Danish Centre for
Cycling Knowledge
CYKELVIDEN.DK

HANDBOOK OF SOLUTIONS

Traffic calming in Cities

Danish Centre for
Cycling Knowledge

CYKELVIDEN.DK

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Preface

The Danish Centre for Cycling Knowledge is a centre of excellence working to promote and raise awareness of cycling in Denmark, and globally. The primary audience for the Centre for Cycling Knowledge's publications, handbooks, webinars and newsletters are planners working on cycling infrastructure and promotion.

We hope this handbook of traffic calming solutions for cities will provide inspiration in Denmark, where municipalities in particular experience increasing demands to improve conditions for urban cycling and traffic calming. And while solutions may differ from country to country, we also hope this handbook will provide inspiration abroad. Globally, there is a growing interest in traffic calming as a way to make cities more attractive places for cyclists, pedestrians and urban life into the future.

And just as we hope that other countries may be inspired by Denmark, we in Denmark can also learn from other countries. To this end, the handbook includes inspiring examples from a range of European cities. More information can be found at cykelviden.dk.

Happy reading!

Anna Dinesen
Project manager,
Danish Centre for
Cycling knowledge

About this handbook

Focus of the handbook
This publication presents a series of traffic-calming measures that municipalities in Denmark can use to prioritise cycling, walking and urban life.

Target group
The handbook is aimed at municipal planners, but also decision-makers, local stakeholders and residents, interest groups and consultants, etc. It can be read by anyone seeking an overview of different options for traffic-calming initiatives.

Content
The formal traffic-calming framework in Denmark is described first. Overall traffic-calming measures at an urban and district level are then introduced, along with advice on how to involve users and stakeholders and how to make the interaction between different modes of transport effective.

Following this, 11 specific traffic-calming measures are described in greater detail. These descriptions can be viewed individually or together, depending on needs. Two Danish case studies are then presented, detailing a summer pedestrianised zone in Ærøskøbing and car-free school zones in Odense. Finally, experiences with broader traffic-calming in five European cities are explored.

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Walking and cycling bring cities to life

Many cities use traffic-calming measures to improve conditions for cycling, walking and urban life. Such measures can reduce car speed and car access, and convert roads into pedestrian areas, play streets, bike lanes or wider sidewalks, for example.

The traffic calming measures in this handbook can be effectively combined with other measures such as dedicated walking and cycling infrastructure, attractive urban spaces and adventure opportunities, as well as strategic urban planning that ensures a dense and mixed urban structure connected to public transit.

Creating more vibrant cities

Cities with high levels of cycling, walking and liveability are often characterised by a calm traffic environment.

Pedestrians and cyclists enhance community life
Passing pedestrians and cyclists enhance urban life and make the urban space more lively and inviting.

- Pedestrians and cyclists improve social security by acting as "eyes on the street", particularly in unfrequented locations and during off-peak hours.

Liveability, activity and movement

- Traffic-calming initiatives make urban spaces and streets more attractive and encourage activity, for example by reducing traffic noise and pollution as well as improving road safety and accessibility for cyclists and pedestrians.
- People who get about on foot or by bicycle find it easier to stop spontaneously, engage with others and make use of the many attractions the city has to offer. Studies also point to the fact that cyclists and pedestrians shop more frequently and use local shops more often[1].

Opening up the city to more people

- Streets designed for pedestrians and cyclists make cities more accessible for children, seniors and residents who do not have access to a car.
- Public space is frequently under pressure in dense urban areas, where cycling, walking and public transport are the most efficient modes of transport in terms of use of space.

"From a company standpoint, promoting cycling, walking and urban life is good for business.

Having more employees who cycle to work is profitable for the individual company in question, but also for society at large.

Urban planning and traffic planning, accessibility, shortcuts and perceived safety have a major part to play when it comes to altering transport habits. These factors must take high priority in municipalities.

Active urban life and successful trade and industry require attractive conditions for cyclists and pedestrians, as well as clear access for transport of goods, services, waste disposal, passenger transport and lots more.

We achieve the effective solutions through dialogue and inspiration from solutions in other places."

– Karsten Lauritzen, Confederation of Danish Industry

Urban planning - the foundation of traffic calming

Urban planning and road hierarchy

Many municipal and local plans strategically define the road network, which is divided into a road hierarchy, or road classifications.

Defining roads in this way helps ensure that road design and layout match and support the road's main function. On main roads, the flow of high levels of traffic is prioritised, whereas accessibility for all traffic users is prioritised on smaller, local roads in accordance with the overall planning.

Balance the role of traffic
Prioritise the passage of through traffic on main roads so that local streets can have calmer traffic with increased accessibility and liveability.

Integrate and connect
Good connections between traffic-calming measures and the surrounding cycling and walking network and public transport services will have the most effective impact overall.

Adapt to local conditions
Customised solutions take into account the surrounding area's use and layout. For example, some traffic-calming measures are suitable for residential areas and others are more obvious in city centres or near schools. See pages 16 and 17 for a summary of relevant measures in different areas.

Planning framework

Municipal plans, strategies goals and road hierarchies make up the framework for many traffic calming measures. These may include road safety, air quality, noise pollution, promoting cycling, walking and liveability and local business life, as well as public health, schools and leisure.

Funding for traffic-calming measures can be provided by grants from local committees, potentially co-financed by private stakeholders, foundations, developers, etc., or as resident-funded traffic calming in private streets.

Explain the overall vision
Clear communication about the policy framework and strategic objectives to which the traffic-calming measures contribute may increase public support for the initiative.

Examine the comprehensive impact of the initiative
Co-benefits are often the result of measures to promote cycling, walking and urban life. A holistic approach considers traffic interventions in the context of environmental, health-related, social and economic issues. This may give a broader picture of how the measure supports the municipality's policy objectives. However, also pay attention to the impact on road users whose access is restricted by the measures.

Involve various disciplines
Cross-sectoral cooperation across authorities and organisational roles can ensure that a measure is integrated within the general planning framework, but also that local awareness and knowledge of local stakeholders and adjacent projects in the area are considered from the start.

Danish regulatory framework

Legal framework

The legal framework for traffic calming measures in Denmark is defined by the Public Roads Act, the Road Traffic Act, executive orders and road standards. While the Danish regulatory framework outlines how legislation and road standards interact with specific road solutions in a Danish context, we nevertheless hope it may provide inspiration and ideas for other countries.

The Public Roads Act

The Public Roads Act defines the following areas as particularly relevant in relation to traffic calming measures:

- Road administration (Chapter 2)
- Road planning (Chapter 3)
- Access conditions (Chapter 6)
- Changes of road use (Chapter 9)

The Danish Road Traffic Act and executive orders

- **Signs and markings** are referred to in greater detail in the Executive Order on Road Markings, and the Executive Order on the Use of Road Markings. These executive orders are frequently used in day-to-day traffic planning, as they establish specific instructions for signs, road markings and street design.
- **Local traffic improvements** are made possible by Section 40 of the Traffic Act, which is relevant for measures such as establishing recreational and play areas and road closures. Local traffic improvements are explained in more detail in the Guidance on implementation of traffic improvements and the Executive Order on Recreational and Play Areas.
- **Reducing speeds** in more densely built-up areas is made possible by Article 42(5) of the Road Traffic Act. This is outlined in greater detail in the Executive Order on Local Speed Limits.
- **Traffic restrictions** for vehicles, such as pedestrianised zones, are made possible by Article 92 of the Road Traffic Act.

Danish Road Standards

The Danish Road Standards comprise a collection of guides for the planning, design, construction and operation of road infrastructure in Denmark. The road standards provide information on most aspects of road engineering and traffic planning. Traffic planning should always attempt to comply with the guidelines and recommendations.

The Road Standards Portal, where applicable publications, guides, handbooks, etc. can be found, is available at www.vejregler.dk (see page 53 for suggestions for relevant items to read). Most of these resources are only available in Danish.

Police consent

The police must provide consent for road facilities that alter the use or layout of the road in terms of traffic (see Articles 92, 95 and 100 of the Road Traffic Act).

Impact on road safety and traffic flow form the primary basis for the assessment of traffic calming measures by the police.

Early police involvement is recommended as this may help clarify any queries, particularly in the case of measures that go beyond familiar “standard solutions”.

Road safety audits

Road safety audits help to ensure that the implemented projects are as safe as possible for all road users. Audits are conducted by an accredited road safety auditor and can take place at several stages during the planning and design of a measure. The earlier a road safety audit is conducted, the better the eventual solution.

Strategic approaches to urban traffic calming

Individual urban traffic-calming measures are often implemented at road and intersection level, which is the primary focus of this handbook. However, traffic calming as a strategy may make more sense to road users – and enable road user behaviour to be more intuitive – if traffic calming interventions are scaled up from individual, intersection-level initiatives to district or citywide level initiatives.

Larger-scale initiatives which make it possible to expand traffic-calming measures to a district-wide or city-wide level are gaining ground in Denmark. These initiatives can serve as an overlay for the road specific measures described in this handbook. (See pages 50–51 for five European examples of large-scale traffic calming measures.)

"World-wide there is a growing interest in creating good lives by rethinking urban space and structure.

We need to view streets and roads as serving much more than just traffic. The qualitative value of urban space and the role played by liveability are making rapid progress, at the expense of asphalt and cars.

Traffic calming measures no longer simply involve scattered interventions, with primary emphasis on road safety. Cities want to create attractive, inclusive, vibrant urban spaces which excel in a range of positive aspects. And the only way to achieve this is to do something about motor traffic."

Malene Freudendal-Pedersen, professor of Urban Planning, Aalborg University

City-wide and district-wide initiatives

SPEED LIMIT ZONES

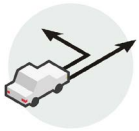
Implementing local speed limit zones in larger areas improves walking and cycling conditions. A number of Danish cities have had positive experiences with local speed limit zones. For example, Gladsaxe has introduced 40 km/h zones in all residential areas in the municipality, including low-speed roads where the speed limit is 30 km/h.

LOW_EMISSION ZONES

Low-emission zones restrict the most pollution-causing traffic in cities. The five largest cities in Denmark currently have green zones where diesel lorries, buses and vans must have a particle filter to gain access. Cars may be added to this list from 2023. These zones are regulated by the EU.

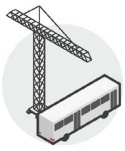
PARKING STRATEGIES

The location, number and pricing of parking spaces and the time limits for parking are an important tool for regulating the volume and flow of motor traffic. Strategic positioning of parking spaces at shared facilities, e.g., on the outskirts of an area, can limit motor traffic inside the area.



TRAFIC MANAGEMENT

Signal-controlled intersections control traffic flow and volume. Intelligent Transport Systems (ITS) and strategic traffic management can help prioritise cycling, walking and public transport.



TRANSIT_ORIENTED DEVELOPMENT

The planning and development of new districts and buildings can be integrated with public transport hubs. Urban development that prioritises transit concentrates urban functions and housing close to good public transport links in a traffic-calmed environment, thereby creating optimal conditions for urban life, cyclists and pedestrians.

Involving local stakeholders

Changes to urban space are normally subject to considerable local debate, with people either for or against traffic-calming measures.

Vibrant dialogue is a precondition for democratic society, but it can also challenge whether a traffic-calming measure is justified or appropriate. For this reason, it is essential to communicate and consult relevant stakeholders and end-users about them in advance.

Solutions can be co-created with local stakeholders in some instances, who then go on to adopt a more active role as co-creators. The process ideally extends throughout the period before, during and after the measure is planned, designed, approved and established.

Stakeholder involvement, communication and co-creation can benefit from cross-disciplinary competences and in different municipal departments.

> **A successful co-creation process will build trust and reciprocity between politicians and officials on the one hand, and residents on the other.**
>
> Decision-makers will gain invaluable insights, and residents will feel recognised and that their voices are being heard. This will ensure that decisions are firmly rooted and viable."

– Annika Agger, Lecturer specialising in resident involvement, urban development and the green transition, Department of Social Sciences and Business, Roskilde University

Stakeholders and their focus areas

Residents and visitors are the end-users of traffic calming measures, alongside a number of other stakeholders who are also relevant to engage:

CITIZENS
Focus: Traffic flow and accessibility, creation of value on a local level, (re)vitalisation of urban space.

DECISION-MAKERS
Focus: Popular support, strategic gains and creation of value at a local level.

PLANNERS / OFFICIALS
Focus: Traffic synergies, feasibility, maintenance and formal framework.

COMPANIES / SHOP OWNERS
Focus: Accessibility for customers and employees, (re)vitalisation of shopping areas and delivery of goods.

ASSOCIATIONS / ORGANISATIONS
Focus: Accessibility for target groups such as older adults, disabled persons and schoolchildren, access to cultural and recreational urban spaces.

POLICE
Focus: Statutory authority in respect of approving the measures, enforcement in respect of commissioning.

EMERGENCY SERVICES / GARBAGE COLLECTION
Focus: Accessibility and flow for emergency services' rescue and garbage collection vehicles.

CONTRACTORS / LANDOWNERS
Focus: Accessibility and flow, construction costs, physical conditions and maintenance.

TRANSPORT COMPANIES
Focus: Traffic flow for buses, reinforcement of public transport hubs and access conditions for pedestrians and cyclists.

Six tips for gaining support

Begin with an open dialogue on local needs

Invite locals to answer questions such as: Is there too much traffic in the area? Does it feel safe for pedestrians and cyclists? Are local shops and businesses struggling? This will ensure a common understanding of the need for changing the traffic conditions.

- **Dialogue tools** can structure the process with regard to urban investment, for example[2].

Involve and co-create solutions with local residents, businesses and associations so that their local knowledge benefits the design of the solution. The more local ownership for the measure, the better the subsequent use of the measure.

- **Create city centre partnerships** with the business community, landowners and developers.

- **Local funds** for traffic-calming measures, e.g. on residential streets, can help to support local initiatives from residents and shops.

Consider trialling temporary traffic-calming that introduces the new solution and highlights the positive benefits for residents and businesses before making the measure permanent.

- **Portable elements** such as planters, benches, "parklets" (portable, temporary urban spaces with recreation facilities and greenery), road markings and signs can be established relatively quickly and inexpensively.

Explain the shared benefits of the measure so that it does not come across as an "us versus them" situation. For example, a bicycle street may also mean more people visiting restaurants, and a one-way road with landscaping may allow more children to play. Consider not using negatively charged terms in your communication.

- **Visualisations** of urban beautification measures and **empirical data** from similar measures in other cities can help to illustrate the measure's positive impact.

Be prepared for scepticism

Scepticism and disagreements are to be expected when measures alter urban space.

Ensure you are prepared early on in the process, and counter arguments in an open and objective way at meetings with local residents, on social media and in the local press, for instance.

- A **FAQ** on the measure can answer the most obvious questions, such as how goods will be delivered; how disabled-badge parking will be managed; how long the construction work will take; what the policy decision framework is, etc.

Make sure the measure can be understood by providing information well before, during and after implementation. Not all traffic-calming measures are equally self-explanatory: for example, not everyone knows that signs indicating pedestrianised zones mean the speed limit is 15 km/h.

- **Signs, flyers, videos, social media posts** and local press can prepare residents for the change in traffic conditions.

Effective interaction between modes of transport

To succeed in promoting cycling, walking and urban life, well-functioning co-existence between all road users is essential. Clearly prioritising more vibrant urban spaces must go hand-in-hand with ensuring that the city's functions and services are considered.

It is especially vital to ensure that traffic calming does not restrict disabled parking access for emergency services and goods delivery. This inclusive approach means all modes of transport should be incorporated in traffic calming solutions. Clear communication in this respect can help to enhance collective understanding of the option selected.

