the cycle lane doesn't start until after the bus stop (marked in yellow). When a bus comes, the rules of the road are unclear - do cyclists wait for busses or go into traffic and then back to their lane?

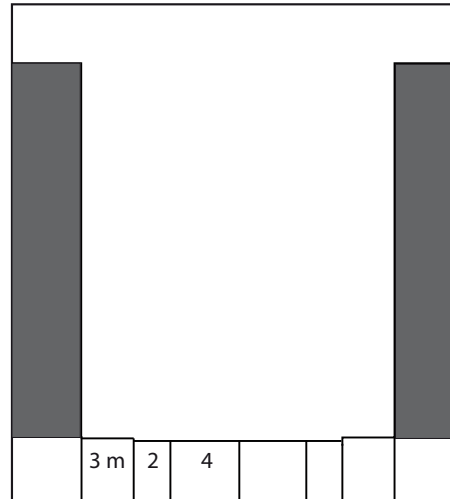
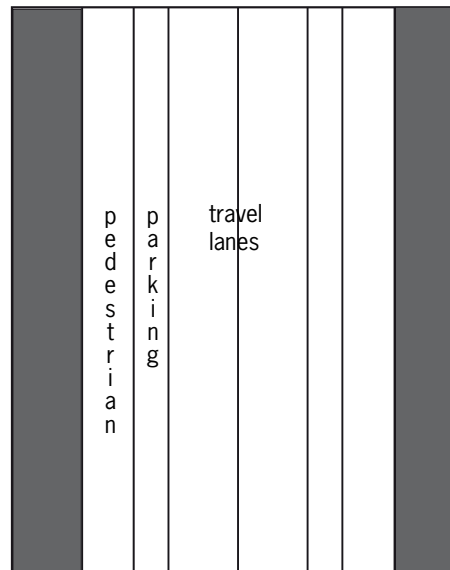


Stormgade is a bus priority street which lacks adequate attention to cyclists.

## Type I

Mixed street without traffic calming elements but with high speeds and/or high traffic volumes:

- In Denmark, nearly half of all cyclist deaths and injuries occur in mixed traffic. The behavior of moving traffic and parked cars is particularly important with regard to cyclists' sense of security and actual safety;
- When parking is allowed in mixed traffic, speeds must be low in order to maintain safety for cyclists. Speeds along streets with parallel parking should be 30 kph, and in places with diagonal parking speeds should be between 10-20 kph. If parking is prohibited, accidents can be reduced by 20-25% even though doing so often corresponds with an increase in car traveling speeds (Jensen, 2000);
- Mixed streets feel particularly uncomfortable when the traffic volume is high or fast. In addition, areas with a high parking turnover or frequent bus stops can be difficult for cyclists;
- Traveling along busy mixed streets is especially uncomfortable for slower-traveling cyclists, such as the elderly, or children.



Typical plan and section of a Type I street. A bus lane may be incorporated rather than on-street parking.



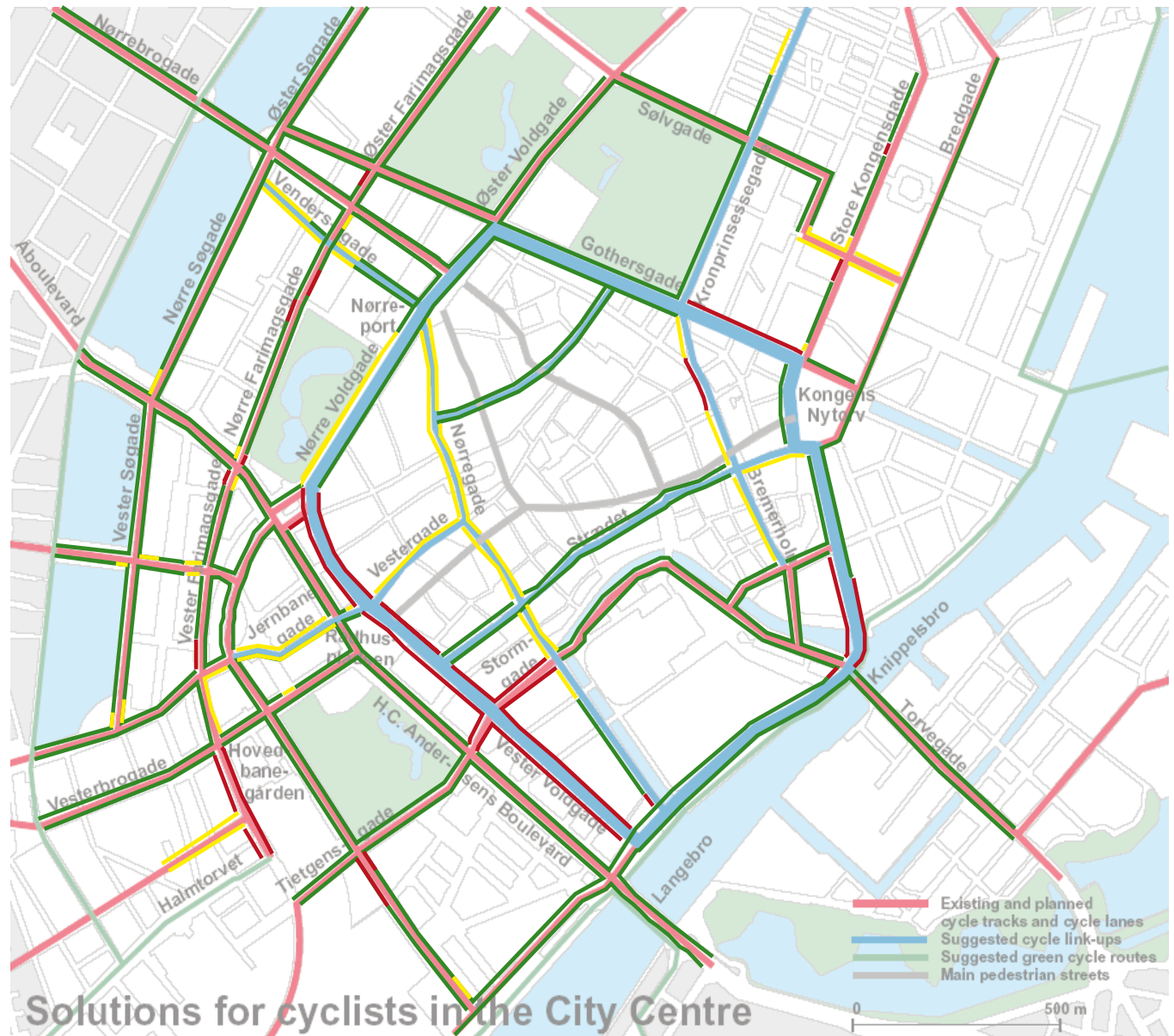
Along the Bremerholm route nearing Strøget, bicycles and cars mix together, which is uncomfortable due to a high volume of cars and busses. The critical mass of cyclists who use the route do add to the cyclists' sense of security.



However, even on the worst streets, such as Stormgade, a critical mass of cyclists can make cycling feel much safer. In addition, some mixed streets have a dedicated bus lane that bicyclists can use, which can be more comfortable except when busses wish to pass.

# typology of intersections in the inner city

Type	Intersection Characteristic
A	Track to intersection with an advanced stop or bicycle light and a marked crossing
B	Track to intersection with an advanced stop/light (straight-forward route with few right-turning cars) OR a marked crossing (confusing route or many right-turning cars)
C	Truncated track or lane with a narrow painted lane up to the intersection and an advanced stop/light and a marked crossing
D	Truncated track with painted lane to intersection and an advanced stop/light (straight-forward route with few right-turning cars) OR a marked crossing (confusing route or many right-turning cars)
E	Cycle track to the intersection
F	Truncated track or lane with narrow painted lane to intersection
G	Slip lanes that require bicycles to merge with traffic in order to go straight ahead before intersection
H	Truncated track or lane







When Øresundvej, a mixed street, meets the major junction with Amagerbrogade, it has a short cycle lane.

The design of intersections is a very important component of Copenhagen's bicycle network. There are a variety of elements that can be incorporated depending upon if a cycle track or lane continues up to the junction or if it is a shared area for cyclists and turning traffic. The following typology is for signalized intersections, so here I will provide some information regarding priority intersections and T-junctions.

