Oslo

Street Design Manual for Oslo

AGENCY FOR URBAN ENVIRONMENT

Photo: City of Oslo

CITY OF OSLO, AGENCY FOR URBAN ENVIRONMENT

Street Design Manual for Oslo

Foreword

This manual supersedes “Street and Road Design for the City of Oslo”, revised January 2018. The Street Design Manual must be used to plan all municipal streets in Oslo. Norwegian Public Roads Administration Handbook N100 must be used to plan the municipal road network in Marka (protected forest areas surrounding Oslo). The boundary between Marka and the developed area is shown in Figure 0-1. Handbook N100's requirements for geometric composition must be followed unless other requirements are presented in this manual.

The manual describes the expected design of streets in new urban development areas. The manual also applies to existing street structure, with subject to change depending on compromises and deviations based on spatial limitations for street functions.

The manual contains requirements and principles for street design, and is a tool to be used in all phases: analysis, detailed planning, construction, operation and maintenance of the City’s streets.

This street design manual is supplemented with Standard Sheets for the technical design of measures and fact sheets on stormwater solutions. Standard Sheets have been produced to illustrate details of universal design, use of materials, vegetation, and solutions that provide stormwater management and other infrastructure both above and below the ground.

Experts from agencies within the City of Oslo, Ruter AS and Sporveien AS assisted in producing the street design manual. COWI AS was the consultant for this work.

LEGAL BASIS

The street design manual is based on Section 13 of the Norwegian Roads Act and Section 3 of the Regulations on construction of public roads.

The manual contains detailed provisions on the planning and design of all municipal streets. The function of the street design manual and possible waivers are described in this document.

The manual will also govern solutions and product choices for the construction of municipal roads, cf. Planning and Building Act, Section 18-1, second paragraph.

Gerd Robsahm Kjørven
Date 13.10.2020

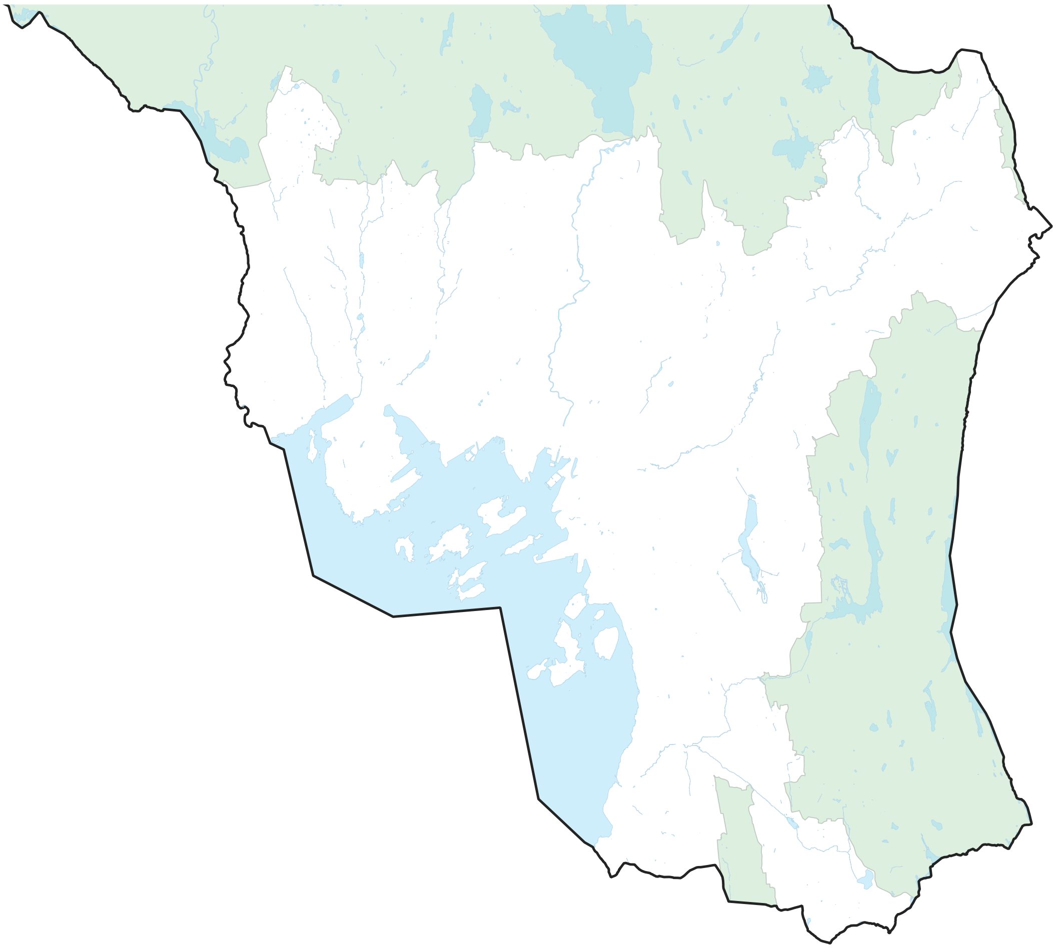

FIGURE 0-1 Boundary of Marka.

Contents

1. Introduction

The municipality of Oslo has a vision of the capital as *"a greener, warmer and more inclusive city for everyone."* The streets must provide functions beyond traffic flow and recreation, on account of the many comprehensive spatial demands. This requires a new approach for planning and implementation.

This street design manual sets out principles and technical requirements for the prioritising of city life, different groups of road-users, infrastructure above and below ground, vegetation and infrastructure that conforms to universal design. Great emphasis has been placed on good solutions for managing stormwater, establishing vegetation and providing for universal design, in addition to the more traditional aspects of street planning on account of different road-users.