> **People with reduced mobility, such as wheelchair users, are frequently overlooked when municipalities transform urban space.** But by giving them a little extra consideration, even tiny details can make all the difference as to whether someone can cross the road or access shops, and whether they feel welcome in the streets and in the urban realm."
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> 
>
> – Susanne Olsen, Chair, Danish Association of the Physically Disabled (DHF)

Balancing considerations

There is no one-size-fits-all way to balance the various considerations and needs of different modes of transport, but key points include the following.

DETERRING DETOURS

Traffic-calming measures can reduce traffic flow and vehicle speed, but may also lead to excessive levels of detours by motor traffic in adjacent streets. Therefore, implementing traffic-calming measures on these roads may also be considered.

WALKING AND CYCLING IN SHARED SPACE

Pedestrians and cyclists often share paths, squares, pedestrianised zones and recreational and play areas. Successful coexistence is reliant on the width of the road, the volume and distribution of cyclists and pedestrians as well as their speeds.

Note: When the surfacing is level-free, "safe zones" for pedestrians and/or bicycle lanes can be indicated by changes in surfacing materials, positioning of benches and greenery, etc.

ACCESSIBILITY FOR ALL

Traffic-calming measures frequently benefit seniors, children, people with reduced mobility, and the visually impaired.

Note: Good accessibility should always be assured in all interventions, with dedicated parking for people with disability, guide strips, etc.

SERVICE ACCESS FOR HEAVY VEHICLES

Access for goods delivery, garbage collection, fire and rescue must be ensured when traffic-calming measures are implemented.

Note: Large vehicles such as fire engines, garbage lorries, removal trucks and buses need more space in order to stop, turn and reverse. Their vehicle turning path should be checked.

BUSES IN SERVICE

Traffic-calming measures that make it easier to access areas on foot and by bicycle can enhance the overall travel experience for bus passengers.

Note: Traffic-calming measures may affect accessibility for buses, which may result in costs for the transport company and longer travel times for passengers.

TARGETED SPEED RESTRICTIONS

Traffic-calming measures and modal filters should be designed in a way that ensures good accessibility and convenience for pedestrians and cyclists.

Note: Bicycle gates can allow cyclists to bypass road humps and modal filters.

Communication and behaviour

This handbook focuses mainly on traffic-related measures that calm traffic through the use of signs, road markings and facilities. However, the success of these measures relies on how they are received – for example, whether motorists respect speed restrictions and understand the new signage; whether cyclists ride according to the new conditions; or whether parents accept the new car-free school zone. In this respect, non-physical measures such as events, communication and enforcement can reinforce the effect of the traffic-related measures described on the following pages.

LOCAL EVENTS

Market days, community festivals, summer markets, sporting events, open-air concerts, etc. frequently lead to temporary closure of roads (and possibly city centres too). Local events can thus highlight the possible benefits of more permanent traffic-calming measures, both for reducing traffic and improving urban vitality, helping to attract visitors and support urban life.

BEHAVIOURAL CAMPAIGNS

Considerate road use is a shared responsibility, regardless of the mode of transport. But being considerate can be challenging when people are busy or there is confusion around, for example, who has right of way. Campaigns and signage are no substitute for traffic-calming measures, but they can provide an additional means to call for consideration on the road. This may be relevant in places where pedestrians and cyclists share the space; in city centres; around schools and in residential areas.

"Please drive slowly" request, Musicon, Roskilde.

Photo: Municipality of Roskilde.

ENFORCEMENT

The police are obliged to enforce speed limits; modal filters; one-way roads, etc. If traffic-calming measures give rise to the need for stronger enforcement, this should be raised with the police in advance.

Other stakeholders, e.g. traffic wardens, school staff, etc., can supplement enforcement by the police by means of their physical presence in the area, and by direct dialogue with road users (e.g. those who have failed to understand the new conditions). Finally, school-crossing patrols can help schoolchildren to cross the road safely in the mornings. Danish Road Safety Council and LB Forsikring (insurance company) have devised a range of resources and campaigns to support school-crossing patrols all over Denmark.

> **Perceived safety benefits road safety as well.** Feeling safe in traffic when walking or cycling is important. That is why it makes sense to take initiatives that make roads and streets safer for vulnerable road users, whether they are on foot or cycling. Greater perceived safety can be achieved in lots of ways, and traffic-calming measures play a vital role.
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> 
>
> That said, all road users share a basic responsibility to make traffic feel safe for individuals and all users of our roads."
>
> **- Michael Svane, Chairman of Danish Road Safety Council**

Traffic calming measures

This chapter covers 11 specific traffic-calming measures. The descriptions of the various measures outline the possibilities for the use and design of the measures, and the advantages and impact of each.

As some considerations apply to multiple measures, the most important aspects to consider are summed up below according to the selection, planning, design and implementation of the measure, respectively.

Things to consider in the selection and planning of measures	
Planning framework - Is the measure linked with relevant municipal strategies, plans and objectives? - Is the measure well connected to the rest of the network of infrastructure for cycling, walking an public transport? - Has the measure, (including its overall design), been agreed politically?	
Ownership / road authority - Has the measure been planned for a municipal road, private common-use road or national road? - Should landowners (if any) be involved?	
Police consent - Can the police be engaged early on as they have to consent to roadworks? - Will the measure increase the need for enforcment, and should this be discussed with the police?	
Construction costs - Will the construction funds for the measure suffice? - Can expenses be brought down by linking with road renovation, climate adaptation, etc.? - Can external funding be obtained, e.g. from natonal funds, private funds, residents (for traffic-calming measures on private common-use roads), landowners (with regard to urban development)?	
Operating costs - Does the measure require more funding for the maintenance of new surfacing, greenery, street furniture, etc.? - Should the people responsible for maintaining the solution be involved in planning the measure?	
Involvement - Is there an overview of stakeholders and users who are key to the measure's success? - Could involvement and co-creation, where applicable, help create a better solution for users? - Have enough internal resources been earmarked for involvement, and are local stakeholders them selves capable of contributing?	
Temporary measures - Could a temporary pilot measure or urban trial generate information on user perceptions and behaviour? - Are there any plans to potentially continue with the temporary measure if it is successful?	

Things to consider in the design and implementation of measures	
Fire and rescue - Does the measure provide enough access for emergency vehicles, and should the local emergency services be involved in the design?	
Garbage collection - Is the measure compliant with local guidelines for access for garbage collection, collection of different waste types, etc.? - Should garbage collection be restricted to certain times of day?	
Goods delivery - Does the measure provide enough access to local shops and residents for goods vehicles and lorries? - Could loading/unloading zones or time-restricted access for goods vehicles be established?	
Accessibility - Is the measure compliant with accessibility requirements, e.g. for the visually impaired and people with reduced mobility? - Is an accessibility audit necessary?	
Buses - Will the measure cause delays to buses in service, and should any funds be earmarked to compensate the transport company for this?	
Car parking - Will the measure impact car parking? - Could motorists be directed to parking elsewhere? - Are replacement parking spaces necessary, or can parking spaces be restricted in terms of time? - Is there enough disabled-badge parking?	
Time restrictions - Should the measure be limited, e.g. to mornings, weekends or the summer? - Could a solution involving time restrictions reduce any local opposition to the measure?	
Information and communication - Is there a plan for communication with regard to the measure so that the solution is easy for users to understand? - Should any affected residents, businesses, etc. be informed about factors such as restricted access, speed restrictions and restricted parking before, during and after the measure has been established?	

Measures in various areas

The purpose and relevance of traffic-calming measures depend upon the area and functions that they are targeting. This section describes various areas that may need traffic-calming measures, and which measures are typically deployed in such places.

CITY CENTRES AND COMMERCIAL STREETS
There is a desire in city centres for attractive urban spaces that allow for and attract a vibrant mix of visitors, clients and locals. Obvious measures include pedestrianised zones and bicycle streets, potentially with time restrictions such as summer streets and modal filters. One-way roads, speed-reduction measures, converting parking facilities and narrowing intersections may be relevant measures. This is frequently combined with placemaking, e.g. greenery and street furniture. Historic urban spaces normally require special design considerations, and traffic calming frequently attracts a great deal of local attention from shopkeepers, residents etc.

PLAZAS AND SQUARES
Many modes of transport converge in plazas and squares. Pedestrians and cyclists may cross paths here, while vehicles are frequently diverted outside these areas. Benches, trees, play equipment and outdoor eateries provide a place where people can rest for a while and support urban liveability and trade. To reinforce these qualities, traffic calming can be implemented around markets and squares by establishing pedestrianised zones and closing roads and intersections, implementing traffic-calming measures, withdrawing parking and improving crossings for pedestrians and cyclists.

RESIDENTIAL AREAS
People in residential areas frequently ask for safer, more secure conditions for pedestrians and cyclists. Traffic-calming measures and modal filters (while modifying the road layout) may be particularly relevant on smaller local streets where there is limited traffic. Recreational and play areas, bicycle streets, withdrawal of traffic lanes, narrowing of intersections and improved crossings may also be relevant measures.

SCHOOLS
In areas surrounding schools and sports facilities, traffic-calming measures are frequently initiated by a desire to improve road safety and security, as well as active transport among children and young people. School zones where car access is restricted at certain times of day are an obvious measure, while modal filters, speed-reduction measures, one-way roads, narrowing of intersections and improved junction design for cyclists and pedestrians may also be relevant measures. Recreational and play areas may also be considered. Traffic measures can be complemented by educational initiatives and campaigns, e.g. to support the impact on behaviour.

STATION AREAS AND HUBS
Stations and public transport hubs are frequently visited by pedestrians and cyclists. Traffic-calming measures here may help to ensure good access and quality waiting time for passengers, and the concentration of urban life can be exploited in order to reinforce local trade. Good access for buses and vehicles should be combined with improved conditions for pedestrians and cyclists. Relevant measures may include pedestrianised zones, one-way roads and speed-reduction measures, converting traffic lanes and parking facilities, narrowing intersections and improved intersection design for cyclists and pedestrians.

TRANSPORT CORRIDORS
On main roads, motor traffic may present a barrier to pedestrians and cyclists. These roads are deliberately designed to facilitate through traffic, so typically only minor traffic-calming measures are deployed, such as improved intersections for pedestrians and cyclists.

Overview of measures

This table provides an overview of the traffic calming measures described individually below.

The table sums up the overall objectives of the measures, as well as their main areas of relevance, which are marked with a ✔-symbol. Large symbols indicate clear relevance, while small ones indicate partial relevance.

The measures are grouped into three categories:

- Road types for cycling, walking and urban life
- Access and speed restrictions
- Changed use of road space

The relevance of each individual measure depends on local circumstances, so the contents of the table must be viewed as indicative.

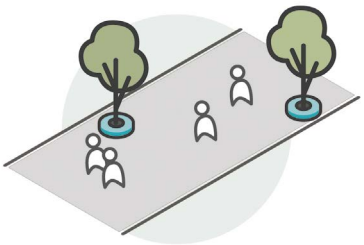
Measure	Purpose	City centres/ commercial streets	Markets and squares	Residential streets	Schools	Stations / hubs	Transport corridors
ROAD TYPES FOR CYCLING, WALKING AND URBAN LIFE							
Pedestrianised zone	Prioritisation of pedestrians and recreation	✔	✔			✓	
Recreational and play areas	Prioritisation of play and recreation			✔	✔		
Bicycle street	Prioritisation of cyclists	✔		✔	✓	✓	
ACCESS AND SPEED RESTRICTIONS							
Modal filter	Filtering traffic with a view to reducing vehicle numbers in the area	✔	✔	✔	✔	✓	
School zone	Safe conditions for active transport for schoolchildren				✔		
One-way roads for vehicles	Fewer vehicles passing through and more space for pedestrians and cyclists	✔	✓	✓	✔	✔	
Speed reduction	Vehicle speeds reduced	✔	✔	✔	✔	✔	✓
CHANGED USE OF ROAD SPACE							
Conversion of car parking	More space for bicycles, pedestrians, urban life, etc.	✔	✔	✓	✓	✔	✓
Conversion of traffic lanes	More space for bicycles, pedestrians, urban life, etc.	✓		✔	✓	✔	
Narrowing of intersections	More space for bicycles, pedestrians, urban life, etc.	✔	✓	✔	✔	✔	
Improvements for pedestrians and cyclists at intersections	Prioritisation of pedestrians and cyclists at intersections and crossings	✓	✔	✔	✔	✔	✔

Road types for cycling, walking and urban life

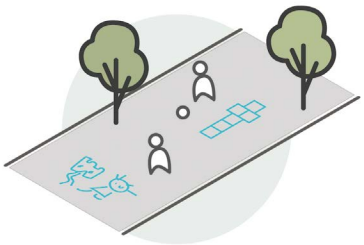
Road classes in Denmark are divided into main roads and local roads, as well as various road types with associated legislation. Major parts of the urban road network are designed to reduce congestion as much as possible for moving traffic, primarily motor traffic. This is particularly true of the road class for main roads in municipalities, but many local roads are also designed with vehicles in mind.

That said, some types of roads are particularly appropriate for supporting cycling, walking and urban life. These types of roads are described here as independent traffic-calming measures.
Existing streets and roads can be converted to these road types in combination with traffic calming and spatial transformation. Similarly, new urban areas can be designed from the outset using these cyclist and pedestrian-friendly road types.

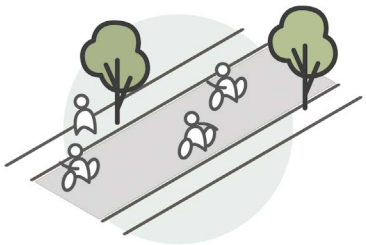
The following measures are described below: Pedestrianised zones, Recreational and play areas, and Bicycle streets. The measures in this category are mutually exclusive as independent road types, although they can certainly be combined with many of the other measures outlined in this handbook. Other road types such as 2 minus 1 roads, bus roads, etc. are not described in this handbook as they do not fall within the handbook's focus of walking and cycling in an urban context.



Pedestrian street



Recreational and play area



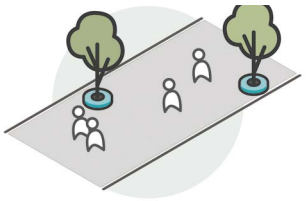
Bicycle street

Overview of road types for cycling, walking and urban life and their traffic calming factors

The table below provides an overview of the various road types that prioritise cyclists, pedestrians and urban life. Here the road is frequently shared between various road users, and this is also referred to as "shared space"[3].

See Article 27 of the Executive Order on Road Markings, Signs and Signals, and Articles 131 to 136 of the Executive Order on the Use of Road Markings for more information on Danish legislation.

Road type	Access, vehicles	Shared area	Priority	Speed	Traffic volume	Separate footway	Separate bicycle track	Road profile
Pedestrianised street	Option	All	Pedestrians	Max. 15 km/h	Low	No	No	Single level surface
Recreational and play area	Yes	All	Play & rest	Max. 15 km/h	Low	No	No	Single level surface
Bicycle street	Option	Bicycles & vehicles	Cyclists	Max. 30 km/h	Low - medium	Yes	No	Footway + carriageway
Low-speed road	Yes	Bicycles & vehicles	Cyclists & pedestrians	Max. 30 km/h	Low - medium	Yes	No	Footway + carriageway



Pedestrian streets

Pedestrian "summer Street" in Vestergade, Aarhus. Photo: Urban Creators

Pedestrian street, Vejle Midtpunkt. Photo: Visitvejle.

Examples of Danish pedestrian streets

Pedestrian streets can be found in many Danish cities. The most famous of these is probably Strøget in Copenhagen. Houmeden, in Randers, which dates back to 1963, was the first permanent pedestrian street, while Kongegade in Esbjerg is the longest and Søndergade in Hadsten is the shortest pedestrian street in Denmark.

- Large pedestrian streets in city centres include Vejle, Odense, Helsingør and Copenhagen.
- Pedestrianised "summer streets" take place in Aarhus and Faaborg.