#### Priority Intersections

- Parking should not be allowed close to junctions, as it reduces the visibility of bicycles to turning, entering, and exiting traffic from side streets. Cyclists should be visible to traffic at least 20 meters before the intersection;
- A continuous cycle track is a good option where there is moderate traffic volumes, as calms traffic since drivers must go over both the pedestrian crossing and the cycle track;

- An interrupted cycle track is best at busy junctions, but turning cars will turn at greater speeds. Since cyclists are on the same level as cars, they will have a greater awareness, but a crossing across the junction can remind turning motorists to look out for cyclists;
- A recessed cycle track is raised from the road and removed from the main roadway approximately 5 to 7 meters. This gives a place for cars to wait to pull out from a side road without obstructing the flow of traffic. It also makes it easier for motorists to evaluate conflicts with bicycles separately;
- Cycle lanes should continue with a broken line through junctions with side roads. A profiled strip should be used along the lane before the junction to reduce the potential for side-to-side conflict with cars and bicycles on the main street. When the pedestrian crossing continues across the intersection, it will have an additional traffic calming effect;
- In mixed traffic, junctions should be designed with speed reducing measures such as continuing the pedestrian sidewalk across the side road. Corner radii should be short as well.
- Where mixed entry roads carry a high volume of cyclists, it can be effective to add a short lane for cyclists at the last 20-50 meters before the intersection with a main street in order to make sure cars leave room for cyclists, and because it makes a marked crossing across the junction possible (Jensen, 2000).



H.C. Andersens Boulevard features a separate area for turning cyclists, making it easy to cross this main street.

#### T-Junctions

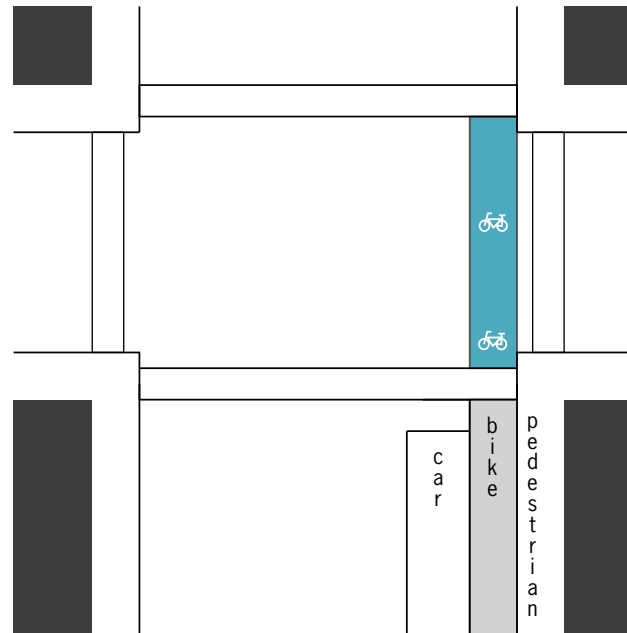
- Bypassing traffic signals can speed up cyclists' commute time by allowing them to travel through signalized T-junctions where a track continues through the intersection so long as they yield for pedestrians;
- Channelizing cyclists at T-junctions by providing a left-turn lane for cyclists who are waiting to cross the junction can add to cyclist comfort since they have a designated space to wait without blocking straight-going cyclists. Right-turn lanes can also be established so that bicyclists do not have to wait unnecessarily at the junction for a green light;
- An adequate amount of space must be given for cyclists to wait at channelized junctions, this will depend upon bicycle volume;
- Pedestrian islands can be beneficial to designs in such cases, because they give pedestrians a place to stand. This ensures that they do not disrupt bicycle flow unnecessarily.

# typology of intersections in the inner city

## Type A

Type A has a track to the intersection with an advanced stop or bicycle light and a blue marked crossing:

- Cyclists have the most sense of security, since they have their own space up to the intersection, but there are also measures taken to increase the awareness of vehicles to the bicyclists' presence;
- A profiled strip approximately 8-10 mm in height can enhance safety by moving cars and cyclists closer together (Dijkstra et al, 1998);
- The blue marked crossings have the best effect on safety and are important at complex intersections or junctions with a high accident risk for bicyclists;
- White marked crossings with broken lines 50 cm long by 30 cm wide offer minimal safety advantages;
- A cycle light, which turns green six seconds before the light for cars, prioritizes bicycles and increases their visibility. They only work where cycle tracks continue to the junction and will reduce the intersection's vehicular capacity;
- A less expensive option is to recess car stop lines 5 meters from the pedestrian crossing, giving cyclists the same head start as they would get with a pre-green bicycle light;
- Channelizing right-turning and straight-on cyclists along busy cycling routes is essential, especially where the traffic signal features a right-turn cycle. It is important to also provide a separate right-turn bicycle light.



Typical plan of a Type A intersection. This example includes a bike light instead of an advanced stop line.



Along Dronning Louises Bro, a bicycle light and 1.5 meter lane is provided for both straight and right-turning cyclists.



Another mechanism to improve safety where bicycle tracks continue to the intersection is to create a profiled strip, here at Bredgade and Sankt Annæ Plads, which narrows the cycle track to approximately 1.3 meters, depending upon the volume of bicycles who use the route (above). Narrowing the cycle track at the intersection brings bicyclists and cars closer together, thus raising their mutual awareness. The width of the marked crossing should be the same as the width of the cycle track opposite the intersection. Profiled strips have been shown to reduce the amount of vehicles who turn in front of cyclists, from 12 to 26% before they were introduced to 3-6% afterwards.

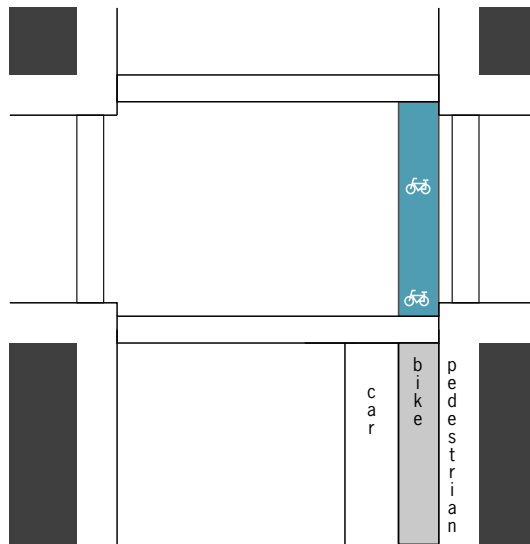
## Type B

At intersections with a high volume of right-turning or left-turning traffic and/or a confusing route, a track to the intersection with a blue marked crossing is ideal:

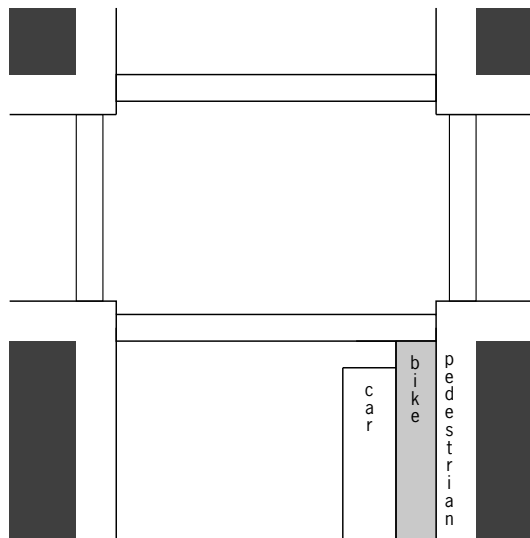
- At wide junctions with many traffic lanes, particularly when there is a high volume of left-turning vehicles, a marked crossing is an important component to ensure cyclist safety and sense of security;
- The blue marked crossing should be used at major intersections since they have been found substantially safer than white marked crossings;
- Marking crossings across junctions can be a way to show bicycles their path when it does not follow the traditional system.

At intersections with a low volume of right-turning traffic or a straight-forward route, a track with an advanced stop or bicycle light is ideal:

- At typical intersections along major streets, where there is less concern about cars turning, an advanced stop line or bicycle light is adequate;
- Staggered stop lines makes cyclists more visible to vehicles, especially large trucks. It also allows bicyclists to have a head start across the junction. The area between the recessed car stop line and the bicycle stop line can also be used for bicycles to wait, making it possible for many cyclists to enter the junction before the cars.



Plan of Type B intersection with no advanced stop but with a blue marked crossing.



Plan of Type B intersection with an advanced stop line but no marked crossing



The intersection of Vindebrogade at Holmens Bro is an example of a track to the intersection with an advanced stop but no marked crossing. The stop line for cars has been withdrawn five meters from the pedestrian crossing, which adds to the intersection safety both by making drivers more aware of bicyclists and by giving bicyclists a head start across the intersection.



Along Torvegade near the Christianshavn Metro, an advance stop reduces conflicts with right-turning cars.

# typology of intersections in the inner city

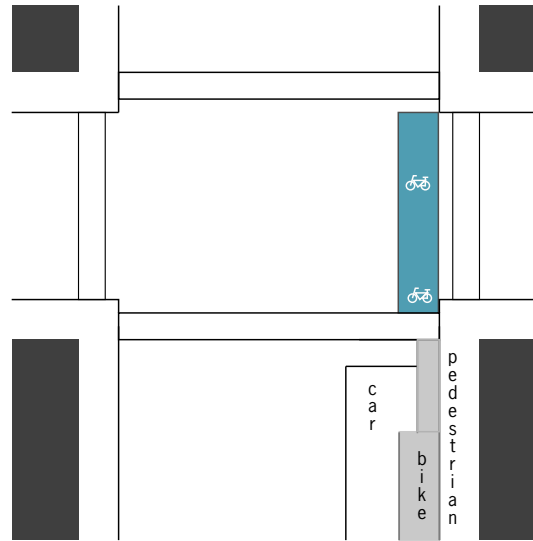
## Type C

Truncated track or lane with a narrow painted lane up to the intersection and an advanced stop/bicycle light and a blue marked crossing:

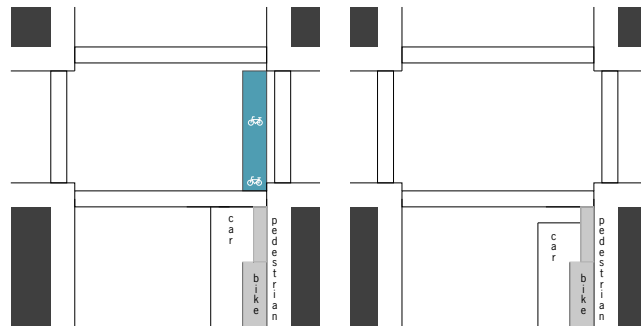
- The white lane should be 1.1 to 1.7 meters wide and have a profiled marking in order to separate cars and cyclists;
- The design balances safety (increasing the alertness of cyclists and cars by reducing the distance between them and placing them on the same level) and security (giving cyclists their own space);
- Narrow lanes reduce the number of cyclists who merge with cars and can make it easier for cyclists to move into the intersection before cars, instead of getting held up behind cars waiting for pedestrians at crossings, which happens in traditional truncated track intersections (Dijkstra et al, 1998);
- A marked crossing, advanced stop, or bicycle light add safety at busy junctions where many cars are turning.



Tietgensgade and H.C. Andersens Boulevard is an example of a truncated track with a narrow painted lane to the intersection with an advanced stop and blue crossing.



An example of a Type C intersection, where the narrow lane continues after the truncated track for the approximately 20-30 meters to the intersection.



A Type D intersection would either omit the advanced stop (left) or the blue marked crossing (right).

## Type D

At intersections with a high volume of right- or left-turning traffic and/or a confusing route, a truncated track with a painted lane to the intersection and a blue marked crossing is ideal:

- A blue marked crossing is the most effective to ensure adequate cyclist safety, especially at large intersections with high volumes of turning traffic.

At intersections with a low volume of right- or left-turning traffic and a straight-forward route, a truncated track with a painted lane to the intersection and an advanced stop or bicycle light is ideal:

- Studies have shown that this design leads to fewer motorists turning in front of straight-on cyclists and an increased alertness of cyclists (Jensen, 2000).
- Lanes that are too narrow cause capacity problems where there is a high volume of bicycle traffic, which might be alleviated with the advanced stop. The space between the cycle stop line and the car stop line could also be a bicycle waiting area.



At Ved Vesterport and Bernstorffsgade, a blue marked crossing directs bicyclists across a confusing intersection.

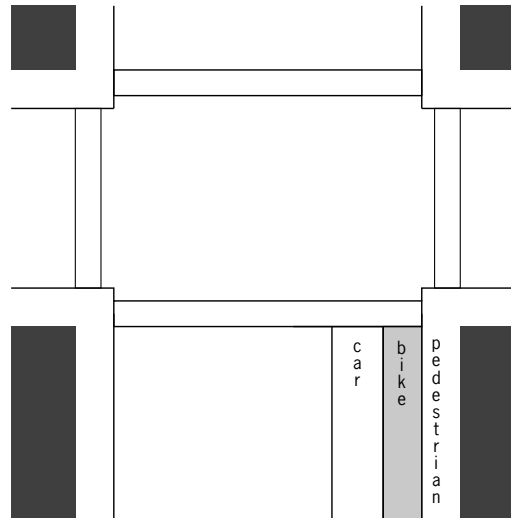
## Type E

Cycle track to the intersection with no advanced stop, bicycle light, or marked crossing:

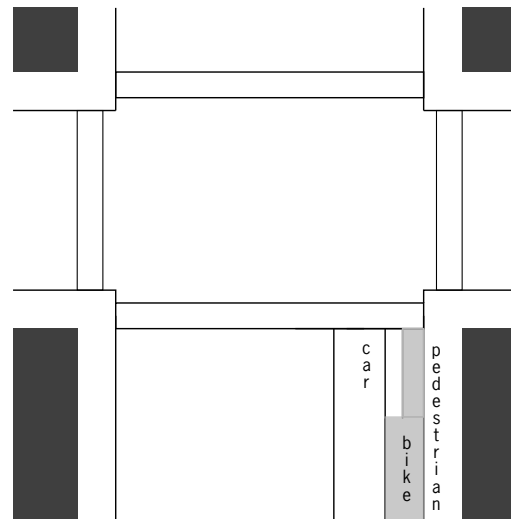
- This situation is adequate where there is a very low volume of turning traffic or where right-turns are not allowed;
- Conditions must ensure that turning traffic does so at slow speeds;
- Cyclists will feel secure with the intersection condition, but will not be as aware of the presence of car traffic.



At the intersection of Bernstorffsgade and Ved Vesterport, the cycle track continues up to the pedestrian crossing with no bicycle-priority elements.



A Type E intersection, an interrupted cycle track with no elements to prioritize the bicycle.



Type F intersection, with a painted lane to the pedestrian crossing.

## Type F

Truncated track or lane with a narrow painted lane to the intersection:

- A painted lane to the junction offers a substantial benefit for cyclists, since they know that they have a place at the junction and will not have to merge with traffic directly;
- In addition, the safety is increased because cycles and cars are on the same level, making both more aware;
- At low volume junctions or junctions with few cars turning right, no additional bicycle priority elements may be necessary.



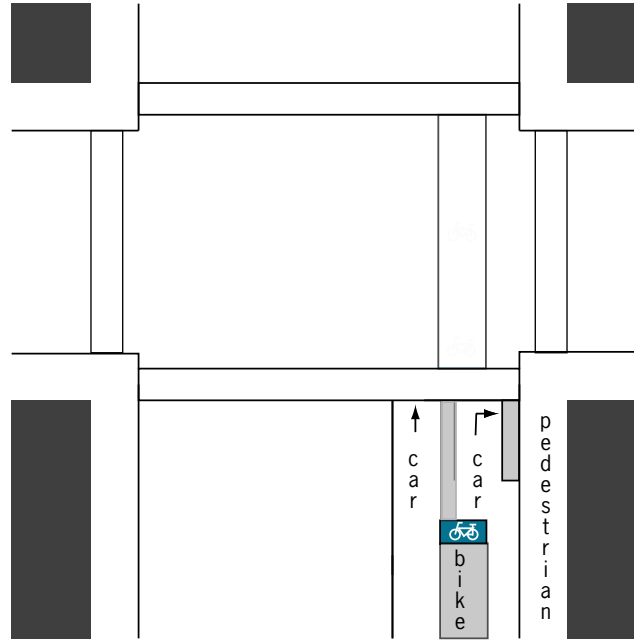
Along Nørrebrogade, near the junction with Elmegade, the cycle track transitions into a painted lane up to the intersection. Note that cars are not permitted to turn right at this intersection.