See also **the case study for the Ærøskøbing modal filter and pedestrianised "summer street"**, pages 45 to 47.

What characterises a pedestrian street?

Space for urban life, trade and recreation

Most cities of a certain size in Denmark have one or more pedestrian streets in the city centre. The purpose of pedestrian streets is to create good conditions for pedestrians and to support urban life and commercial activity in the city centre. Pedestrian streets can be combined into a zone that covers the entire inner city or be deployed as standalone initiatives. The general closing down of local shops, which is partly due to increasing competition from online shopping, is being seen in pedestrian streets all over Denmark. Young people in particular are keen to do things other than just shopping when they visit the city centre, which is why liveability in pedestrian streets should be reinforced by means of varied functions such as cultural events, restaurants, fitness, and social activities and events run by local organisations.

Different degrees of traffic calming

Vehicle use in pedestrian streets may be permitted in one or both directions, potentially at selected times such as during the evenings and at night, on selected days of the week or in months when there are fewer pedestrians. Cycling may also be permitted, either all the time or for a restricted period.

Pedestrianised "summer streets" gain ground

A number of cities are establishing pedestrianised "summer streets" in order to accommodate large numbers of pedestrians in summer. This measure may be implemented in larger cities, but also in smaller towns in tourist destinations such as the islands and popular coastal areas. This gives visitors more of an opportunity to experience what the city centre has to offer and relieve pressure from traffic during peak season.

Low-speed streets

Some municipalities apply the concept of "low-speed streets" (Danish: "sivegade" – literally "trickle street") as an alternative or a complement to "pedestrian streets". This is not an official term when it comes to road markings, so it is used in a slightly different way. Typically, low-speed streets are pedestrian streets that allow motor traffic 24 hours a day, albeit on pedestrians' terms. That said, in some cases, low-speed streets may also be local streets with speed limits of 30 km/h or less, referred to as "quiet roads", see page 20.

Benifits

- ✓ **Better accessibility and security for pedestrians** as vehicles travel at lower speeds and there are fewer vehicles.
- ✓ **A more vibrant urban environment in city centres and on shopping streets** where pedestrians are in the majority and where shops and restaurants should be prioritised.
- ✓ **More space for attractive urban spaces and landscaping,** by converting road areas for vehicle traffic into landscaped areas and walkways.
- ✓ **Bicycle connections** can also be routed through pedestrian streets. Cyclists can conveniently pass through pedestrian streets outside the busiest daytime hours, at which times they have to adapt to pedestrians' pace or use other routes.

Physical design

- **Pedestrian streets typically have uniform, kerb-free surfacing** from one side of the street to the other, ideally in a style that respects any historic urban features in the city centre.
- **Squares and plazas** can also be signposted as pedestrian streets and can form part of a larger pedestrian zone.
- **Walkways in pedestrian streets where vehicles are allowed** can be indicated by means of a shift in the surfacing or the placement of trees and benches, for example. That said, pedestrians still have priority throughout the entire street.
- **Limit the number of parking spaces** in order to encourage priorities for pedestrians and possibly cyclists, and reduce conflicts with vehicles.
- **Loading/unloading spaces/zones** could ideally be incorporated, potentially with goods delivery during restricted hours and/or in side streets.

Potential synergies

- **Placemaking that provides greenery, decor and street furniture** attract and retain locals and visitors, and can be integrated with, for example, planned road renovation, or climate adaptation.
- **Pedestrian priority at intersections** (see page 42) may enhance pedestrian accessibility and safety by giving pedestrians right of way over crossing vehicles and bicycles.
- **Modal filters** (see page 26) in the form of bollards, trees or street furniture, for example, may make it clear that vehicle access is restricted. Dynamic bollards or signs can be used if vehicle access is time-restricted.

Points of attention

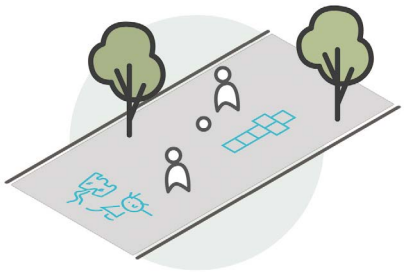
- – **Speed limit is 15 km/h and cars must park in marked spaces,** enabled by clear information or signs.
- – **Be clear in your communication** about access for goods deliveries, public transport and parking.
- – **Access for emergency vehicles** must be ensured, not least in the case of temporary measures such as pedestrianised "summer streets". This can be achieved through timely dialogue with the local emergency services.

§ Relevant Danish Executive Orders

Executive Order on Road Markings, Signs and Signals, Article 27

- The area or road is signposted with special regulation signs for pedestrians.
- Any permission to use a motor vehicle and/or permission to use a motor vehicle at restricted times is signposted with additional panels.
- Only travelling at very low speeds is permitted, and motorists must show particular consideration for pedestrians.
- Cars must not be parked outside specifically marked spaces.
- Motorists have an absolute duty to give way on exiting a pedestrian street.

Pedestrian street where vehicles are allowed, with time-restricted parking, Ribe. Photo: Hasse Jørgensen, RykIndRibe



Recreational and play areas

Recreational and play area, Nørregade, Odense. Photo: Urban Creators.

Recreational and play area. Photo: Ramboll on behalf of the Danish Road Directorate.

Recreational and play area, Rostockgade, Nordhavn, Copenhagen. Photo: Urban Creators.

What characterises a recreational and play area?

Space for children playing and local street users

Recreational and play areas create open spaces for children and adults in residential districts where people need to access their homes by car, but where they also want safe and secure opportunities for recreation and play.

Sharing the road

Essentially, when it comes to recreational and play areas, the entire road space has to be designed for recreation and play. Motorists travel under the conditions defined by cyclists, pedestrians and children playing. Hence the traffic-related function is secondary and the nature of the road is of a peaceful urban space.

"Quiet roads" for slightly busier sections

The term "low-speed roads" is used in municipalities occasionally and can be interpreted in different ways due to it not being an official term defined in the Road Traffic Act. That said, the term frequently refers to local streets with more local traffic, or where there is no desire to level out existing footways. Speed limits of up to 30 km/h can be signposted here, and speed-reduction measures can be deployed.

Examples of Danish recreational and play areas

- **Odense:** Newly constructed recreational and play areas in Nørregade, Graven and Dansestræde in 2022.
- **Copenhagen, Nordhavn:** Extensive use of recreational and play areas in new developments.
- **Copenhagen, Humleby:** Cohesive recreational and play area implemented in an existing residential area.
- **Hjørring, Bjergby, Hvedevænget, Rugvænget, Havrevænget:** Converted road profile due to separate drains and adaptation to climate change for a greener road profile in recreational and play areas.

Benifits

- ✓ **Maximum traffic calming,** where cyclists and pedestrians are also required to respect play and recreation.
- ✓ **Local meeting point and attractive living environments** by prioritising recreation and play. This extends the street's experience-based value, turning it into a meeting place, outdoor space and play zone.
- ✓ **Space for children, older adults and vulnerable road users,** making street spaces more inclusive.
- ✓ **Improved road safety and environment,** particularly for children and older adults, as there are fewer road accidents, and noise and air pollution are reduced.
- ✓ **Option of access to cars for residents,** but through traffic is reduced.

Physical design

- **Surfacing is frequently established as single-level** from one side of the street to the other, sometimes with marking of "safe zones", e.g. by means of shifts in surfacing or positioning of trees and benches.
- **The road must not be divided into carriageway and footway,** and there must be no height differences in the cross-section of the roads. That said, a "safe zone" for pedestrians can be indicated, e.g. by means of surfacing in a different colour. When reconstructing existing roads, footways and kerbstones may be maintained if they are clearly interrupted at intervals of no more than 25 metres.
- **Parking spaces** must be marked and limited in number, and be placed so that reversing is avoided out of consideration for children playing.
- **"Quiet road areas",** where the road is used mainly for local traffic, can be dimensioned and signposted for a 30 km/h speed limit in the interests of cyclist and pedestrian safety.

Points of attention

- **Signage alone** will not suffice to slow traffic. The physical design and location of the street – e.g. in a residential area – must help this.
- **Children playing** must be able to see clearly where the recreational and play area ends so that they do not form a false sense of safety on busy adjacent roads. Dedicated playgrounds should be kept separate from the roads.
- **Existing streets with footways** are less appropriate as recreational and play areas, as they indicate that walking, playing and recreation should be restricted to the footways.

§ Relevant Danish Executive Orders

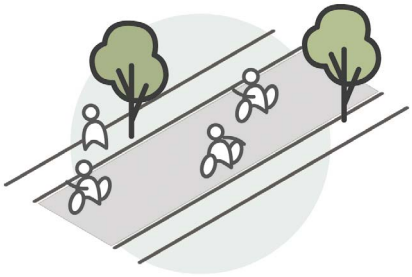
- **Executive Order on Road Markings, Signs and Signals,** Article 27:
- The area or road is signposted with special regulation signs for the recreation and play area.
- Recreation and play on the roads in the area are permitted for everyone, but vehicles have to demonstrate particular care and consideration for pedestrians.
- Cars must not be parked outside specifically marked spaces.
- Vehicular traffic has a duty to give way when leaving a recreational and play area.

Executive Order on the Use of Road Markings, Article 135

- There must be no separation between carriageway and footway or height differences in the road cross section.

Potential synergies

- **Play and recreation facilities such as benches, greenery, play equipment, etc.** make the road more attractive for residents and help to keep vehicle speeds down.
- **One-way roads, modal filters and speed reduction measures** may also help to reduce motor traffic. See pages 25 to 34.



Bicycle street

Nørregade, Haderslev. Photo: Danish Cyclists' Federation.

Jernbanegade, Næstved. Photo: Lárus Ágústsson, COWI A/S.

Examples of Danish bicycle streets

- **Haderslev:** Nørregade
- **Næstved:** Jernbanegade
- **Holbæk:** Højen
- **Copenhagen:** Vendersgade

What characterises a bicycle street?

Street in which bicycles and vehicles demonstrate mutual respect

Both bicycles and vehicles have access to bicycle streets and have to share the carriageway while respecting one another. The speed limit in bicycle streets must therefore match the speed of cyclists, i.e. 30 km/h or lower.

Option for narrow streets

Bicycle streets are frequently used in narrow streets where space is too limited to provide a bicycle track of proper width, or where there are other constraints such as necessary parking bays (for people with disability), goods delivery, trees, etc.

Balance between bicycles and vehicles

Bicycle streets assume there is a significant amount of cyclists compared to vehicles, or at least this is expected following implementation. There are no defined criteria for the precise ratio at present, but having twice as many bicycles as vehicles is one suggestion, while the minimum number of cyclists or the maximum number of vehicles can also be considered. The presence of buses in bicycle streets should depend on their size, frequency and speed.

Communication about any new concept is vital

Bicycle streets are still a new solution in most Danish cities, and so it is important to make sure both motorists and cyclists know what the concept involves. This might include information videos, direct dialogue with road users in the area, posts on social media and articles in local newspapers, and signage explaining road signs and how to behave in the bicycle street.

Benefits

- ✓ **Allows space for walking and cycling along narrow streets** where constructing bicycle tracks is either not possible or is only possible in the form of a very narrow bicycle track that does not allow people to cycle alongside a child or overtake other cyclists.
- ✓ **Reduces through traffic** and makes short trips in vehicles less attractive, while still allowing access by vehicle.
- ✓ **More urban vitality** such as recreation, outdoor dining and walking may result from the urban space where the traffic-calming measures are implemented, and more cyclists using the street.
- ✓ **Bicycle streets may be relatively inexpensive** as they do not necessarily require major reconstruction work compared to, for example, bicycle tracks. However, this should always be viewed in light of the desired impact of the measure and the specific needs of the area. Placemaking measures such as narrowing of the carriageway, widening of footways, vegetation, etc. frequently result in greater satisfaction and more users.
- ✓ **Evaluations** of a number of Danish bicycle streets[4] [5], show that after just a few years:
  - there are significantly more cyclists (approx. 100%);
  - there are four times as many cyclists as motorists;
  - 90% of cyclists feel safe in the bicycle street;
  - 79% of cyclists think the concept is logical;
  - the majority of cyclists are satisfied using the bicycle street on a daily basis.

⚠ Points of attention

- – **Bicycle streets are still a relatively new concept** in Denmark, and residents may find it difficult to understand how to use them. Therefore, it may take some time for the full impact of the bicycle street to be achieved.
- – **There is a general lack of evaluation** of bicycle streets, not least because they can vary widely in design and scale, thereby making it difficult to demonstrate comparable effects.
- – **Bicycle streets as standalone measures** are less beneficial if they do not connect to other cycling infrastructure, and unless signage and road markings are complemented by improvements to the urban space.
- – **Some cyclists prefer bicycle tracks** to bicycle streets and feel that bicycle tracks are safer. It is important to make it clear why the bicycle street has been selected as a solution, and why it is deemed an advantage.
- – **Increased liveability may put pressure on urban space:** More pedestrians and people visiting restaurants may present challenges on narrow footways along the bicycle street and disturb the flow for cyclists.

Bicycle street, Højen, Holbæk, with red surfacing and central rain gutters. Photo: Municipality of Holbæk.

Physical design

- **Bicycle streets have different designs** in different places in Denmark. They may use special stone paving or similar, or regular asphalt. The road could ideally be narrowed at the point where the bicycle street starts and ends. Bicycle streets can be arranged with one-way traffic in narrow streets.
- **Use signage to enhance recognition** and make it easy for all road users to decode the traffic rules when entering the zone. This can be done using the same road sign and road markings, for example. The surface of the road must be uniform across the entire length and breadth of the road**.**
- **Limit the number of parking spaces** in order to reduce numbers of cars turning and looking for parking.
- **Avoid diagonal or perpendicular car parking** due to the risk of accidents involving reversing vehicles. Establish longitudinal parking if parking is needed.
- **Loading/unloading spaces or zones** can be incorporated, e.g. with goods delivery during restricted hours and/or in side streets.
- **Improve crossings for pedestrians** by narrowing the road and create raised surfaces, as bicycle streets frequently do not have pedestrian crossings.

Bicycle street signs indicating that traffic is allowed and reminding road users that parking is permitted in marked spaces only, Jernbanegade, Næstved. Photo: Hverdagensalmindeligheder.dk

Potential synergies

- **Greenery, benches, décor etc.** in bicycle streets make them more attractive, also to pedestrians and reduce the speed of vehicles.
- **One-way roads** (see page 30) are an option in bicycle streets, providing greater accessibility for cyclists, while also potentially making space for wider footways, greenery, etc.
- **Speed-reduction measures** (see page 32): Bicycle streets can help to keep vehicle speeds down when deployed with local speed limits.
- **Prioritising cyclists at intersections** (see page 42) where the bicycle street meets other traffic can increase the flow and access for cyclists.

§ Relevant Danish Executive Orders

Executive Order on Road Markings, Signs and Signals, Article 27:

- The area or road is signposted with a sign indicating a bicycle street.
- The speed limit in bicycle streets may only correspond to cycling speed, i.e. 30 km/h or lower.
- Permitted motor vehicle access is shown on an additional panel.
- Cars are not allowed to park outside specially designated parking spaces in bicycle streets.

Executive Order on the Use of Road Markings, Article 131:

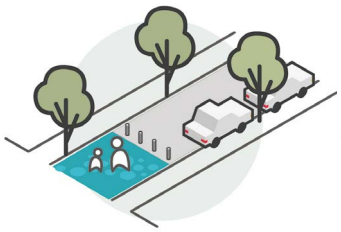
- Road signs indicating a bicycle street must be set up at all access points to the bicycle street.
- The carriageway in a bicycle street must be clearly apparent and appropriate for cyclists. For example, there must be no side islands or parking on the carriageway or any other obstacles that could be perceived as obstructing cyclists.
- Moving traffic and pedestrians must be kept separate by means of footways.

Adaption of access and speed

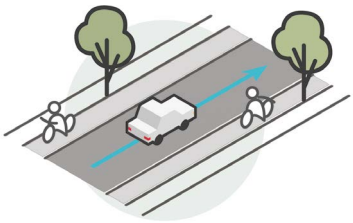
The volume and speed of vehicles frequently determine the safety, flow and comfort experienced by pedestrians and cyclists when travelling.

Specifically, it may be difficult to cross busy roads on foot or by bicycle if many vehicles are travelling at high speed. Moreover, fear of traffic accidents may discourage pedestrians and cyclists from using the road in the first place – just as vehicle noise may reduce the chances of conversation and hence recreation.

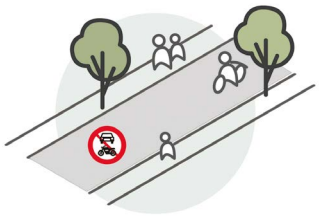
When roads and spaces are "closed" to vehicles, and areas are "opened" to other road users, they can experience a much more attractive urban space in which to move around and spend time. Therefore, measures that reduce vehicle access and speed will frequently have a positive impact on cycling, walking and liveability.



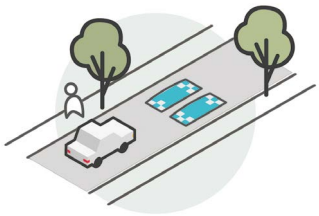
Modal filter



One-way roads for vehicles



School zone



Speed reduction measures

Location-specific measures versus large-scale measures

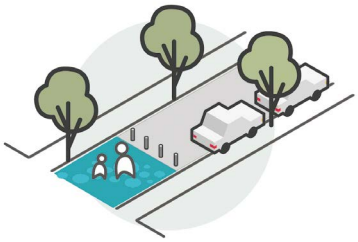
The measures described in this section involve individual streets, roads and intersections. However, more extensive initiatives can also be introduced in larger areas such as at district level or city level (e.g. speed limit zones and low-emission zones). These are referred to in the section "Strategic approaches to urban traffic calming", page 9.

Some European cities have introduced more extensive initiatives for restricting car access and speed. Five selected case studies that include circulation plans, superblocks and 15-minute cities are described on pages 50 and 51.

Restricted traffic areas

A restricted traffic area is an urban area that is closed to through traffic by means of one-way roads and modal filters, for example. Vehicles can access restricted traffic areas, but these vehicles must either belong to residents, or be running errands or providing services to local businesses etc. Individual restricted traffic areas are linked to the main road network by means of a limited number of access roads.

Cyclists, pedestrians and public transport are able to cross restricted traffic areas. Thus, restricted traffic areas help to reduce vehicle numbers and make cycling, walking and public transport more efficient and therefore more appealing than driving. Read about the deployment of restricted traffic areas in Ghent on page 50.



Modal filter

Modal filter with rising bollards at Raupachsgade in Odder. Photo: Municipality of Odder

Modal filter with full intersection closure in Guldbergsgade/Sjællandsgade, Copenhagen. Photo: Urban Creators

Examples of Danish modal filters

- **Odder,** Odder Torv: Variable modal filter in the summer, with rising bollards, street furniture and outdoor eateries.
- **Copenhagen,** Guldbergsgade/Sjællandsgade: Full intersection where vehicle access is restricted by a traffic island with greenery.
- **Frederiksberg:** Side road with closed access to a major road, for example Thurøvej/Nordre Fasanvej, with square and cycle gate.
- **Helsingør,** city centre: Bollards permit only limited access for motorists who do not have access cards.

See also the ***Ærøskøbing case study***, with modal filters in the form of bollards in summer, on pages 45 to 47.

What characterises modal filters?

Street remains open to pedestrians and cyclists

Modal filters do not restrict cyclists or pedestrians, who may still pass through freely when a road or intersection is closed to vehicles. This approach is called "filtered permeability". Several cities in North America use the term "open streets", which highlights the fact that streets are opened up to people rather than closed for vehicles.

Appropriate for residential roads, plazas and squares

Modal filters are of particular relevance where there is a desire to create a more attractive urban environment by reducing through traffic while also prioritising cyclists and/or pedestrians in residential areas and at plazas and squares, for example.

Different design types

In a typical scenario, one end of the road is closed to vehicles, which makes the road into a dead end with no through traffic. A modal filter on a side road heading for a major road (that is, a partial intersection closure) is also frequently used. As an alternative, the road may be closed at both ends and potentially turned into a pedestrian zone or bicycle street, for example where vehicles are only allowed to deliver/collect goods or run errands. Finally, modal filters can be placed at intersections to close them off to vehicles in all directions.

Limited duration, for example in summer

A number of Danish cities are working on closing streets, market squares or city centres to vehicles at selected times when the need for traffic-calming measures is greatest. This could take place in summer, when there is more concentrated urban life in the city centre, or near to schools in the mornings (see Pedestrian streets in summer on page 18 and School zones on page 28). Modal filters may also apply at certain times of day, when most cyclists and pedestrians are out and about.

Selective or systematic application

Modal filters and the resulting change in road layout can be used both selectively, for example on local streets and in city centres; but they can also be deployed more systematically in order to control the circulation of vehicles in restricted traffic areas (see page 25). The Belgian cities of Leuven and Ghent frequently use, for example, partial intersection closures, which alter the road layout and create restricted traffic areas (see page 50 for more on Ghent).

Benefits

- ✓ **Prioritisation of pedestrians and cyclists,** who can pass through the modal filters.
- ✓ **Continued access by vehicles** to a greater or lesser extent on many occasions, but a reduction in through traffic.
- ✓ **Less noise and greater road safety** for residents as fewer vehicles pass through.
- ✓ **Opportunity for local landscaped areas and urban spaces,** for example spaces from which parking has been withdrawn, and/or urban space on street corners.
- ✓ **Fewer potential points of traffic conflict** as a result of fewer access/exit points.

Physical design

- **Modal filters are signposted as a minimum,** but the design may vary widely, from major reconstruction of the road profile and surfacing, to lesser measures such as the installation of planters or barriers.
- **Bollards** may be of fixed or rising design, allowing traffic to be filtered at certain times.
- **Landscaped areas** are frequently an option, potentially equipping a small urban space with street furniture, benches, greenery, and possibly parking for bicycles.
- **Buses can be exempt from the modal filter** if their route uses the road in question; otherwise, the impact on bus services should be considered.
- **Bicycle gates** permit access for cyclists (and pedestrians) in places where the road is otherwise closed to vehicles. These can be designed with unidirectional bicycle tracks on either side of the road, or a bidirectional bicycle track on one side or in the middle of the road.
- **One-way roads** are an unsuitable measure for closing roads to vehicles on side roads to major roads where vehicles can still access the road from the other side, as in this scenario, vehicles cannot exit the road. In this instance, the road has to be bidirectional.
- **Challenges to traffic safety** can result, because of larger numbers of vans and lorries needing to reverse. This makes it a good idea to incorporate existing and future flows for vans and lorries. Loading/unloading zones can also be established, and/or delivery of goods can be subject to time restrictions**.**
- **Clarify requirements from local emergency services** early on in your discussions with them, particularly in relation to emergency vehicle access.
- **Dimensions for turning areas:** see the Danish Road Directorate's "Anlæg for parkering og standsning i byer" [Facilities for parking and stopping in cities], section 4.1.

Points of attention

- **Potential detours for vehicles,** which could affect traffic flow on surrounding roads.
- **Larger vehicles may need to reverse out,** for example when delivering goods, unless there is space to establish a turning area.
- **Dialogue with all stakeholders and users** is important.

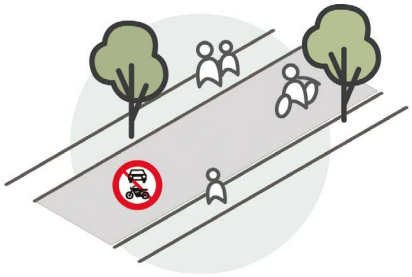
§ Relevant Danish Executive Orders

Executive Order on Road Markings, Signs and Signals:

- Prohibition of motor vehicles and prohibition of access are signposted by means of restrictive signs: see Article 19.
- Signage to indicate dead ends, including any continued access for cyclists and pedestrians, is signposted by means of special regulation signs: see Article 27.
- Mandatory signs are used for partial intersection closures with mandatory direction of travel: see Article 23.
- Additional panels can be used in combination with other signs to exempt certain road users – cyclists, residents, etc. – and to limit the amount of time when the road is closed: see for example Article 9.

Potential synergies

- **Withdrawal of parking facilities** (see page 36) can free up space, for example for landscaped areas.
- **Community events** (see page 13) such as market days, street food-markets and car-free Sundays may include modal filters on selected days.
- **Restricted traffic areas** (see pages 25 and 50) may comprise modal filters with partial intersection closures in a larger, cohesive area.



School zone

"No access for motor vehicles" restrictions at certain times, Sønder Felding Skole, Herning. Photo: Via Trafik on behalf of the Danish Road Directorate.

Dynamic signage indicating "no access for motor vehicles" in the mornings at Brøndby Strand Skole. Photo: Via Trafik on behalf of the Danish Road Directorate.

Roersvej outside Vestre Skole, with a recreational and play zone with "no access for motor vehicles" restrictions in the mornings. Photo: Municipality of Odense.

What characterises a school zone?

Wide range of traffic calming measures

"School zone" is not an official road marking in Denmark, but it may cover a range of different traffic-calming measures that make roads around schools safer for children walking and cycling. This description of measures looks mainly at car-free zones, for example where "no access for motor vehicles" restrictions apply. Other relevant measures such as speed reduction and one-way roads are also described in this handbook as separate measures.

Marking of "school zones"

As a minimum, school zones are made up of road markings and signage on the roads around the school. These give motorists timely warnings to pay particular attention to students on their way to school.

Car-free zones in the mornings

A number of schools have introduced "no access for motor vehicles" restrictions in the mornings. This calms the traffic in the area around the school so that children and young people can walk, cycle and scoot safely. Car-free zones are respected most extensively if there are alternative places near the school where students can be dropped off, and if they are otherwise supported by the physical conditions.

Examples of Danish school zones

- **Herning,** Sønder Felding Skole: Car-free zone where "no access for motor vehicles" restrictions are in place in the mornings and parking is further away.
- **Brøndby,** Brøndby Strand Skole: Dynamic signage indicating "no access for motor vehicles" restrictions in the mornings.
- **Odense,** Roersvej at Vestre Skole: "No access for motor vehicles" restrictions in the mornings and a recreational and play zone with various activity elements invites children to take part in outdoor play and learning.
- **Rungsted,** Rungsted Skole: "No access for motor vehicles" restrictions in the mornings for parents in cars.
- **Frederiksberg,** Nyelandsvej: Highlighting of the school road with the warning sign "A 22 Children" on the carriageway in order to attract motorists' attention.

See also the **case study on car-free school zones in Odense** involving seven schools, which includes modal filters and through traffic being banned in the mornings (pages 48 and 49).

Benefits

- ✓ **Traffic safety and perceived safety** around the school is enhanced, particularly for younger students.
- ✓ **More space for students cycling and on foot, and more orderly drop-off points** around the school in the mornings, where parents who arrive by car cause congestion and decrease pedestrians' and cyclists' perception of safety.
- ✓ **Enhancing students' health, concentration and learning** due to the fact that more children and young people are physically active because they walk and cycle to school.

Physical design

School zones frequently comprise the following:

- **Signage to indicate car-free zones**, with "no access for motor vehicles" or "no access for through traffic" restrictions (see also page 26 on modal filters).
- **Prohibition of stopping and parking** around the school entrance, thereby reducing the number of students dropped off outside the school or entirely eliminating such drop-offs. This prohibition is respected most effectively if there are alternative drop-off points for motorists near the school.

The following measures may also be included in school zones:

- **Local speed limits** that reduce the speed of vehicles (see page 32 on speed reduction measures).
- **One-way roads** can simplify traffic flow around the school and provide more of an opportunity to prioritise space for pedestrians and cyclists (see page 30).
- **Crossings for pedestrians and cyclists** may include raised areas and humps, footways and bicycle tracks, central and side islands, and clear pedestrian crossings (see page 42).
- **Conversion of traffic lanes** may provide space for wider footways and bicycle tracks and make it easier for students and others to cross roads at the school (see page 38).

Points of attention

- **New measures require resources if they are to be to enforced:** for example, it is often signage for the most part that creates a car-free school zone, and only the police can formally enforce this. However, the headteacher can also influence the behaviour of parents and staff, for example by working more actively with traffic policy at school.
- **New traffic flows** may place strain on adjacent roads with detours, which is why dialogue with local residents is important.
- **For motorists, accessibility is restricted** to a smaller area and/or time of day.
- **Household waste collection and goods delivery** must be managed, for example by means of dialogue with relevant parties in order to clarify specific needs, if there are "no access for motor vehicles" restrictions in place.

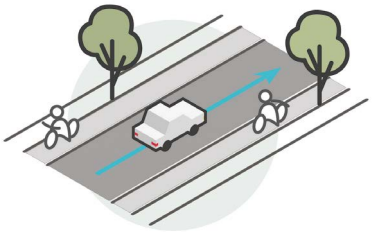
§ Relevant Danish Executive Orders

Executive Order on Road Markings, Signs and Signals:

- Various signs can be used for the measures that may form part of a school zone. See for example Article 19 for signs indicating no motor vehicles, no through traffic, no stopping, no parking, etc.
- Warning signs indicating particular hazards due to children being on or near the road may be used: see Article 13.
- Additional panels can be used in combination with other signs for defining time restrictions for signs or to allow access for residents: see for example Article 9.

Potential synergies

- **Walking bus:** A number of Danish schools have established walking buses, where older students aged 12 to 15 years accompany younger students aged 6 to 9 years to make sure they get to school safely.
- **School crossing patrol:** Schools are required to consider the option of setting up school crossing patrols in partnership with the police, which can help school students safely negotiate morning traffic.
- **Communicative and behavioural initiatives** can be used to complement physical initiatives (find out more on page 13).



One-way roads for vehicles

One-way road with bicycle tracks at Hornslet Skole in the Municipality of Syddjurs. Photo: Urban Creators.

One-way road with a bicycle lane up to an intersection and a continuous footway. Photo: Troels Andersen, Idékatalog for cykeltrafik.

What characterises a one-way road for motor traffic?

More space for other purposes

Motorised traffic can travel in only one direction on a one-way road, creating more space for green urban spaces and improving conditions for pedestrians and cyclists with bicycle tracks or wider footways, for example.

Reduces through traffic

Unidirectional streets reduce through traffic but continue to allow access by vehicle.

Used particularly in city centres

One-way roads are used in many places in Denmark, particularly in city centres, but also around schools and in some residential streets.

One-way roads as a strategic approach

Establishing a large number of one-way roads in a large, continuous area can limit through traffic, for example in residential areas and central city districts. That is why one-way roads are typically a key instrument in restricted traffic areas and circulation plans (see page 25 and European case studies on pages 50 and 51). That said, one-way roads can also be designed to optimise the flow of vehicles, as is the case in North American cities. One-way roads should therefore be planned according to specific needs at the location.

Examples of Danish one-way roads

- **Syddjurs,** Hornslet Skole: Humps have been installed on Skolevangen and Ballesvej and both have been turned into one-way roads, which has made space for a bicycle track on Skolevangen and helped to ensure a calmer traffic environment around the school.
- **Svendborg:** Møllergade and Bagergade (city centre), Dronningholmsvej (residential street).
- **Aarhus,** city centre, for example Mejlgade, Skolegade, Vestergade: One-way roads between parts of the main road network have been introduced on many smaller streets and combined with reduced speed limits to reduce through traffic.
- **Copenhagen,** Indre By, Vesterbro and Nørrebro: Many local streets in residential areas are one-way.