# typology of intersections in the inner city

## Type G

Slip lanes that require bicycles to merge with traffic in order to go straight ahead before the intersection:

- This design might be adequate where most cyclists are turning right and few are traveling straight ahead;
- Markings can include a blue lane or two white lanes, both should incorporate bicycle symbols at regular intervals;
- Dimensions for the right-turn lane should be 3.25 meters and the straight cycle lane should be 2.25 m;
- The design is experimental, based on the presumption that the conflict between cars turning right and bicycles heading straight is less dangerous before the junction itself;
- Another presumed benefit is that straight-going cyclists will be more visible with this design to cars turning left;
- Slip lanes are meant to be used at intersections with a high volume of right-turning traffic (Jensen, 2000);
- Studies have been inconclusive in showing that the slip lane design is safer (Dijkstra et al, 1998);
- This may be seen as an erosion in the priority of cyclists in Copenhagen while adding capacity for cars in junctions.



A typical example of a Type G intersection. In this situation, cyclists going straight must be aware of cars turning right, as they weave to a right-turn lane before the actual junction. This example also incorporates a narrow painted right-turn lane for turning cyclists. In addition, a blue marked crossing gives cyclists greater visibility. This design is thought to increase the visibility of straight-going cyclists to left-turning vehicles.



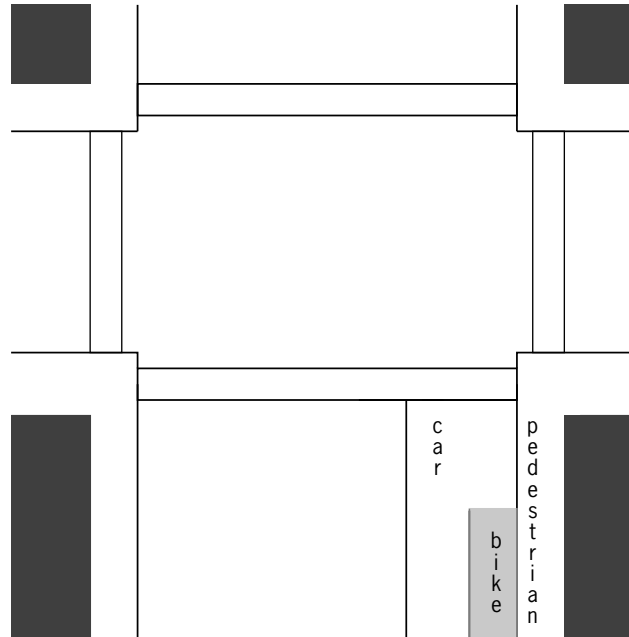
At Kampmannsgade and Vester Søgade, cyclists traveling straight must watch for merging right-hand traffic even before the intersection. This is thought to be a safer condition for cyclists, as they merge with traffic prior to the junction and will be more visible to cars turning left.



At Nørre Søgade and Gyldenløvesgade, the cycle slip lane is signaled with bicycle lights, but still requires straight-going cyclists to maneuver through two sets of lights to get back to their route.

## Type H

- Truncated track or lane with no painted cycle lane up to the intersection;
- Shared right-turn and bicycle lanes can be effective when cyclists are traveling at high speeds, however, they are uncomfortable for some cyclists, including children;
- Where to truncate the track or lane will depend upon the volume of right-turning traffic, but it is typically between 20 to 30 meters before the junction;
- A shared right-turn and bicycle lane should be at least 4 meters wide;
- If this design is the only option that will give space for a right-turn lane, it is thought to be safer than not having a right-turn lane;
- Entries or exits onto the road must be prohibited between the truncated area and the intersection (Jensen, 2000). This should include bus stops located too close to a junction;
- Truncated tracks or lanes make it difficult for straight-going bicyclists, especially where there is a large volume of right-turning traffic, as they must choose between safety and time by deciding whether to wait for right-turning vehicles or to go into traffic in order to cross the junction.



A typical example of a Type H intersection. Junctions of this nature feature a truncated bicycle track or lane that transitions into a lane for right-turning vehicles and bicyclists going straight or turning right. During times of the day when there are many bicyclists out on the roadway, these junctions can work adequately for cyclists, as they will typically be able to be ahead of right-turning cars. However, when there are cars turning right in front of waiting cyclists, many bicyclists will either be forced to wait impatiently for the car to be able to turn (after pedestrians have crossed), or they have to weave into traffic to be able to go straight.



At Gothersgade and Store Kongensgade, a bus priority project has changed the design from an advanced cycle stop and a lane up to the intersection to a shared design. Remnants of a blue-marked crossing are visible.



at Prinsessegade and Torvegade, a truck turning right comes in front of a straight-going bicyclist, forcing her to wait although she should have the right-of-way

## case: holmens kanal



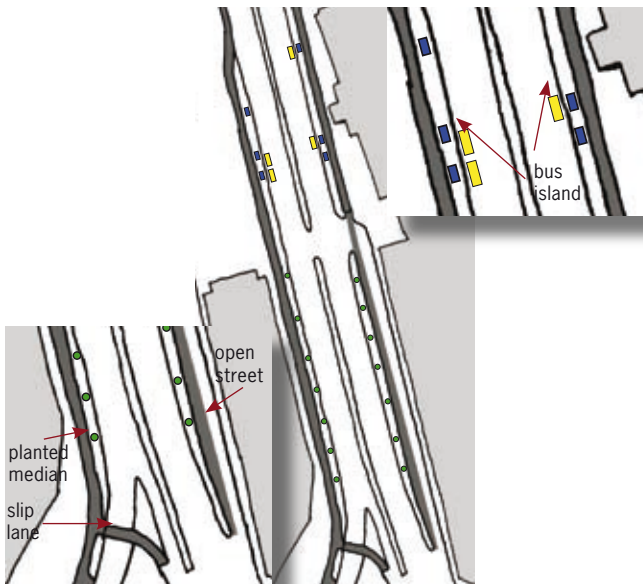
Context Map with Holmens Kanal in red (above) and overview image with the cycle tracks on the far right and left, just past the bus islands and shelters (right).



downtown arterial and transit hub with bus island

Holmens Kanal is a busy street. It is an important component in the second ring around Copenhagen, linked with Store Kongensgade, Bredgade, and Christians Brygge. At Kongens Nytorv, there is also a bus hub and Metro station. In addition, there are many pedestrians who use the area, enjoying the culmination of Strøget at Kongens Nytorv and continuing on towards Nyhavn. With all of this activity, one might think that bicycle flow would be difficult, but it runs smoothly because of an excellent design. The key to this street's success is the bus islands, which are wide enough to accommodate many people waiting for the bus, even incorporating bus shelters and seating. This means that bicyclists have the right-of-way over bus patrons, and do not

have to worry about being slowed by pedestrians crossing over the cycle tracks. While many areas with bus islands in Copenhagen feature designs that leave too little room for people to maneuver comfortably getting on and off of the bus without taking up some space on the cycle tracks, the design at Holmens Kanal also works well for bus patrons. After the bus stop zone, the median transitions to an area with planted street trees, which enhances the pedestrian and bicyclist experience. Even though the sidewalks along Holmens Kanal are relatively narrow in places, the median alleviates the typical congestion found at bus stops, where many people wait for the bus on the sidewalk and obstruct pedestrian flow.



The plan of Holmens Kanal, with the Metro square on the left. The dark grey represents the area of the street for bicycles. The blue and yellow rectangles represent the busses and bus shelters.

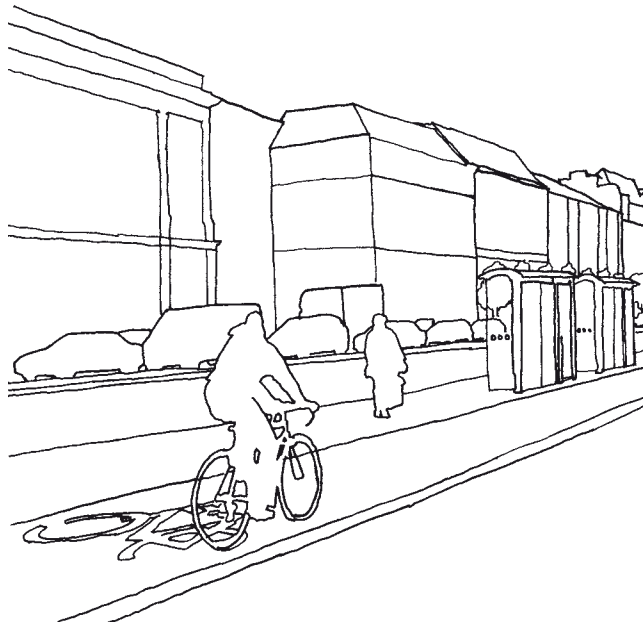




At busy bus hubs like Holmens Kanal, bus islands improve bicyclist traveling speeds, since cyclists no longer have to yield to bus patrons.