Benefits

- ✓ **Free up part of the road** for urban spaces, greenery, bicycle tracks or wider footways as there are fewer vehicles.
- ✓ **Reduces through traffic** if used as a strategic initiative, for example alongside modal filters and the creation of bicycle streets. This is demonstrated by experiences in Leuven and Ghent in Belgium, where such measures have considerably reduced through traffic.
- ✓ **Safety and accessibility for pedestrians and cyclists can be enhanced** as there is less through traffic, particularly if the one-way roads are used in combination with improved cycling conditions and wider footways.

Physical design

- **Contraflow cycling and possibly contraflow bicycle tracks** will maintain good accessibility for cyclists, but this must be separately signposted. On streets with fewer vehicles, allowing contraflow cycling using additional panels may suffice. Establishing a contraflow bicycle track is recommended if there are more vehicles.
- **Speed-reduction measures on one-way roads should be given priority,** particularly on wider and busier roads (see page 32). Speed-reduction measures may include bumps or raised surfaces, bus bulbs and landscaped areas, all of which will help to keep vehicle speeds down.
- **The price and scale** are dependent on whether the road has to be rebuilt or can simply have signage installed, which will frequently be the case on smaller, single-lane local streets.
- **Parallel parking for cars** on busy roads is preferred so as to avoid vehicles reversing out onto the carriageway, which may create unsafe conditions and challenges for road safety.
- **Additional manoeuvring space for car parking on the left-hand side** of a single-lane, one-way road is recommended as this is necessary for parallel parking
- **Car parking on both sides of the road** may cause traffic to stop at every parking space. Removing car parking on one side of the road and/or establishing two narrow lanes could be considered if the accessibility for vehicles and buses is to be given priority.

Points of attention

- **There may be confusion and an increase in detours for vehicles,** particularly at the outset, so provide clear information.
- **Driving the wrong way on a one-way road** can be avoided if the one-way road is planned in connection with the flow on surrounding roads**.**
- **Vehicles may be diverted to other roads,** which may inconvenience local residents. However, empirical data from extensive use of one-way systems in Belgium indicates only a minimal increase in the number of vehicles on the main road network[6].
- **A less-straightforward bus network,** as passengers will not be able to start and end their journeys on the same road, which means they will have longer to walk to stops in one direction.
- **Speeds may be higher on one-way roads** unless speed-reduction measures are established as there are no oncoming vehicles.

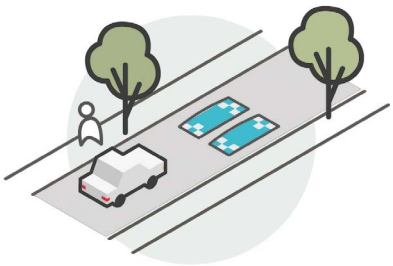
§ Relevant Danish Executive Orders

Executive Order on Road Markings, Signs and Signals:

- One-way systems are indicated by means of mandatory signs: see Article 23.
- Permission to contraflow cycling can be signposted using additional panels.

Potential synergies

- **Speed-reduction measures** (see page 32) can ideally be established with one-way systems in order to avoid high speeds.
- **Conversion of parking** (see page 36) may provide more space on the street, for example for proper conditions for counterflow cycling: this is frequently unavailable if vehicle parking is maintained.
- **Restricted traffic areas** (see page 25) are frequently based on the establishment of one-way roads over a larger area.
- **Placemaking and greenery** can be established in the space freed up.



Speed-reduction measures

Raised surface, pinch points and a continuous bicycle track on a quiet road with a 30 km/h speed limit, Kong Hans Allé, Gladsaxe. Photo: Urban Creators.

Speed reduction measures in combination with rainwater beds in residential areas in Middelfart. Photo: LYTT Arkitekter.

Examples of Danish speed reduction measures

- **Citywide speed reduction measures in residential areas:** In 2000, Gladsaxe was the first municipality in Denmark to introduce 40 km/h zones on most roads in the municipality's residential areas (existing quiet roads already had signage indicating a 30 km/h speed limit). This has reduced vehicle speeds, as well as the number of road traffic accidents.
- **Climate adaptation and speed reduction measures in "the Climate City of Middelfart":** Rainwater beds are designed as speed reducing elements. The Municipality of Aarhus and Aarhus Vand are also working in partnership to use rainwater beds as speed reducing measures, for example on J. Skjoldborgs Vej and Carl Plougs Vej.

What characterises speed-reduction measures?

Physical measures and signage
Vehicle speeds can be reduced physically, for example by means of humps, chicanes and narrowing of the carriageway, and also by reducing the sign-posted speed limit. A combination of these will frequently have maximum effect.

The design of the road must match the speed
Introduction of lower local speed limits is reflected only in an actual reduction in speed if the design and nature of the road corresponds to this. Signage alone is rarely sufficient. The road can be designed with a variety of speed-reduction measures, for example a narrow road profile, trees, adjacent recreational and play areas, etc. Motorists frequently slow down when it is obvious that they are driving in residential areas, near schools, pre-schools, or nursing homes, etc.

Different types of signposted speed limit
Traffic calming measures can be regulated by means of either lower recommended speeds or lower local speed limits, which prohibit motorists from driving faster than the indicated speed.

Greater road safety
The higher the general speed on the roads, the more accidents will occur, and the more serious they will be[7]. Conversely, lower speeds can reduce the number of accidents. Empirical data, for example from Copenhagen, show a 50–75% decrease in serious injuries and fatalities when the speed limit was reduced from 50 km/h to 40 km/h in local areas[8].

European trend
Cities all over Europe are working to reduce speed limits to 30 km/h in most places. The standard speed in urban zones in Denmark is 50 km/h, but in 2022 the Ministry of Transport granted permission to 16 municipalities to run trials implementing 40 km/h local speed limits.

Benefits

- ✓ **Increases road safety,** as lower speeds mean fewer road accidents.
- ✓ **Increased perceived safety for pedestrians and cyclists,** particularly for cyclists on roads without bicycle tracks and where the road is shared with vehicles.
- ✓ **Greater accessibility and flow for pedestrians and cyclists** as it is easier for them to cross roads when vehicle speeds are lower and traffic-light sequencing can be adjusted according to the speeds travelled by cyclists.
- ✓ **Less traffic noise** due to lower speeds, particularly in synergy with, for example noise-reducing asphalt and fewer vehicles on the roads[9].

Physical design

- **Many different speed-reduction measures** can be used, for example humps, raised surfaces, chicanes/pinch points, narrowing of the road, advance warnings, gates, side and central islands, surface changes, rumble strips, edge restrictions and vegetation[10].
- **Bus-friendly humps** should be installed on roads used by buses in service on a set route, for example speed cushions or offset speed humps.
- **Bicycle-friendly humps/bicycle gates** should be installed on roads without bicycle tracks. That said, parked cars may make bicycle gates difficult or impossible to access.
- **Bicycle tracks/lanes** should be routed through speed-reduction measures so as to ensure that cycling conditions are not impaired.
- **Signal-controlled intersections** can be adjusted to increase green time for pedestrians and cyclists, or include a pre-green or green wave for cyclists.

Potential synergies

- **Restricted traffic areas, circulation plans,** etc. (see pages 25 and 50) constitute more extensive traffic-calming measures, and are frequently complemented by speed-reduction measures.
- **Pedestrian streets, recreational and play areas and bicycle streets** (see pages 17 to 24) require speed-reduction measures.
- **One-way roads** (see page 30) should be combined with speed-reduction measures as motorists tend to speed up if they do not encounter oncoming traffic.
- **Modal filters** (see page 26), conversion of traffic lanes (see page 38) and narrowing of intersections (see page 40) all help to slow vehicles down**.**

Impact and challenges

- – **Reduced flow for vehicles** as they are only able to travel at lower speeds.
- – **Reduced flow for bicycles,** particularly where there are no bicycle tracks, and if no bicycle-friendly humps are installed.
- – **Reduced flow for buses,** although this is dependent on existing speeds travelled by buses.
- – **Signs per se have limited impact in respect of speed reduction**, and so the road layout and design should be used to support the signposted speed, for example by using physical speed-reduction measures.
- – **Risk of increased detours** by vehicles in surrounding streets who seek to avoid speed-reduction measures.

§ Relevant Danish Executive Orders

Executive Order on Local Speed Limits:

- See Article 6 onwards with regard to speed limits lower than the generally applicable limits (for example 50 km/h in urban areas).

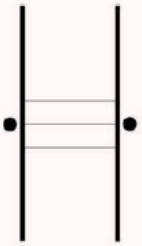
Executive Order on Road Markings, Signs and Signals:

- Use the red restrictive signs for local speed limits: see Article 19.
- Use the blue special regulation signs for recommended speeds: see Article 27.

Executive Order on the Use of Road Markings:

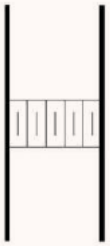
- See Articles 97 to 100 for sections on local speed limits.
- See Article 125 with regard to recommended speed.
- See Articles 145 to 151 with regard to zones with local speed limits.

Overview of 14 types of physical traffic calming measures

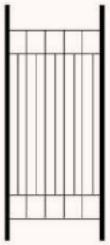


1. Advance signage

2. Gates

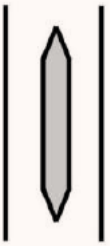


3. 2-lane humps



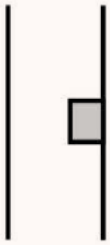
4. 2-lane raised surfaces

5. Pinch points

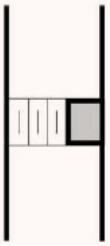


6. 2-lane narrowing from the middle of the road

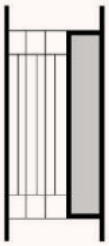
7. 2-lane narrowing from the roadside



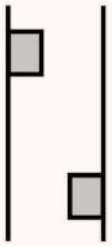
8. Narrowing to 1 lane



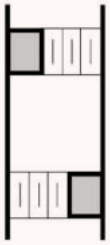
9. Narrowing to 1 lane with humps



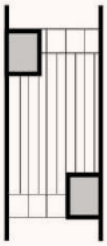
10. Narrowing to 1 lane with raised surface



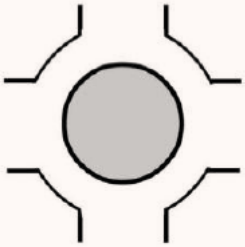
11. Pinch points with narrowing to 1 lane



12. Pinch points with narrowing to 1 lane and hump



13. Pinch points with narrowing to 1 lane and raised surface



14. Roundabouts

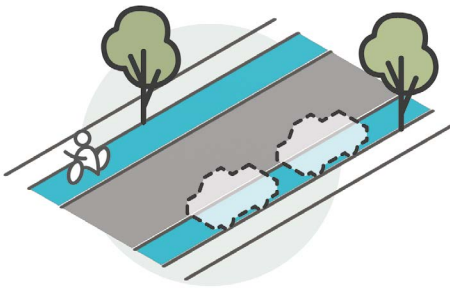
Source: Håndbog om fartdæmpere [Handbook on speed reduction measures], Danish Road Directorate 2013

Measures for changed use of road space

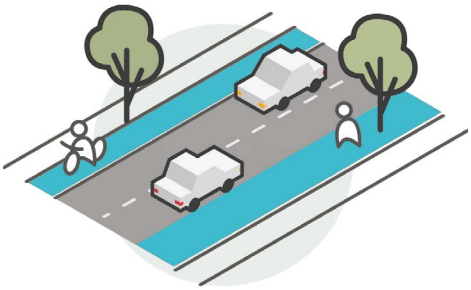
Public space is frequently at a premium in urban areas and it can be difficult to find available space for bicycle tracks or lanes or footways etc., that are sufficiently wide. Space is also needed for landscaped areas, trees, benches, outdoor dining and bicycle parking.

Changing the use of road space can provide better conditions for pedestrians, cyclists and urban life, while also limiting vehicle traffic and vehicle speed on account of the restricted space. This type of initiative is colloquially referred to as a “road diet”, as areas otherwise reserved for motor traffic are reduced and converted to other purposes.

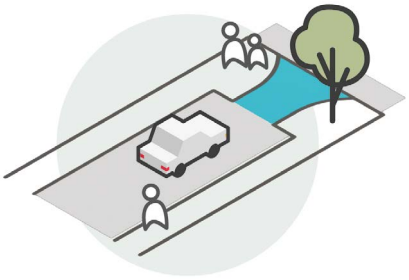
The following measures are described below: Conversion of parking facilities; Conversion of traffic lanes; Narrowing of intersections and Improved crossings for pedestrians and cyclists. These measures can benefit from being combined with the measures described in earlier sections of this handbook.



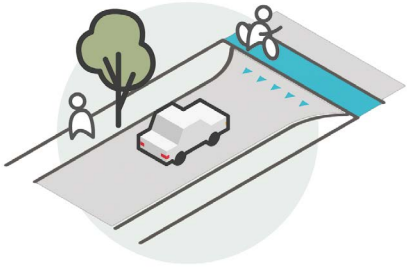
Conversion of parking



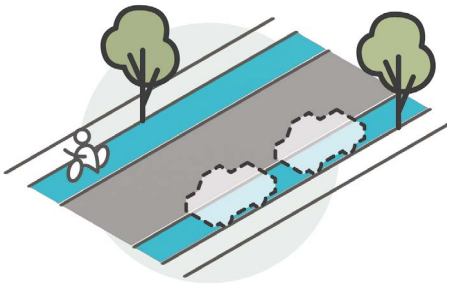
Conversion of traffic lanes



Narrowing of intersections



Improved crossings



Conversion of parking

Fredens Torv, Aarhus. Top: The market square with parking before transformation of the urban space. Bottom: Temporary landscaping following withdrawal of parking facilities (the building on the right has changed colour from red to blue in the interim). Photos: Municipality of Aarhus.

What characterises conversion of parking facilities?

Providing more space for the street

Converting parking spaces to other purposes makes it possible to give more space for pedestrians and cyclists, urban life and/or greenery in street spaces.

Subject of debate

Larger-scale removal of parking may create local dissatisfaction and result in lively debate. This can be addressed by communicating the purpose of the measure clearly and/or including it in an overall parking strategy. Alternative options for parking and arrival should be communicated widely – for example if there are private car parks or good parking facilities in adjacent areas. Restricted or temporary removal of parking spaces during daytime hours or in summer, for example, may also meet local opposition.

Make positive benefits apparent

Quickly demonstrating how the converted space gives something back to residents using measures relating to the urban space – such as temporary greenery, benches, etc. – may be an advantage.

Full or partial withdrawal of one lane

Conversion of a whole parking lane will provide enough space for a bicycle track or lane and/or wider footways, potentially with greenery, recreation facilities or outdoor eateries. Partial conversion of parking facilities creates "pockets" that can slow vehicles and/or be used for trees, recreation facilities, bus bulbs, etc.

Examples of conversion of parking in Denmark

- **Aarhus:** Fredens Torv, temporary transformation in 2022. Bispetorv was also transformed in 2015 following trials involving green urban spaces and a "festival week" forest.
- **Ribe Domkirkeplads**: This reconstruction initiative – which includes parking, installation of outdoor eateries, seating and new surfacing – has transformed the square into an active urban space.
- **Kolding,** Jernbanegade: Partial conversion in order to provide wider footways, benches, trees, planters and waste-sorting facilities.
- **Aarhus:** Parklets on streets such as Borggade, Guldsmedgade or Jægergårdsgade, where since 2017 it has been possible to convert parking spaces into outdoor eateries.
- **Copenhagen:** Tactical urbanism in Middelalderbyen involving temporary conversion of 66 parking spaces in 2021 for trees, benches, outdoor eateries, art and social and cultural events.
- **Copenhagen:** Flexi-parking, for example at Gasværksvej Skole and Ingrid Jespersens Skole, where evening and night-time car parking switches to day-time bike parking.
- **Bornholm**, Østermarie Torv: Transformation of a town square from a car park into a multifunctional square emphasising interaction, recreation and play.

Benefits

- ✓ **Frees up space** for greenery and urban life.
- ✓ **Opportunity to improve flow and perceived safety for cyclists** if a bicycle track is installed so that cyclists do not feel they are being squashed between moving cars and parked cars.
- ✓ **Opportunity for wider footways,** which may enhance perceived safety for pedestrians and provide more opportunities for recreation and movement.
- ✓ **Removes the visual barrier** formed by rows of parked cars and helps to provide access to shops, eateries and other ground floor facilities, making them easier to see.
- ✓ **Better visibility for motorists** who do not have to deal with cyclists and pedestrians crossing the road between parked cars.
- ✓ **Encourages more cycling, walking and use of public transport** as parking is less attractive for vehicles.

Physical design

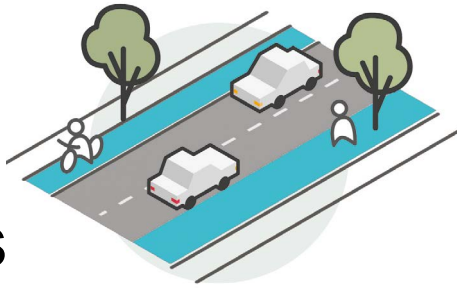
- **Parking for the disabled** will still be necessary in some places, which is why it is not always possible to convert all parking facilities.
- **Electric and shared vehicles can be retained** when converting parking facilities, potentially using hubs of parking facilities reserved for electric cars to raise awareness and provide economic benefits. That said, charging stands should not take up room on footways and bicycle tracks.
- **Goods loading/unloading zones** may be an advantage, particularly on shopping streets in order to prevent illegal parking on bicycle lanes and tracks.

Points of attention

- **Car users** may find that accessibility is reduced.
- **Cars looking for parking may have to make detours,** meaning they have to drive further on every trip.
- **Risk of illegal parking,** which may present a particular challenge in bicycle lanes and may therefore require increased enforcement and signposting indicating where alternative parking can be found.
- **Service vehicles and goods deliveries blocking parts of the bicycle track or footway** in areas for short-term parking, thereby creating unsafe conditions for cyclists and pedestrians. Loading/unloading zones may therefore be incorporated and/or goods can be delivered during limited periods, for example in pedestrian streets.
- **Risk of vehicles travelling at higher speed** as parking facilities can have a traffic-calming effect. This can be dealt with by converting the space to other uses that also calm traffic, for example bicycle parking, outdoor eateries, rainwater beds, benches, etc.

Potential synergies

- **Speed-reduction measures** (see page 32) to ensure that traffic speeds are kept low when parking facilities are removed.
- **Pedestrian streets, bicycle streets and recreational and play areas** (see pages 17 to 24) work best when there are few parking spaces available.
- **Bicycle lane:** The space freed up by withdrawing parking facilities can be quickly turned into a bicycle lane, which can be upgraded to a bicycle track in the longer term.
- **One-way roads** (see page 30) will frequently require conversion of parking for the contraflow bicycle track.
- **More greenery and better urban spaces:** Space freed up can provide space for more green areas, as well as community activities, for example recreation, play or outdoor eateries.
- **Bicycle parking:** Converted space can provide room for more bicycle parking.
- **Climate adaptation:** Converted space can provide room for climate for adaptation through sustainable urban drainage.



Conversion of traffic lanes

Nyhavnsgade in Aalborg. Top: Before the transformation. Bottom: Traffic lanes are converted into a bicycle track. Photos: Cowi on behalf of the Danish Road Directorate.

What characterises conversion of traffic lanes?

Providing more space for the street
Conversion of traffic lanes allows other uses such as wider footways, bicycle tracks, bus lanes and landscaping to be prioritised.

Reducing vehicle capacity
Converting or reducing traffic lanes will decrease the capacity for motor traffic and hence the number of vehicles that can use the road.

Increasing overall capacity for all road users
Empirical data from the high street Nørrebrogade in Copenhagen has shown that overall capacity for all road users increased by 20% after converting the road capacity for vehicles. Cycling alone increased by 60% because of factors such as wider bicycle tracks at the expense of vehicle lanes.

Traffic safety when removing turning lanes
Be careful not to impair road safety for pedestrians and cyclists by removing turning lanes. To ensure this, each individual intersection should be analysed in order to highlight the impact on safety, as well as perceived safety and accessibility, for various road users.

Examples of conversion of traffic lanes in Denmark

- **Aalborg,** Nyhavnsgade: Conversion of traffic lanes into a bicycle track.
- **Odense,** Thomas B. Thriges Gade: The transformation of a 4-lane road into a vibrant urban area with new homes, offices, shops, and squares attractive to cyclists and pedestrians, began in 2014.
- **Vejle:** Flegmade: Narrowing of traffic lanes has provided enough space for bicycle tracks and wider footways with artistic lettering on the surface.
- **Aarhus,** Havnegade/Skolebakken/Kystvejen: Traffic lanes converted to wider footways, a bicycle track, priority for bus, central refuge and light railway.
- **Copenhagen,** Nørrebrogade: Conversion of traffic lanes into wider bicycle tracks, footways, better bus facilities and attractive recreation areas. This has enabled a 20% increase in the total number of people using the street at Dr Louises Bro (from 2008 to 2016), and the presence of 60% more cyclists[11].

Benefits

✓ **Frees up space** in order to prioritise walking, cycling, buses and more green and active urban spaces.
✓ **Greater perceived safety** for pedestrians and cyclists due to wider footways and/or bicycle tracks and fewer vehicles on the road.
✓ **Greater accessibility** for pedestrians and cyclists because of a reduced severance effect when it comes to crossing the road, particularly in combination with wider footways, bicycle tracks, regular terminated cycle tracks and cycle boxes, for example.

Physical design

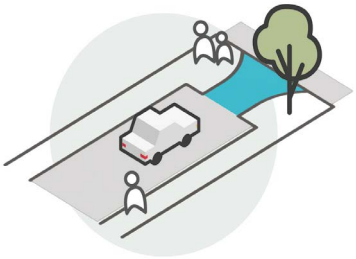
- **Converting traffic lanes can create room for cycling, walking and recreation** in the form of bicycle tracks, wider footways, trees, benches, etc. Central and side islands can also be created by making the road narrower, which helps make the road easier to cross and reduces speed.
- **Prioritisation of bicycles and buses:** There is a risk of decreasing traffic flow and safety for cyclists, particularly at intersections, when turning lanes are removed. Cyclists can be given priority, for example by means of wider bicycle tracks, cycle boxes and regular terminated cycle tracks. In a similar way, giving priority to buses at intersections can help ensure flow for bus traffic.
- **Continued turning or turning prohibited:** Removal of turning lanes can be implemented by either continuing to make it possible to turn (to the left or right), or by prohibiting turning at the intersection.
- **Conversion of turning lanes may make things more confusing and inconvenient for motorists,** thereby creating a risk of tailbacks and congestion as well as risk of more accidents between vehicles turning right and pedestrians.

Points of attention

– **Traffic flow slowed for vehicles** at intersections and on sections as there is less room for vehicles. This may result in vehicles travelling further on every trip, but overall, motorists may make fewer trips because they will switch to other modes of transport.
– **Flow for buses and cyclists** may be reduced unless this is taken into account.

Potential synergies

- **Speed-reduction measures** (see page 32) can be implemented by means of full/partial removal of traffic lanes in order to support lower speeds, particularly on wider roads.
- **Altered road layout due to modal filters** (see page 26) may reduce through traffic.
- **Narrowing of intersections** (see page 40) may help to reduce speeds, create space and implement cycle boxes, regular terminated cycle tracks and safer pedestrian crossings.
- **Bus lanes and Bus Rapid Transit (BRT)** can be accommodated by converting traffic lanes into dedicated bus lanes.
- **Greener, more attractive urban spaces** can be prioritised by converting traffic lanes into landscaped areas, for example with more trees and benches.
- **Climate adaptation** can be accommodated by converting traffic lanes into, for example, storm drains for sustainable urban drainage.



Narrowing of intersections

Chr. Kiers Plads (Gerlachsgade/Trepkasgade), Aarhus. Top: Original design of the intersection. Bottom: The intersection after narrowing and installation of "elephant ears". Photo: Municipality of Aarhus.

Examples of narrowing of intersections in Denmark

- **"Elephant ears" in Aarhus, Frederiksbjerg:** A number of intersections are being narrowed from 2020 onwards by widening street corners with what are known as "elephant ears" ("dog ears" in Danish). This provides room for benches and new trees. See for example the Gerlachsgade/Trepkasgade intersection (including transformation of all of Gerlachsgade) and the Jægergårdsgade/Marselisborg Allé intersection.
- **Copenhagen, Østerbro and Vesterbro:** Extensions of footways at intersections installed in a series of streets as part of diagonal parking projects. See for example Dybbølsgade.

What characterises narrowing of intersections?

Footway extensions and "elephant ears"

A relatively large amount of road has been set aside at many intersections which could be converted into extended footways with widened street corners. This creates better conditions for pedestrians and cyclists and potentially makes the urban space more attractive. This measure has been termed "elephant ears" ("dog ears in Danish") in some places because of the rounded shape that replaces the traditional perpendicular layout of footways up to intersections.

Better crossings for pedestrians and cyclists

Narrowing the road at intersections enhances access for cyclists and pedestrians by reducing the distance they have to cross. Narrowing the intersection can be complemented with other improvements at the intersection, such as continuous footways and/or bicycle tracks and lanes, pedestrian crossings, cyclist crossings, etc.

Reduced speeds and greater perceived safety

Vehicles reduce their speed at the intersection because of the narrower road profile and sharper bends. This enhances road safety and perceived safety among pedestrians and cyclists and reduces road noise for people living in the area.

Attractive urban spaces and recreation

The narrowed road space may provide space for trees, benches, child-friendly play and recreation areas, sustainable urban drainage, recycling/sorting points and bicycle parking. It might even be possible to create small, landscaped areas or parklets, depending on the size of the intersection. Bus stops can also be incorporated in the solution, where applicable.

Residential streets and city centre

Narrowing of intersections can be used, for example in residential areas and near schools, where there is a particular desire for traffic-calming measures and urban space for recreation purposes. Intersections in the city centre that are heavily used by pedestrians and cyclists can also be narrowed.

Benefits

- ✓ **Calms traffic** and creates better road safety and perceived safety, as well as reducing noise.
- ✓ **Makes it possible to establish attractive urban spaces,** including on smaller streets in residential areas and near schools, and frees up space for trees, recreation, bicycle parking, etc.
- ✓ **Frequently supported by local people,** as narrowing intersections is not deemed to be a negative measure and improvements to urban spaces are clearly apparent.
- ✓ **Kerbside parking for cars can be retained and potentially expanded,** as in many instances cars can park closer to the kerb because of extension of the footway.
- ✓ **Bus platforms up to intersections** may be included in the solution and ensure good conditions for passengers heading to and from the stop.

Physical design

- **Physical reconstruction and relocation of kerbstones** will normally be required if the intersection is to be narrowed. That said, temporary installation of planters or bicycle parking, for example, potentially in the form of parklets, can be trialled prior to permanent installation.
- **Urban spaces and small landscaped areas** can be established in the converted space and provide opportunities for recreation, bicycle parking and outdoor eateries.
- **Continuous footways, bicycle tracks and lanes** can further enhance cyclist and pedestrian flow and perceived safety.
- **Bicycle parking and recycling/sorting facilities** can be integrated into the urban space.
- **Climate adaptation** can be incorporated in the form of rainwater beds for sustainable urban drainage.
- **Parking close to the intersection** may need to be altered, for example if lorries find it difficult to turn left or right.

Points of attention

- – **Physical reconstruction work** may be costly, which is why coordinating reconstruction with other construction work, for example climate adaptation, road renovation, etc., may be considered.
- – **Motorists may experience poorer flow** because of reduced speeds and more difficult turning.
- – **Motorists may find visibility is reduced,** for example because of trees and street furniture.
- – **Buses in service** may find it difficult to turn, so their access has to be considered. The same applies to heavy goods vehicles that are delivering goods to shops near the intersection.

Potential synergies

- **Pedestrian streets, bicycle streets and recreational and play zones** (see pages 17 to 24) and school zones (see page 28) may comprise narrowed intersections that provide more space for pedestrians and cyclists.
- **One-way roads** (see page 30) can also be combined with narrowing of intersections thanks to the resulting reduction in vehicle numbers.
- **Conversion of traffic lanes and parking** (see pages 36 to 39) can be supplemented with narrowing of intersections as part of a more major street transformation, for example to create a high street.
- **Speed-reduction measures** (see page 32) are closely linked with narrowing of intersections as this in itself has a speed-reducing effect. This can be reinforced in combination with additional measures such as humps, pinch points, etc.
- **Modal filters** (see page 26) are an alternative to narrowing intersections, although both measures can be used on different parts of the same intersection.
- **Other construction works,** such as road renovation or climate adaptation, may provide a cost-effective opportunity to narrow the road at intersections.

Improved crossings

Two-lane raised flat surface at a pedestrian crossing. Photo: Danish Road Directorate.

Completed footway, Vedbækgade, Copenhagen. Photo: Ramboll on behalf of the Road Directorate, Christoffer Askman

Continuous pavement and bicycle track at a T-junction, combined with footway build-outs and greenery to visually reduce speed. Photo: City of Copenhagen.

What characterises improved crossings for pedestrians and cyclists?

Increased accessibility for pedestrians and cyclists

Crossings for pedestrians and cyclists can help to enhance accessibility for pedestrians and cyclists and lessen the severance effect of motorised traffic by making it easier to cross the road.

Greater perceived and actual safety

Good crossings can also help to improve safety and the feeling of safety for pedestrians and cyclists. New crossings can also reduce the number of irregular crossings and thus help to improve road safety.

Implementation at intersections and on road sections

Crossings for pedestrians and cyclists can be provided both at intersections and on a wide range of road section layouts. For example, at intersections this may include continuous pavements and bicycle tracks, longer green time for cyclists and pedestrians, and raised surfaces. On road sections, this may include traffic islands, pedestrian crossings, raised surfaces and bumps.

Particularly relevant for connecting functions

Crossings are of particular relevance where there is a desire to link areas heavily used by pedestrians and cyclists, for example around shops, schools, nursing homes, stations, bus stops and parks, etc.

Examples of crossing design in Denmark

There are lots of different examples of cyclist and pedestrian-friendly crossing designs in cities in Denmark, with a wide variety of sizes and designs. Inspiration for more detailed crossing design can be found in the following publications:

- Håndbog om vejkryds i byer [Handbook on intersections in cities], Danish Road Directorate 2018
- Håndbog om krydsninger mellem stier og veje [Handbook on crossings between paths and roads], Danish Road Directorate 2016
- Håndbog om stikryds [Handbook on intersection of paths], Danish Road Directorate 2016
- Vejtekniske løsninger for cyklister [Road engineering solutions for cyclists], Danish Road Directorate 2022
- Trafiksikkerhed ved afkortede og fremførte cykelstier i signalregulerede kryds [Traffic safety at truncated and regular terminated cycle tracks at signal-controlled intersections], Via Trafik on behalf of the Danish Road Directorate 2020

Benefits

✓ **Greater accessibility for pedestrians and cyclists,** who can cross roads more easily without detours: this is particularly helpful for people with mobility issues.
✓ **Greater road safety and perceived safety** because there are more crossings, and these are more clearly defined.
✓ **Safer urban environments** with good at-grade crossings, as subways under roads can be dark and perceived as unsafe.