The bus islands along Holmens Kanal are 3 meters, which provides enough space for entering and exiting patrons to comfortably pass between the sidewalk and the waiting zone. At junctions, the bus islands transition into pedestrian crossing medians. This makes it easier to cross the busy street, by making the area to cross less wide.



A cyclist makes his way past the Kongens Nytorv metro and bus hub without being slowed by public transit passengers. Pedestrians must yield the right-of-way to cyclists, waiting to cross to the bus median until there are no cyclists coming. This reduces the likelihood of cyclist and pedestrian collisions, since passengers getting off the bus cannot see coming cyclists, and some cyclists do not yield the right-of-way when busses unload directly onto the cycle track. The Holmens Kanal solution is one of the best examples of bus stop designs in Copenhagen.



On the right side of the street (facing Kongens Nytorv), Holmens Kanal begins with an open street from the intersection at Holbergsgade. This design does not have the same sense of security for cyclists, since they must be aware of cars coming and going, waiting for parking, or opening car doors. However, the space is wide enough to adequately accommodate both users.

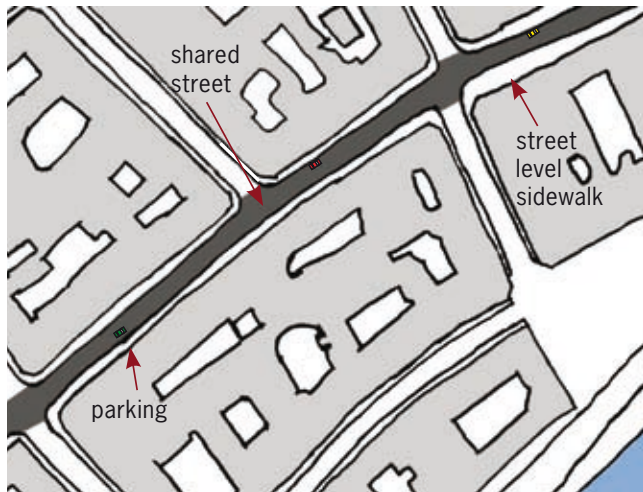


The left side of the street features a slip lane that allows bicyclists to go straight via a separate left turn lane with a bicycle light and then merge back into traffic. This area features a withdrawn stop line for cars to ensure bicyclists are visible, and when bicycles get across to the median, there is a blue cycle marking. Most cyclists traveling down Holmens Kanal turn right, thus avoiding the slip lane.

## case: strædet



Context map with Strædet in red (above) and overview image of the street section (right).



The plan of Strædet, with the shared area for bicycles, pedestrians, and cars in grey. The cross street on the left is Rådhustrædet, a section of the Nørrebro link through the inner city. The white area on the far right is the square along Gammel Strand, close to the canal.



### commercial shared street

A bicyclist along Strædet weaves through pedestrians and cars, enjoying the urban street scene. Strædet was the first designed shared street in Copenhagen, dating back to 1992. It is 8 to 11 meters wide and features buildings with a uniform setback and height of approximately 4 to 6 storeys (Dijkstra et al, 1998). The street is designed as a shared space along the streets of Kompagnistræde and Læderstræde. Along this stretch, the street is one level with granite and concrete pavers. The typical sidewalk paving, with cobblestones and concrete takes up its usual space and dimension, but does not have a curb to

differentiate it from the rest of the street section. Most people walk down the middle of the street. The shared street design permits one-way travel for cars, but bicycles can travel either way. Vehicles can not drive all the way through Strædet, since the direction of one-way traffic changes. Now the street is being transformed between Vester Voldgade and Hestemøllestræde and between Kongens Nytorv and Højbro Plads to allow two-way bicycle traffic via a contra flow lane. This will make Strædet an important cycle link, connecting the city east and west between Rådhuspladsen and Kongens Nytorv.



At the meeting of Strædet and Højbro Plads, the route ahead is shown with silver markings on the street.



Bicyclists encounter parked cars, slowly moving traffic, and crowds of pedestrians along the street (above). It is possible to weave around pedestrians, but most often the bicyclist must travel at slow speeds. With the presence of many sidewalk cafes and activity on the street, Strædet does not function as a street made for fast travel by bicycle, so it will not work perfectly for commuters in a hurry. However, the commuting peak hours may correspond with the hours that Strædet is less busy, as it will be most heavily used during the weekend. In the central heart of the city, it is best to prioritize pedestrians, so the decision not to build cycle tracks in the main pedestrian areas is not by accident, but rather by choice. Strædet is an important link for bicyclists, and the urban life available makes up for any time delays.



At intersections, cobblestone pavement reminds bicyclists, pedestrians, and vehicles that they have entered a conflict zone and should be attentive to crossing traffic.



However, bicyclists often park and block the path through, making it difficult to continue without dismounting your bicycle. This will need to be addressed when the contra flow lane is established from Kongens Nytorv in order to facilitate cyclist flow.

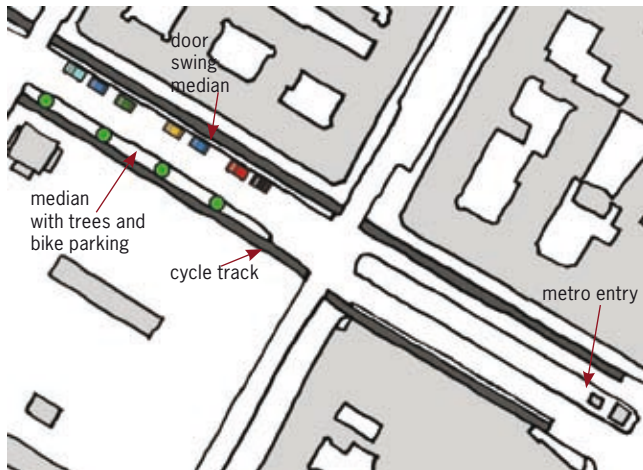


The use of bicycle parking near the junction acts as a traffic calming device by narrowing the usable roadway for cars. Car parking spaces are marked with white pavers so that drivers know where they are allowed.

## case: frederiksborggade



Context map with Frederiksborggade in red (above) and overview image, with the cycle tracks on the far right and left, just past the medians (right).



The plan of Frederiksborggade, with Israels Plads representing the white space at the bottom left. The Metro stop is found at the far right corner, within the street's median. The area for bicyclists is represented in dark grey. The medians function as spaces for trees, for street fixtures, or as car door swing areas, such as on the right side of the street.



downtown connector street with parking and planted median

Frederiksborggade is a street which connects Nørrebro with inner Copenhagen. It carries a high volume of bicycle traffic and a moderate level of vehicular traffic. The side streets feeding from Frederiksborggade are less busy, and priority junctions are handled by traffic calming techniques such as continuous pedestrian crossings. Frederiksborggade has many pedestrians, especially towards its southern end, where it meets Nørre Voldgade and the Metro and S-train stations. There

is also a daily market at Israels Plads (Square). To be a pedestrian on Frederiksborggade is a pleasant experience, as bicycle parking and other necessary street fixtures for cars such as signage and parking meters are placed along the median. In addition, the street trees provide a green setting. Bicyclists also receive a bit more room away from cars, and since the median is level with the bike lane, it is easier to pass other cyclists comfortably.



The median along Frederiksborggade is used as a space for parking meters, which is a convenient location for cars as they do not have to make their way across the bike path and back to pay for parking.



Closer to the Nørreport train station and metro stop, the median is used mainly for bicycle parking, which is an important use as the sidewalks are busy with pedestrians from a nearby grocery and square.



The bicycle tracks along Frederiksborggade are 2.2 meters, which feel quite comfortable to ride along even though they are heavily trafficked. This may have to do with the median, which is at the same height as the track itself, so it gives a passing cyclist more comfort and space to move around a slow cyclist. It is essential that cycle tracks have enough room so that people can pass each other easily. Above, a man takes his dog along for a bike ride, which is a typical scene in Copenhagen. Cycling in Copenhagen is just something that you do on a daily basis: to get groceries, to go to work, to visit a friend, or to “walk” your dog. It must be comfortable and convenient, or people will not do it. Streets with medians provide a good setting for bicycling and walking in Copenhagen, taking advantage of larger streets and using that space for people, not cars.



This bicyclist makes his way past the metro station, which lies in the middle of Frederiksborggade at the junction with Nørre Voldgade. A wide pedestrian crossing with bicycle symbols on each side remind both pedestrians and cyclists to respect each other's place on the road. A bicycle light stops cyclists during the crossing period for pedestrians.



A bus island overflows with people waiting, blocking the sidewalk. At busy bus stops, a wider median may be warranted. Here it is 1.5 meters.

## case: store kongensgade



Context map with Store Kongensgade in red (above) and overview image, with the cycle lane at the far left, transitioning near the white parked car into a shared car and bike lane (right).



The plan of Store Kongensgade, with Gothersgade at the bottom. The dark grey area represents the space for cyclists on the street. Cars can park on only one side.



one-way downtown street with a painted cycle lane

Store Kongensgade is a typical downtown street, outside of the historic center of Copenhagen. It features painted cycle lanes, one or two traffic lanes, and parking along one side of the street. The street has recently been redesigned as a bus priority street. Changes include intersections with a shared right-turn and bicycle lane with no cycle lane up to the pedestrian crossing; a removal of the blue marked crossing where Store Kongensgade meets Gothersgade at Kongens Nytorv; and in some areas,

the cycle lane has been removed altogether in order to facilitate bus loading and unloading. In these areas, the curb is marked in yellow and there are no cycle lanes. During field observations, it seems that busses either pull up to the curb or stay a distance from the curb at a bus stop. The decision not to pull up to the curb does not seem to be for bicyclists' sake, but rather to facilitate an easy return into moving traffic, as the bus can just keep moving after picking up passengers.



At a busy four-way junction at Fredericiagade, a blue marked crossing is used instead, which is more visible to motorists and can add to the safety of cyclists at the crossing.



T-junctions along Store Kongensgade are usually marked with a dashed white line along the entire length of the junction with the side road, as in the photo above at the junction with Landgreven.



Above, bicyclists leave the cycle lane to merge with right-turning traffic at a junction. Along Store Kongensgade, the cycle lanes are 1.8 meters, but the turn lanes can be only 2.5 meters wide, which can be too narrow and cars sometimes do not leave enough room for bicycles to head straight across the intersection.



Busses stop at the curb in order to make it easier for passengers to load and unload onto the sidewalk instead of lower onto the travel lane. This makes cyclists either have to wait until the busses merge back into traffic, or weave into moving traffic to get around the bus and back to their cycle lane.

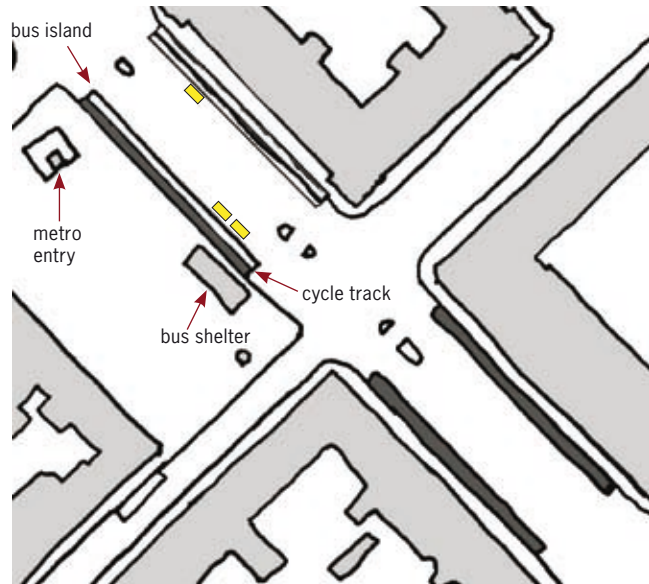


On Store Kongensgade, bus traffic is heavy, so it is a frequent occurrence for cyclists to encounter stopped busses at bus stops during their time down the road.

## case: torvegade



Context map with Torvegade in red (above) and overview image, with bike lanes on the far right and left, adjacent to the bus waiting islands (right).



The plan of Torvegade, with the dark grey area representing the space for cyclists. The metro is the white area on the left. The cross street through the middle is Dronningensgade.



neighborhood connector with downtown and transit hub

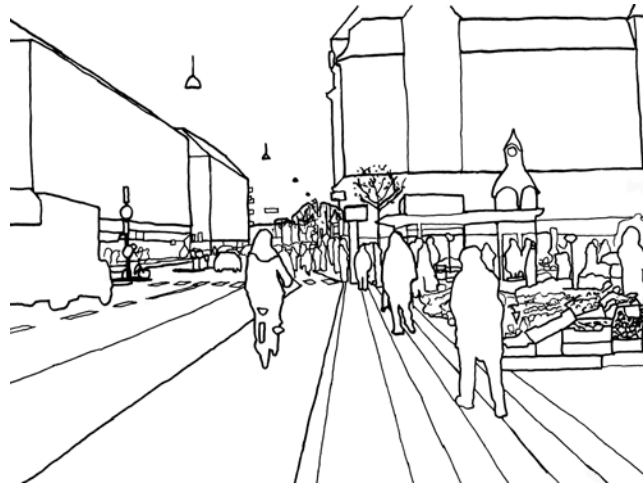
Torvegade is the main street that runs through Christianshavn, connecting Amager with inner Copenhagen. It is a busy street, both for vehicles and bicycles. Between Dronningensgade and Prinsessegade, the street features a bus hub, Metro station, and the central square of the district. Needless to say, the street is busy with movement: people shopping, walking, getting on and off busses, and so on. However, Torvegade functions without problems, due to a well-functioning street design. Bus stops feature long and narrow bus waiting islands, which ensure that cyclists do not get held up by passengers getting on and off busses.

The bus stops are 2 meters in width and level with the bicycle lane, which is also 2 meters along the street. Bicycles have their own lights at the busiest junctions. However, Torvegade does not work well at its junction with Prinsessegade, which is a busy side street. The Royal Danish Academy of Fine Arts, Christiania, and the new Opera House all lie past Torvegade along Prinsessegade, making this junction of key importance. At this junction, cyclists traveling toward the city's center on Torvegade have a cycle track with a bicycle light, but cyclists coming from Prinsessegade face a busy shared right-turn and bike lane.





A 2 meter bus median and bicycle track on Torvegade opposite the Metro station that takes up the entire length of the block, allows quite a few people to wait if they wish. In practice, most people choose to wait on the sidewalk.



A bicyclist makes her way through the Christianshavn metro and bus hub, able to maintain her speed because of separated bus medians for pedestrians to wait. Pedestrians also have an advantage with this design, since more bus patrons will wait along the median, reducing sidewalk congestion. However, in Torvegade, the median is quite narrow, meaning most people still wait on the sidewalk until their bus comes. This is less of a problem on the side of the street that features the public square, where there is a bus shelter and additional space for people to wait. Unfortunately, bicyclists still often get stopped by people who choose to wait on the sidewalk, who will walk in front of cyclists when crossing the cycle track to enter the bus. This is a dangerous condition, since cyclists actually should not have to stop, and are in the mind set of not stopping. A wider median might resolve some of these issues.



At Torvegade and Prinsessegade, the junction features bicycle light that has separate straight and right-turn functions. Since the track does not feature separate lanes for cyclists, right-turning cyclists either wait for straight-on cyclists to go, weave into traffic, or bike on the sidewalk.

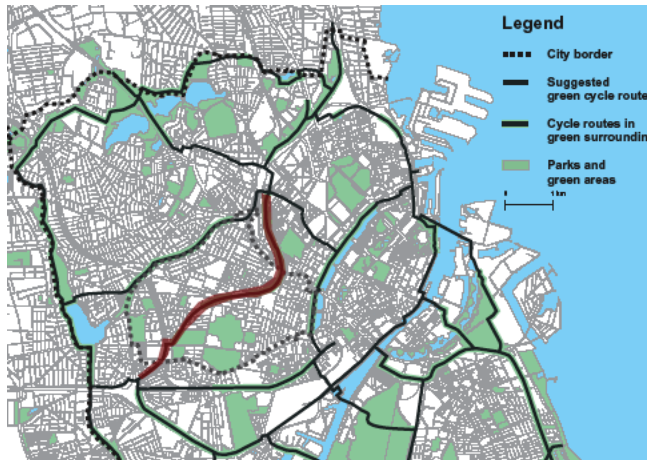


The bus median along the Metro side of Torvegade is also 2 meters. There is a bus shelter in the square.