Physical design

Relevant on road sections and at intersections

- **Raised surfaces** over a longer distance, for example 10–15 metres, over the entire intersection area at intersections.
- **Pedestrian crossings with/without signal control** must be designed so that vehicles have time to slow down before they reach the pedestrian crossing.
- **Continuous footway and bicycle track** (as opposed to interrupted) crossing side roads or for right turns at intersections. The latter is also referred to as a bicycle shunt.

Relevant on road sections

- **Central islands with a wait option** can help to facilitate crossing, so people crossing the road only have to keep an eye on one direction at a time.
  - **Side islands** allow people to move forward more before crossing the road. These are particularly helpful when there are a lot of cars parked along the road.

  Relevant at intersections
- **Blue cyclist lanes through signal-controlled intersections** make cyclists more visible and enhance traffic safety – no more than one blue cyclist lane per intersection is recommended[12].
- **Regular terminated cycle tracks** may increase accessibility and safety for cyclists, but cause more accidents[13].
- **Truncated bicycle tracks** where bicycles and vehicles are mixed may reduce road accidents and increase safety[14].
- **Bicycle boxes** help to improve accessibility and speed up traffic flow at intersections. Positioned as an extension to a right-turn lane.
- **Right turns permitted for cyclists when the lights are on red** can increase accessibility at intersections.
- **Altered signal settings**, for example increased green time for pedestrians and cyclists at traffic lights, pre-green for cyclists, green wave for cyclists.

Points of attention

– **Physical reconstruction work** may be costly, which is why coordinating reconstruction with other construction work, for example climate adaptation, road renovation, etc. may be considered.
– **Reduced accessibility for vehicles,** which have to slow down more often, keep an eye out and stop for pedestrians and cyclists crossing the road.
– **Bus priority through intersections** may conflict with accessibility for pedestrians and cyclists at intersections, and these considerations have to be weighed up.

§ Relevant Danish Executive Orderes

Executive Order on Road Markings, Signs and Signals

- Transverse markings, such as pedestrian crossings, rumble strips, cyclist crossings and bicycle boxes: see Article 55.
- Text and symbols on the carriageway, such as bicycle symbols: see Article 61.
- Light signals, such as cyclist signals and pedestrian signals: see Article 66.
- Special regulation signs, such as pedestrian crossings: see Article 27.
- Danger warning signs, such as pedestrian crossings, cyclists and children: see Article 13.

Executive Order on the Use of Road Markings

- Pedestrian crossings: see Articles 119 and 197.
- Cyclist crossings: see Article 199.

More information is available in Håndbog for krydsninger mellem stier og veje [Handbook for crossing between paths and roads][15].

Potential synergies

- **Speed-reduction measures** (see page 32) frequently form part of intersection solutions, while lower speeds can make it safer and easier for pedestrians and cyclists to cross the road.
- **Reduction of traffic lanes** (see page 38) can make it easier and safer to cross roads.
- **Narrowing of intersections** (see page 40) can make it easier for cyclists and pedestrians to cross the road.

Case studies: implemented traffic calming measures

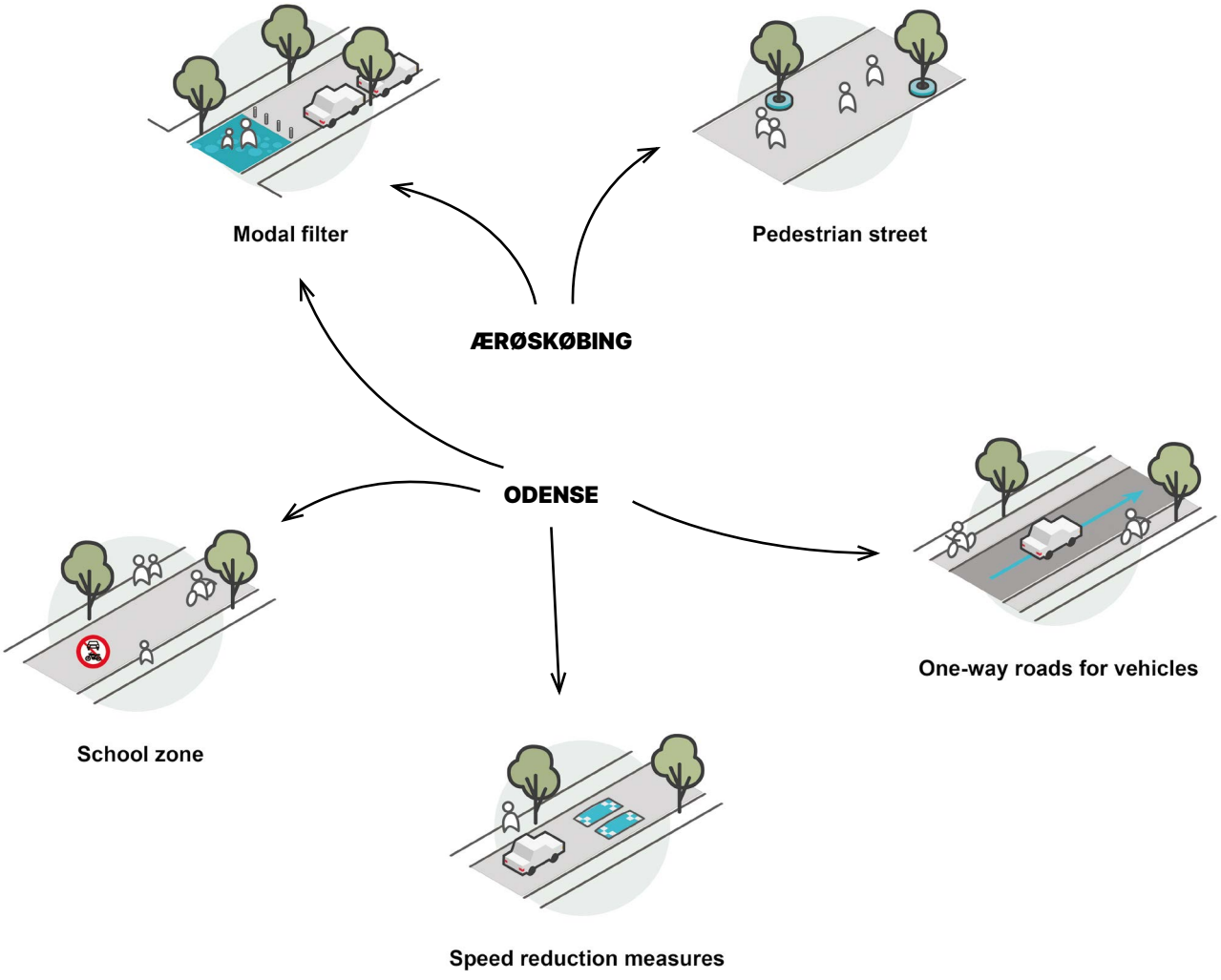
There are many different examples of traffic-calming measures in Denmark, including small, one-off initiatives as well as major urban transformations, and well-known measures such as pedestrian streets and newer initiatives such as car-free school zones.

Two case studies are presented in this section, with examples from municipalities in Denmark that have introduced traffic-calming measures of different kinds.

These show how solutions have been implemented in practice, as well as the lessons learned and experiences gained by the municipalities.

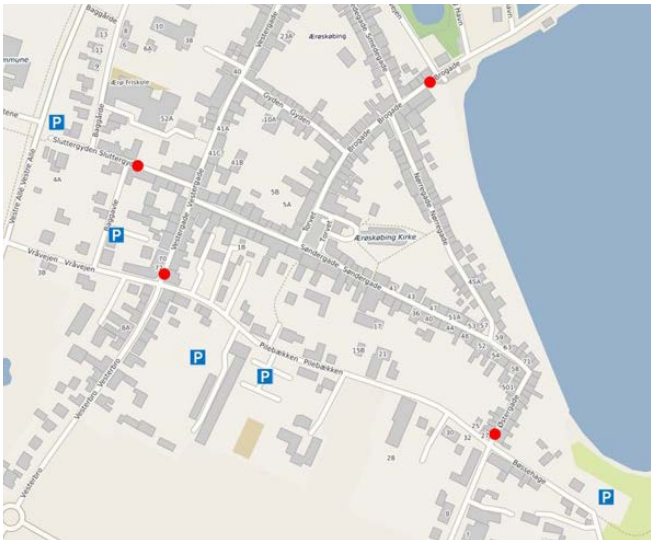
The first case study is from the island of Ærø, where a modal filter involving rising bollards in a pedestrian zone prevents vehicle access in summer. This solution calms car traffic in central Ærøskøbing at times when the town at its busiest, with visitors making the most of what the town has to offer.

The second case study comes from Odense, where car-free school zones around seven schools prioritise students who walk, bike or scoot to school in the morning.



Case 1

Modal filters and pedestrianised zone in summer, Ærøskøbing



Map of the siting of the five rising bollards in Ærøskøbing, as well as parking facilities outside the area.
Map: Municipality of Ærø.

Rising bollards in the pedestrian street in summer in Ærøskøbing, where vehicle access is allowed with special permission and at night and in the mornings from 11pm to 10am.
Photo: Municipality of Ærø

Implemented solution

Ærøskøbing is the main town of the popular vacation island Ærø in southern Denmark. It welcomes many tourists in the summer months, resulting in many vehicles accessing the densely packed historic town centre. Rising bollards were installed at five different locations in 2022, forming a pedestrianised zone in summer. The desire has been to design the area on pedestrian terms and reduce other traffic, including bicycles, during the daytime when numbers of pedestrians peak. Bicycles and motor vehicles can move freely in the pedestrianised zone when the bollards are down, between 11pm and 10am.

The bollards and the pedestrianised zone are deployed from 25 June to 31 August. Residents, businesses and others who have regular errands to make in the area can still access the centre by applying for an access permit. Guests and others can also obtain codes that will allow them to load and unload, while emergency services can lower the bollards and enter the area at any time. The bollards can be operated by means of a code, app, phone call or remote control.

Time and duration

Summer 2022
(25 juni to 31 august, 10am to 11pm).

Price

Approximately €133,000 for installation of the bollard solution. Expenses have also been incurred for renting private land to provide temporary parking.

Impacts

This initiative, which was implemented in summer 2022, has not been evaluated as yet. However, it is already clear that there are fewer vehicles in the town centre. The area has not been completely car-free, as access permits have still been granted to a number of motorists with addresses and errands in the area.

Lessons learned

Involvement and strategic suspension

For a long time the business community in Ærøskøbing wanted to reduce traffic and parking facilities in the narrow streets of Ærøskøbing in summer.

This was part of the reason for the town council adopting a traffic plan in 2018 with the aim of reducing car traffic. One of the initiatives in the traffic plan was to restrict the access for car traffic in summer.

From planning to implementation, the municipality has continuously involved residents and the trade association, as well as the disability council, the tourist and trade association, the emergency services and the police. This has provided an opportunity to engage in dialogue with opponents as part of the process. For example, a meeting was held with residents where the bollard supplier was able to give a presentation about the bollard solution selected. Residents were able to ask practical questions, and to express preferences about the times when the bollards should remain open and to whom access permits should be allocated, for example.

Flexible solution that is easy to use

”**We are pleased with the rising bollard solution** as it is flexible and we can adapt it easily to our needs – both in relation to when the bollards are used during the day and throughout the year, but also in relation who access permits are awarded to.”

- Kurt Nørmark, Maintenance Manager, Parks and Roads, Municipality of Ærø

The flexibility involves the rising bollards, which allow access permits to be adjusted. There has also been emphasis on making the solution easy for everyone to use – i.e. they can be operated using an app, a code or making a phone call, and some residents have also been given a remote control. The municipality has also installed a flexible solution for the signage indicating the pedestrianised zone, which is easy to install and remove thanks to cast mounting holes.

Balancing of demands

There are lots of different local interests when it comes to traffic and parking, and Ærøskøbing is no exception. The municipality has had to balance the demands of people who want to take cars out of the town centre entirely, and people who would like to go on driving and parking in the town centre.

A temporary trial involving a pedestrianised zone and flower boxes took place in the summer of 2021. No physical road closure was involved, however, so the trial did not reduce traffic to any major extent. Given this fact, the current rising bollards were subsequently installed, and this reduced traffic the following summer.

The bollards will be lowered completely as of 1st of September 2022, and an evaluation will be conducted after that. But that is not the end of the bollard adventure. Of late, the trade association has also requested use of the rising bollards for the Christmas market, and possibly for Easter and Whitsun as well.

Good communication pays off

The emphasis has been on good, clear communication throughout the implementation. The municipality has sent letters to all local residents, and has provided information to visitors travelling on ferries to the island, etc.

”**Good cooperation with the communication department has been important** when it comes to communicating widely and reporting any maintenance problems quickly.”
– Tine Rasmussen, administrative employee, Parks and Roads, Municipality of Ærø

This good communication has paid off, as evidenced by the fact that almost everyone on the island of Ærø has heard about what is happening with the bollard solution. This has also addressed any potential confusion, and countered scepticism. The outcome of this effort is that the municipality has received just a small number of complaints and enquiries throughout the summer.

Practical points of attention

Temporary parking spaces in the local area
The municipality has leased private land throughout the summer in order to install parking spaces. These are situated 5 to 10 minutes' walk from the pedestrianised zone.

Successful trial with the police and emergency services
When the bollards were installed, they were tested in practice: a call to the emergency services resulted in all bollards being lowered simultaneously.

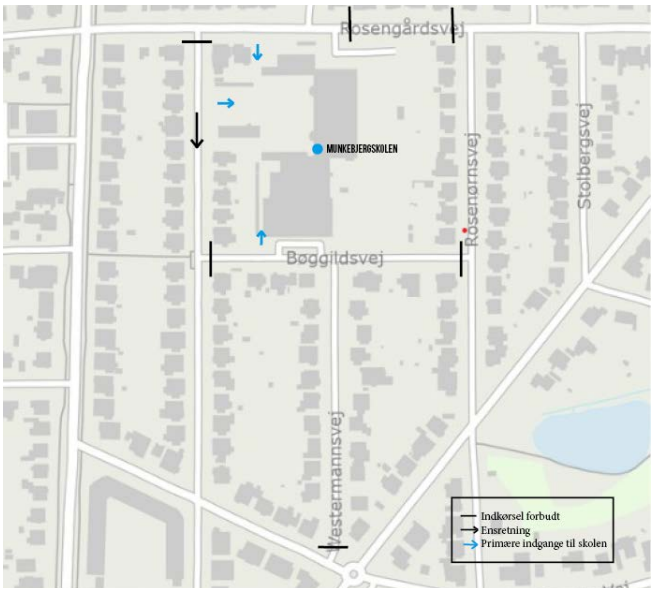
Cars required to park in marked parking bays
Because the area is established as a pedestrianised zone, the Executive Order requires cars to be parked in marked parking bays. The municipality obtained a temporary exemption from the police so that parking bays did not have to be installed for the summer of 2022, as it was difficult to find room for marked parking bays in the narrow town streets. Therefore, there will be a need to re-apply for this concession the next time the bollards and pedestrian street are to be used, otherwise another solution will have to be found.

Rising bollards in Ærøskøbing. Photo: Municipality of Ærø

Case 2

Car-free school zones in the mornings in Odense

"No access for motor vehicles" restrictions in the morning at Munkebjergskolen, one of Odense's seven car-free schools, on Rosengårdsvej. Photo: Municipality of Odense



Map of Munkebjergskolen indicating "no access for motor vehicles" restrictions on three out of four roadsides near the school. Map: Municipality of Odense

Implemented solution

Car-free school zones have been set up at seven schools in Denmark's third-largest city, Odense. In these zones, cars are banned on weekdays between 7.30am and 8.15am. During this time, people have to walk or travel by bicycle or scooter if they want to access the school. A few places can also be accessed by bus.