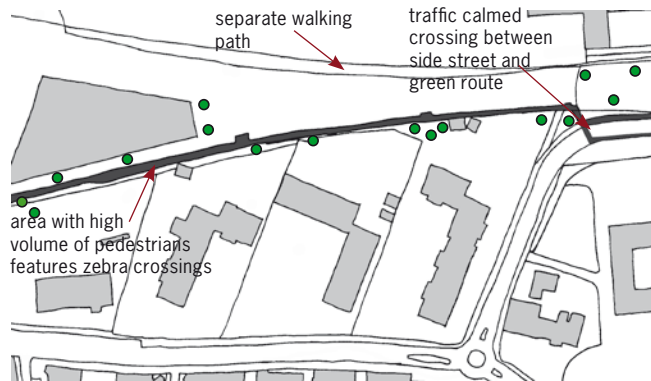


At Prinsessegade and Torvegade, a right-turning cyclist is pushed onto the sidewalk. Next to the green car, one observes a cyclist merging with traffic. Cyclists going straight-on or turning left indirectly must go out into traffic, as the volume of right-turning cars makes it feel unsafe to go straight from the usual location on the right side of the right-turn lane.

## case: nørrebro green route



Context map with the Nørrebro route in red (above) and overview image (right).



As the Nørrebro green route passes Frederiksberg's Solberg Square and metro station, the bicycle path features an area with bicycle lanes differentiated from the area for cars with green lights (far right). Then the two-way bicycle path becomes separated from both cars and pedestrians until it reaches the building on the top left. At this point, the path incorporates two-way bicycle traffic, separated by green lights, and an adjacent pedestrian pathway.



green route for recreation and commuting

The Nørrebro green route follows an old railway line that falls in both Copenhagen and Frederiksberg, an independent city surrounded by Copenhagen on all sides. The route will be a total of nine kilometers, connecting Valby north into Nørrebro. Much of the route is already completed, and the route will be finished in 2007. The route goes through green areas of the cities wherever possible, but also remains close to many shopping streets, where a cyclist can connect with the existing cycle track network. In Frederiksberg, the route runs through the city's center, where the Metro station, library, college, and

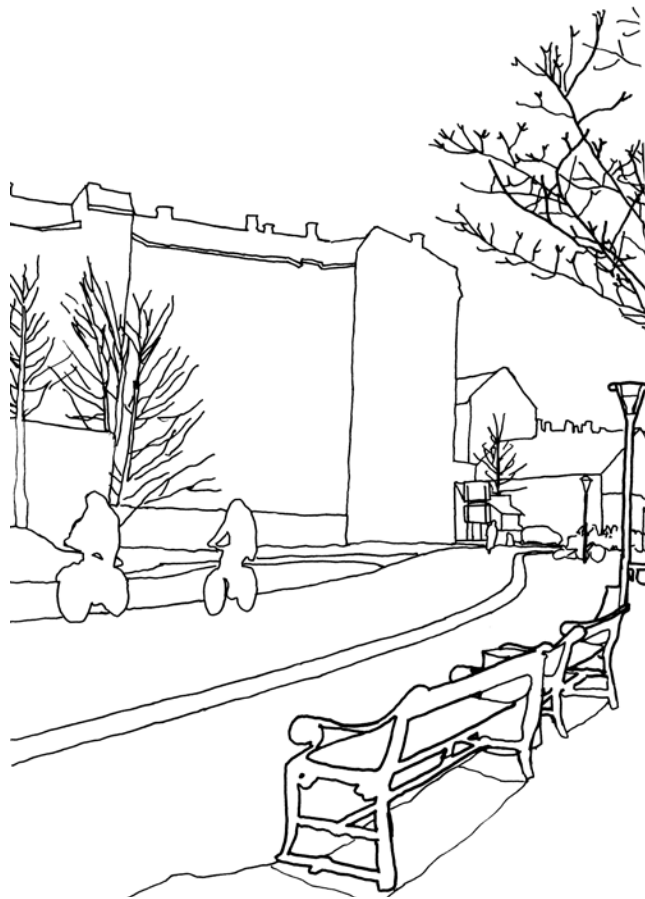
shopping center are all located. The typical design incorporates separate bicycle and walking paths, with a two-way bicycle path that has lanes separated by a painted white broken line or green lights at Frederiksberg's Solberg Square. The width for the two lanes is 3.7 meters. The walking path surface is usually a brown or black gravel, and is typically 2 meters wide. Along the route, there are areas with places to sit, human-scaled light fixtures, and the route adjoins many small parks or squares which adds to the life along the route but also function as destinations for recreational cyclists.



Where the Nørrebro route meets major roads, the junction is usually signaled, like this one above at Nørrebrogade. Road signs, painting, and rumble strips give cyclists a heads up about the approaching intersection as well.



Where the green route nears the Frederiksberg Metro station, it passes a low volume street, and cyclists along the route yield to oncoming traffic. The roadway also features traffic humps in order to slow down vehicles.



A couple cycles together along the Nørrebro green route, just past Nørrebrogade and Aksel Larsens Plads. Here, the green route features a path for two-way bicycle flow separated by a white painted line, and an adjacent walking path. It also features benches along the way for cyclists and pedestrians to stop and enjoy the green surroundings.



The problem of good bicycle planning with less focus on pedestrians is evident in the above photo taken near the current end of the route in Frederiksberg, at Rolighedsvej. While many of the footpaths along the green route are nice to walk along, some areas have received little work.



A bridge is currently being constructed which will go over Ågade, a busy main street that connects with H.C. Andersens Boulevard.

## conclusions: learning from copenhagen

What's it going to take to make you think you're equal?  
David Smith, quoted in Bock, 2006



A woman on a three-wheeled bicycle has greater mobility to do her daily tasks than if she had to depend upon the bus or walking only. These bicycles makes it easier for elderly residents of Copenhagen to cycle.



A woman and man ride together across the intersection at Gothersgade and Store Kongensgade.

### remember transport quality

If a city wishes to increase the amount of trips by bicycle, it must be able to be an enjoyable experience. Transportation quality is multi-faceted. Things that matter include the quality of the path surface, are there potholes or dips that cyclists must watch out for, which will distract them from the surrounding environment? On busy routes, is the path wide enough to allow cycles to pass one another? Is it easy, secure, and comfortable to get from one

destination in the city to another? Is the network coherent, consistent, and safe? Can two friends or a family ride side-by-side without slowing down cycle flow? There is little that a city can do to change the topography or climate of their region, but if there is anything to learn from Copenhagen, it is that people will still cycle in many conditions. However, planners must seriously consider and create excellent physical and social conditions on the cycle network in order for cycling to be a competitive mode.



An advanced stop where cycles can wait between the car stop line and the pedestrian crossing.

### prioritize the bicycle

Obviously, the car has many advantages over a bicycle. It is comfortable: insulated from the weather, as well as from social contact. In order for bicycling to be competitive, it must have significant advantages over the private automobile. The bicycle does have advantages over walking or public transport, since it is much easier to go long distances than walking and it is an individual means of transportation, not having to rely on bus drivers, time tables, and routes to get from one place to another.



Along Christians Brygge, this car is reminded to look out for passing cyclists by the blue painted cycle track. Traffic calming along side roads is essential to cycling safety.

Ways to prioritize the bicycle include physical improvements, such as creating contra-flow lanes for two-way cycle travel on one way streets or providing an advanced stop at intersections to give cycles a faster start across junctions. A new concept that Copenhagen will try out is an advanced stop for cyclists that allows cycles to take up the entire width of the street between the pedestrian crossing and the withdrawn car stop line. In Odense, major commuter routes feature signalized lights at intersections that are timed according to bicycle flow, not vehicular movement. It may just be providing space for cycles on the street and thereby getting rid of car parking, a travel lane, or reducing the travel speed for vehicles.

In Copenhagen during the 1960s, car parking lots became public squares, resulting in the beautiful and well-utilized central city that it has today. Now there is pull to remove the rest of the on-street parking in the center city and create underground or above ground parking garages instead. The idea is that this space can then be used for pedestrians and bicyclists, who should be the ones with the greatest access to the heart of the city.

Other mechanisms include tax reductions for cyclists or encouraging workplaces to provide adequate cycle facilities such as racks and shower rooms. In Odense, you can get bicycle routes sent to your cell phone or use an internet route planner. Still other ways may include planning dense, mixed-use city and neighborhood centers that can make it easy to get everything you need by bicycle.



On a warm day after school, two boys ride on one bicycle, thanks to a specially-designed bar on the rear wheel, which provides a place for a friend to stand and hitch a ride.

### focus on mobility for all

Copenhagen has a handle on this. Restrict cars within the inner city, but while you do so, also make it easier to get around via public transit or bicycle. This will end up with a system that is balanced and that supports all modes. Another way to encourage universal access to mobility is to provide a bicycle network that works for a diversity of users, including the elderly, families with children, and commuting adults. Green routes that link schools, parks, and residential areas may be invaluable for children and recreational bicycling, whereas an urban network that follows main streets will work best for commuters and adults out on daily errands.

## conclusions: learning from copenhagen



In areas without cycle tracks, a cyclist can be all too aware of how small he or she is compared with vehicles.

create a consistent network with an easy to understand design

In Copenhagen, it's not the fact that there are raised bicycle tracks separated from moving traffic that necessarily makes it such an effective system. I believe that it is more about creating an integrated network of routes, especially when there is a focus on key destinations such as shopping streets, residential neighborhoods, and workplaces in the central city. There must be work done to ensure that bicycle routes connect with one another, and it should ensure that there are not areas which are being overlooked. For instance, in Copenhagen, access from the Langebro and Knippelsbro bridges to the waterfront is quite difficult, making cyclists either connect via roads without cycle facilities or traverse the bridge stairways while carrying their bikes. The design does matter, as it should be the same and not become a messy, one experiment here, another experiment there, type of system. I am aware that there are many arguments over where the cycle lanes are best put, whether cycles



A woman carries her bicycle down the stairs at the Torvegade bridge, an area where an evaluation of bicyclist activity might merit a better solution.

should mix with traffic or be separated from cars. I do not wish to fight that battle here, but I will say that Copenhagen is a place where everyone bicycles: children, families, commuters, and the elderly. This is my first urban cycling experience, as I've never felt confident bicycling in a US city. I believe there may be some merit to placing the cyclists next to the pedestrians: perhaps cyclists will replace parked cars in providing pedestrians with some separation from moving traffic. This becomes even more effective on streets with medians, providing even

more separation from moving traffic and a place for necessary street fixtures that do not need to disrupt pedestrian movement. Whether or not to raise the bicycle paths with a track or leave them as painted lanes may not matter as much as the placement of the path next to the sidewalk. Another benefit is there are many more opening car doors on the drivers side, since there are so many more people driving cars alone. A passenger door opening out onto a bicycle path when a cyclist is passing will be a much less frequent hazard.



Along Stormgade, a street which lacks cycle facilities and a high volume of car and bus traffic, this cyclist must not feel secure with a bus on a tight time schedule behind him.

### promote links with public transit

In Copenhagen, satisfaction with links between public transit and bicycling has been steady at 50% for some time. Bicycles are allowed at certain times of the day on S-trains and the Metro, and efforts have been made to improve bicycle parking conditions at train stations. Other key elements for a better future of transit-bicycle linkages might include providing bicycle parking at major bus stops or putting bicycle racks on the front of busses, since busses connect many more destinations within the city than either

the Metro or trains. Another growing problem in Copenhagen is as busses have been losing out to cars with regard to traveling speeds, measures have been taken to prioritize busses along some streets and at intersections. Streets have been redesigned, sometimes at the expense of cyclist comfort. This trend must stop, or some cyclists, in particular children, will be less comfortable riding and cyclist diversity will be reduced.



Nørreport Station, near both an S-train and Metro hub features locked and sheltered bicycle parking. It also has bike racks for short-term cyclists to use.

be publicly accountable and evaluative The Bicycle Account, which began in 1995 in Copenhagen, was the first of its kind, as it tried to determine how the cycle network was working by asking the cyclists themselves. Funding priorities are based on the Bicycle Account, then evaluated two years later to see if the money has had a positive effect according to the daily cyclists of Copenhagen. The City finds that when it applies funding to specific problem areas, such as bicycle track maintenance, it shows in the Bicycle Account. Bicyclists appreciate and notice the City's efforts, particularly because they can influence where money is dedicated.

change behavior with campaigns Campaigns and education provide bicycle planners with essential, inexpensive tools which can bring new people to cycling. A focus on physical infrastructure and design will be less successful in terms of moving car drivers and others to the bicycle than a dual strategy that promotes cycling with campaigns and education in addition to providing a place for cycling along the roadway.

## conclusions: learning from copenhagen



A new pedestrian and cycle bridge opened in September of 2006. While this offers a good non-motorized connection with Islands Brygge and the inner city, the bridge concludes with a shopping mall on one side and the Silos project, which lacks any ground level activity, on the other.

plan for pedestrians, too

Copenhagen has an incredible network of bicycle facilities, many great pedestrian and shared streets, and interesting architecture that helps to activate the streets. However, some new developments have not been as successful in providing a good pedestrian environment on the ground. New developments should be required to provide active ground-floor facades and human-scaled detailing. Some of Copenhagen's bicycle network has been created by taking away space from the sidewalks, often leading to crowded shopping streets. Some of the planned green routes have caused tension between the bicycle planners and the larger Copenhagen community, since they might reduce the space



At Christians Brygge, just past the new Black Diamond library, the cycle path continues on but the sidewalk suddenly disappears without an easy way to cross the busy street.

pedestrians have at key recreational areas of the city. A pedestrian plan should be implemented in order to avoid sacrificing one non-motorized mode for the gain of another. It seems that things are

looking up within Copenhagen, the 2004 Traffic and the Environment Plan dedicated money for studies to help form a pedestrian plan.





A woman escorts her son by bicycle to a playground at a local square near Østerbrogade.

what does a bicycle city look like? Copenhagen does not struggle economically because it has reduced its dependence upon automobiles. It is a wealthy city, where families choose to live instead of the suburbs, where professionals are coming to live, where people are living even though their jobs are in suburbs of the region. People want to live in Copenhagen. Few complain about the restrictions on cars, because it is so easy to get around with a bicycle.

While strolling along Copenhagen's Harbor Park, I thought about Seattle's Viaduct debate. I wondered how the size of the park compared to the size of the highway. I wondered if Seattle would be able to come up with a solution to reconnect the city with the water's edge.

In Copenhagen, the water's edge is almost always a publicly accessible, celebrated place. Rob Adams, the Director of Design and Culture from Melbourne, Australia stated that eighty-percent of a city's open space is streets (Adams, 2006). As Adams convincingly states, "If you design good streets, you'll design a good city". Jane Jacobs put it simply, "Streets and their sidewalks, the main public places of a city, are its most vital organs" (Jacobs, 1961). Should it really be the case that most streets are predominately dedicated to the private automobile?

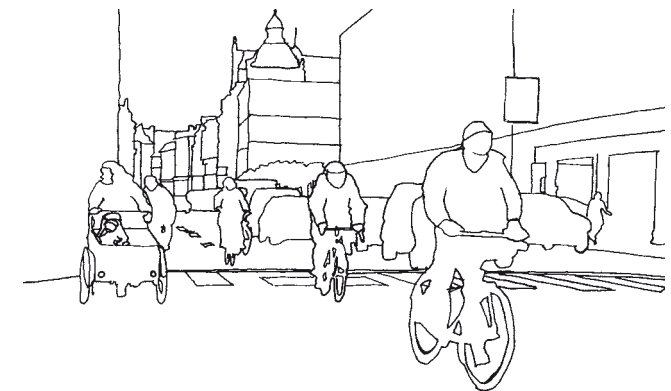
I think it is clear to most that times are necessitating changes in the way we live. There are many consequences to our current development patterns: global warming, the destruction of prime farm and forestland, the loss of endangered species, the social inadequacy of suburban living for those without cars, and the unlivable conditions of many central cities.

My hope is that the bicycle will play an important role in the revitalization of cities, in the creation of good places to live. My hope is that I don't worry about my son as he bicycles to school, that he has the independence I desired as a young adult to get to sports practice or band rehearsal. My hope is that I can work without a morning commute via a car. I



An outdoor cafe next to the neighborhood's community center can be found along Copenhagen's Harbor Park.

would like to not ever HAVE to drive anywhere. My hope is that cities can play an important role in the future of our world. As a planner, I'd like to think that I can do my part to "think globally, act locally". America, it's time to reconsider the bicycle as a viable, sustainable, and healthy mode of transport.



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On the first snowy day of the season, many Copenhageners still made their way by bicycle. This requires a certain amount of dedication, with temperatures below freezing. Most people seemed to still be out doing their typical errands.



Alyse Nelson currently attends the University of Washington in Seattle, where she will graduate in February of 2007 upon return to the United States. For the past five months, she has been studying at the Center for Public Space Research at the Royal Danish Academy of Fine Arts in Copenhagen, Denmark. Her husband, Jason, and son, Orien, have accompanied her during her Copenhagen stay. Alyse will receive a Master in Urban Design and Planning with an Urban Design certificate. She hopes to work in the public or private sector, helping to create cities that are sustainable and livable for families, including her own.