The extent of the car-free school zones varies. Some places establish the "no access for motor vehicles" restrictions on most of the roads around the school, some on one road only. One of the schools with the most extensive restrictions is Munkebjergskolen, where three out of four roads around the school are closed to through traffic in the mornings. This means that children who still come to school by car have to walk about 250 metres to get to the entrance of the school.

Residents living inside the car-free zones are generally exempt from the restrictions. Other exceptions have also been made in some places – for example at Tarup Skole, where city buses and selected business operators are also exempt.
The seven schools assigned car-free zones with "no access for motor vehicles" restrictions in the mornings are: Munkebjergskolen, Tarup Skole, Provstegårdsskolen, Odense Friskole, Vestre Skole, Hjalleseskolen and Tingløkkeskolen.

Time and duration

Ongoing since 2015, weekdays 7.30am to 8.15am.

Price

The actual signage for the "no access for motor vehicles" restrictions can frequently be kept within the operating budget, and cost, for example, about €2,700–€4,000 at Munkebjergskolen. At a number of the schools, signage is supplemented by other existing or new traffic-related measures, for example one-way roads, speed-reduction measures, recreational and play streets and bans on parking.

Impact

This initiative has reduced car traffic around schools in the mornings, which has made it safer to cycle and walk to school. For example, at Munkebjergskolen, the percentage of children cycling and walking to school increased from about 75% in 2014 to about 85% in 2022.

Lessons learned

Inexpensive initiative offering great value

The actual measure restricting access for motor vehicles in the mornings is an inexpensive measure as it essentially involves just putting up signs. This potentially adds a great deal of value for not much money by scaling down car traffic and increasing security and perceived safety for school children.

That said, it is crucial to ensure that the restrictions are respected in order to achieve the desired traffic-calming impact. That is why the process and discussion on the measure have an important part to play. Acceptance of car-free zones among parents varies from school to school, and some may well express dissatisfaction, particularly at the outset. However, most parents in general are understanding about the initiative and follow the new rules.

Good cooperation with the school is a must

The initiative was requested by all seven schools where the car-free zones have been implemented.

> **"The school itself has to see the point of the initiative, otherwise it will frequently fail to have the desired effect."** – Connie Clausen, Traffic Planner, Municipality of Odense

The headteacher in particular – frequently working in partnership with the school board – has an important part to play in successful implementation, engaging in dialogue with parents.

Traffic is rarely at the top of schools' wish lists: it is frequently viewed as something that "just has to work". That is why the municipality is focusing on the individual schools' motivation to do something about traffic, for example health, play, bicycle trips, sustainability, etc., in their general collaboration with schools in order to increase cycling. However, car-free zones are typically introduced due to complaints from parents, as well as at the request of either the school management or the school board.

Enforcement from multiple sides

When it comes to enforcement, the municipality is using its own traffic wardens during the initial phase but is also working with the police in relation to ongoing enforcement.

Finally, the headteacher frequently plays a major role in ensuring that "no access for motor vehicles" restrictions are respected and engages in dialogue with parents who do not comply with the ban.

> **"This type of measure requires a headteacher who is willing to talk to parents and tell them off if they fail to comply with the 'no access for motor vehicles' restrictions."** - Connie Clausen, Traffic Planner, Municipality of Odense

Communication via the school intranet (AULA) has also proven effective in reaching out to parents of students at the schools. Public authorities use a digital mailbox to which all citizens are subscribed (e-Boks) to inform residents in the area when car-free zones around the schools are established.

Gradual implementation

Typically, car-free zones around schools begin by being rolled out on one or two roads around the school, from which the concept can be extended. For example, the car-free zone at Munkebjergsskolen has now been extended from two roads to three.

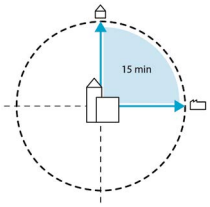
Local residents and parents frequently express concerns about the car-free zones prior to their implementation, but after a period there is often a desire to make the restrictions even stricter – as is the case at Munkebjergskolen. Gradual implementation makes it possible to extend the intervention over time without creating excessive resistance.

Among other things, the municipality of Odense has had to adjust the signage, as in some locations, exemptions for motorists inside the zone were being exploited by people living outside the zone. As a result, the municipality decided, in cooperation with the police, to make the signage more specific, indicating which house numbers are exempt from the "no access for motor vehicles" restrictions.

Five European examples of extensive urban traffic calming measures

A number of European cities are working on extensive initiatives to implement traffic-calming measures throughout their entirety, or in selected districts. They are deploying many of the measures set out in this handbook as part of a more overall strategic initiative.

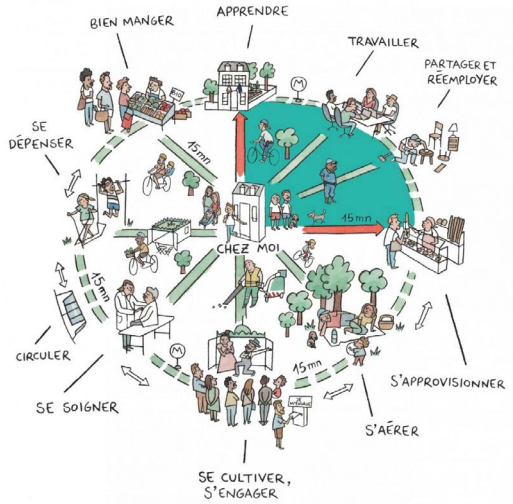
Cities' experience of these initiatives has been positive to date, including less traffic, more walk-ing and cycling, and reduced air pollution, CO2 emissions, road noise and road traffic accidents. This section provides five inspiring European case studies.



15-minute city in Paris, France

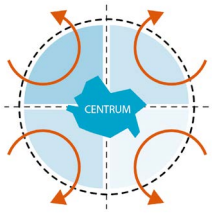
Paris' ambition is to design districts so that all essential functions can be reached on foot or by bicycle or public transport within 15 minutes.

The 15-Minute City's emphasis on enhancing quality of life requires a comprehensive approach involving city planning and traffic-calming measures, but also, for example, social measures for inclusion and involvement of residents. In 2021, the speed limit was reduced to 30 km/h throughout much of the city, traffic-calming measures were implemented on a large number of roads – along the banks of the Seine, for example – and a large number of "pop-up" bicycle lanes were built to respond to the transport impact of COVID-19.



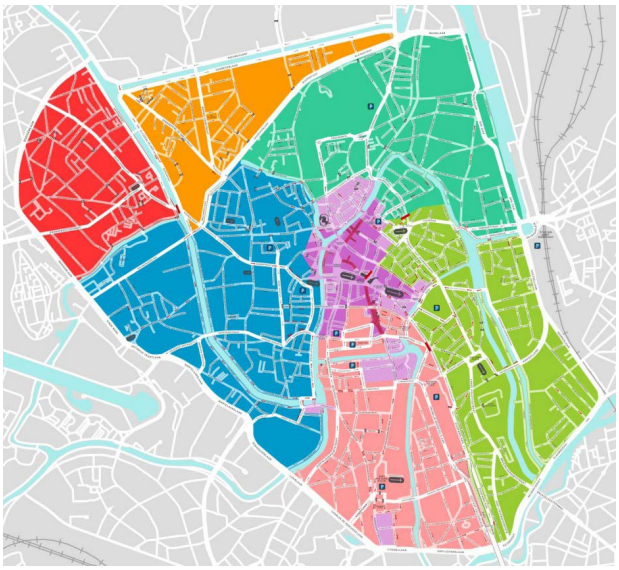
15-Minute City. Illustration: Micaël, Ville de Paris.

Circulation plan and restricted traffic areas in Ghent, Belgium



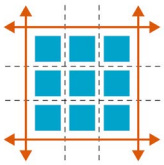
A circulation plan dividing the area into six restricted traffic areas has been introduced in Ghent in order to prevent motorists driving through the historic city centre. The only vehicles that can access these areas are reserved for residents' service trips, and traffic running errands to local businesses.

It is not possible to travel across a restricted traffic area or directly from one restricted traffic area to another, so vehicles travel between the restricted traffic areas via the main road network. That said, pedestrians, cyclists and public transport are able to freely move inside and across the areas. When it introduced the restricted traffic areas, the city extended pedestrian streets by 150%, altered the direction of travel in 80 streets and set up modal filters in 14 locations[16].



Circulation plan and restricted traffic areas, Ghent. Map: City of Ghent.

Superblocks in Barcelona, Spain

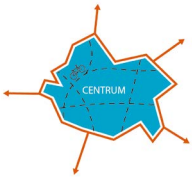


The aim of Barcelona's "superblocks" – or "superilles" in Catalan – is to create room for green urban spaces and reduce road noise, air pollution and road traffic accidents by reducing car traffic.

The city's grid structure forms a basis for "superblocks", which are 3 × 3 residential apartment blocks (approx. 400 m2) that make up a locally adapted concept for restricted traffic areas. Buses and other vehicles can access the fringes of the superblock, while streets between the apartment blocks are reserved for cyclists and pedestrians and multifunctional urban spaces with room for play and recreation. Residents are also permitted to drive between the apartment blocks. In total, 503 superblocks are planned.

Converted street space as part of a "superilla" in Barcelona. Photo: Ajuntament de Barcelona

Car-free city centre in Ljubljana, Slovenia

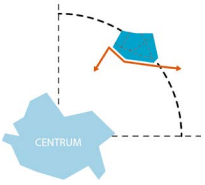


In 2007, Ljubljana introduced an extensive traffic-calming scheme in the city centre, with funding from the EU. The car-free city centre covers an area of over 10 hectares.

Rising bollards permit access for delivery of goods between 6am and 10am only, and people travel around on foot, by bicycle and in small electric minibuses that are free to use. There are car parks on the fringes of the city centre where locals can park cheaply, making it easy to leave the car behind and continue into the city on foot or by bicycle. A major shopping street, Slovenska Boulevard, was also closed to through traffic in 2015. Use of cars has decreased, cycling has increased, and both CO2 emissions and traffic noise have declined as a result.

Rising bollards at the entrance to the car-free city centre in Ljubljana. Photo: Urban Creators..

Vauban car-free urban development area in Freiburg, Germany



In 1992 the Vauban district was transformed from a military base into a sustainable residential district. Vauban is 3 km from the centre of Freiburg and can be reached by bicycle in 10 to 15 minutes.

This district has been developed in close dialogue with its 5,500 residents and offers versatile and colourful architecture, daily activities all within easy reach, and large green spaces and community gardens. All parking facilities are located on the fringes of the district, with a particularly low parking rate of 0.5 parking spaces per household. People mainly get around on foot, by bicycle and by tram on low-speed roads with a 30 km/h speed limit or on recreational and play streets with a 5 km/h speed limit. Only service vehicles are allowed access.

Play and recreation street ("Spielstrasse") in Vauban. Photo: Rahel Varnhagen, City of Freiburg.

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11: City of Copenhagen. Cykelregnskabet 2016 [Bicycle Account 2016].

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14: See section 12.

15: Danish Road Directorate, 2016: Handbook: Krydsning mellem stier og veje – Anlæg og planlægning [Handbook: Crossing between paths and roads – Construction and planning].

16: City of Ghent. The Mobility Plan.

Find more inspiration

The publications below provide more information on different types of traffic calming measures (in Danish):

Guides and handbooks

- Færdselstavler, tavleoversigt, håndbog [Road signs, road signs overview, handbook], Danish Road Directorate 2022
- Trafikplanlægning i byer, håndbog [Traffic planning in cities, handbook], Danish Road Directorate 2020
- Tværprofiler i byer, håndbog [Cross-sections in cities, handbook], Danish Road Directorate 2019
- Vejkryds i byer, håndbog [Urban road intersections, handbook], Danish Road Directorate 2018
- Anlæg for parkering og standsning i byer, håndbog [Urban facilities for parking and stopping, handbook], Danish Road Directorate 2018
- Fodgængerområder, håndbog [Pedestrian areas, handbook], Danish Road Directorate 2016
- Krydsninger mellem stier og veje, håndbog [Crossings between paths and roads, handbook], Danish Road Directorate 2016
- Stikryds, håndbog [Intersection of paths, handbook], Danish Road Directorate 2016
- Supercykelstier, håndbog [Cycle Superhighways, handbook], Danish Road Directorate 2016
- Tracéring i byer, håndbog [Layout work in cities, handbook], Danish Road Directorate 2016
- Trafiksikkerhedsrevision, håndbog [Road safety audit, handbook], Danish Road Directorate 2015
- Trafiksikkerhedsrevision, checklister [Road safety audit, checklists], Danish Road Directorate 2015
- Håndbog, Trafiksikkerhed, Effekter af vejtekniske virkemidler [Handbook, Traffic safety, Impact of road engineering measures], Danish Road Directorate 2014
- Vejledning om anvendelse af Shared Space [Guidance on the use of Shared Space, Danish Road Directorate 2013
- Håndbog om fartdæmpere [Handbook on speed reduction measures], Danish Road Directorate 2013

Catalogues and collections of examples

- Hastighedsafmærkning, eksempelsamling [Speed signs, a collection of examples], Danish Road Directorate 2020
- Katalog over typegodkendte hump [Catalogue of type-approved road humps], Danish Road Directorate 2019
- Cykelvenlig infrastruktur, inspirationshæfte [Bicycle-friendly infrastructure, inspiration booklet], Danish Road Directorate 2017
- Trafikplanlægning i byer – Eksempelsamling [Traffic planning in cities – A collection of examples], Danish Road Directorate 2016
- Skolevejsprojekter – en eksempelsamling [School road projects – a collection of examples], Danish Road Directorate 2014
- Eksempelsamling om fartdæmpere [A collection of examples of speed reduction measures], Danish Road Directorate 2013
- Fleksible anvendelser af vejarealerne, inspirationskatalog [Flexible uses of road areas, inspiration catalogue], Danish Road Directorate 2012
- Eksempelsamling, Shared Space [A collection of examples, Shared Space], Danish Road Directorate, 2011
- Erfaringsopsamling om trafiksanering med hastighedsdæmpning – Vejbump [Collection of empirical data on traffic reorganisation measures with traffic calming measures – road humps], Danish Road Directorate 2004
- Erfaringsopsamling om trafiksanering med hastighedsdæmpning i danske kommuner [Collection of empirical data on traffic reorganisation measures with speed reduction measures in municipalities in Denmark], Danish Road Directorate 2003

Find more inspiration

The publications below provide more information on different types of traffic calming measures (in Danish):

Other publications

- Vejtekniske løsninger for cyklister, Effekt på sikkerhed og oplevet tryghed [Road engineering solutions for cyclists, Impact on safety and perceived safety], Danish Road Directorate 2022
- Partnerskab for levende bymidter, Rapport og anbefalinger [Partnership for liveable city centres, Report and recommendations], Danish Housing and Planning Authority 2021
- Bilfri byområder – Inspirationskatalog til dialog [Car-free urban areas – Inspiration guide for dialogue], Municipality of Copenhagen 2020
- Bilfrie byområder, Eksempelsamling [Car-free urban areas, Collection of examples], Concito, 2016
- Konceptkatalog, Idéer til bedre sikkerhed på skolevejen [Concept catalogue, Ideas for improving safety on school roads], Municipality of Frederiksberg 2016
- Transport, forbrug og adfærd, En undersøgelse af danskernes handelsliv [Transport, consumption and behaviour, A survey of Danes' shopping], Cowi 2015
- Håndbog i cykeltrafik, En samling af de danske vejregler på cykelområdet [Handbook of cycling, A collection of Danish road standards for cycling], Celis Consult 2014
- Byliv der betaler sig – gevinster ved investeringer i byliv og bykvalitet [Liveability that pays off – gains from investments in liveability and urban quality], Danish Nature Agency 2013
- Mere bevægelse i byens rum – et idekatalog om byfornyelse og moderne legegader [More movement in urban spaces – a catalogue of ideas for urban renewal and modern play streets], Ministry of the Interior and Housing 2009


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