The new manual describes the expected design of streets in new urban development and transformation areas. Nevertheless, similarly to existing street structure, these urban development areas may require compromises and deviations from the manual on account of spatial limitations for different street functions.

The street design manual is a tool for all involved parties in the planning process of existing- and new street projects. The manual provides an overview of the subject areas that the Agency for Urban Environment is responsible for managing. It should be used in projects relating to analysis, detailed planning, construction, operation and maintenance of municipal streets.

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1.1 Changes from “Street and Road Design for the City of Oslo” (2018)

This street design manual supersedes “Street and Road Design for the City of Oslo” (2018), which was a simple revision of the 2011 version of the manual.

The principal changes from 2018 are:

1. All municipal streets and roads in the City of Oslo, except for municipal roads in Marka, must now be planned as streets.
2. The manual contains requirements and proposals for solutions regarding stormwater management, cables and pipes, street furniture and lighting, green spaces and trees.
3. The manual has incorporated new and previously adopted climate targets.
4. Greater emphasis on context and main functions as a basis for the choice of street type and criteria for the design of streets.
5. The manual presents several suggested solutions for pedestrians, cyclists and public transport.
6. The manual stipulates that developers must ensure that all necessary functions for the operation of buildings and other real estate are provided on their own land and not on the public street.
7. The manual presents solutions that ensure universal accessibility.
8. The manual includes a toolbox with illustrations that showcase possible spatial divisions, to accommodate different traffic functions in various street types and widths.

1.2 How to Use the Street Design Manual

The design of a street influences in which way it functions with the surrounding area and the street network of the city. The manual provides a precedent regarding the prioritisation of functions according to what the street can accommodate based on available space. In most cases, there will not be space for all of the desired functions. Concern for functions such as city life, sustainable mobility and accessibility for all, stormwater management, vegetation, cables and pipes should be assessed and prioritised prior to the commencement of the detail planning and design.

The manual can be used as a reference tool where individual users can go directly to the sections that are relevant to them. Parts 3-6 on “Detailed planning” contain design requirements for various street elements.

The street design manual is divided into the following main sections:

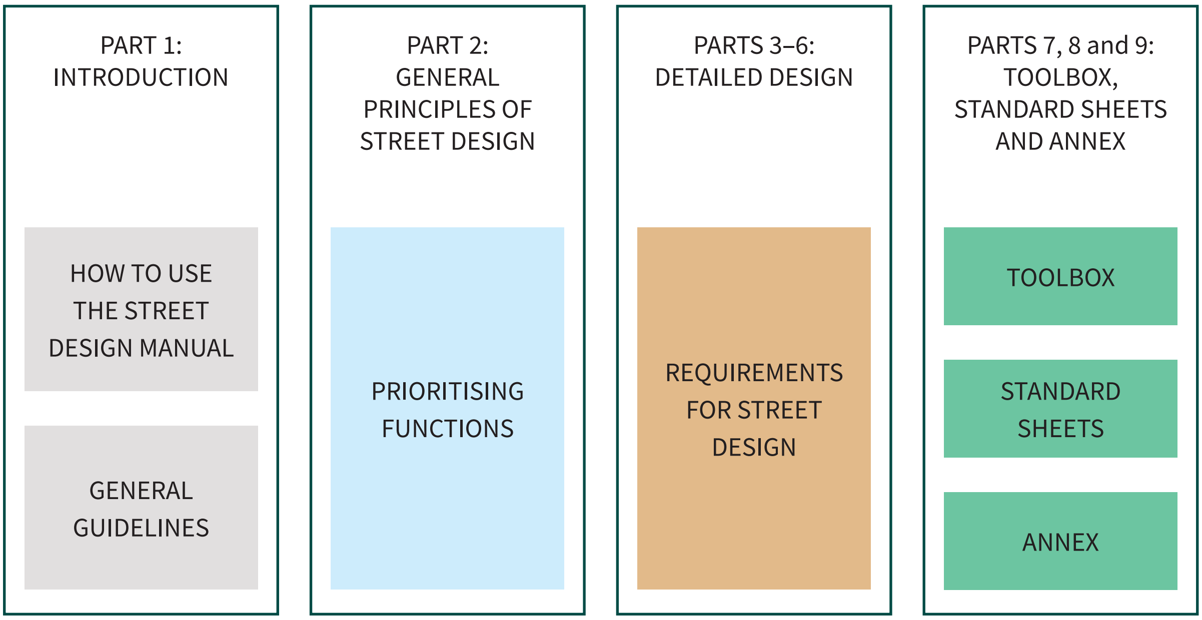

FIGURE 1-1 Breakdown of the street design manual.

PART 1: INTRODUCTION – HOW TO USE THE STREET DESIGN MANUAL

Part 1 describes how the street design manual can be used, changes from *Street and Road Design for the City of Oslo" (2018)*, areas of responsibility, and who is authorised to waive requirements in the street design manual. General guidelines for the design of the street network in Oslo are also set out in Part 1.

PART 2: GENERAL PRINCIPLES OF STREET DESIGN: PRIORITISING FUNCTIONS

Part 2 introduces a system for categorising the city's streets, with a description of how the street network can be analysed. Integral to the approach, is an evaluation of the street's capability as it relates to functions, which functions can and cannot be accommodated for. For example, the planning must take account of lane widths on the carriageway, the design of bus and tram stops, and the location of cables and pipes, as shown in Parts 3-6, as a basis for prioritising functions. Traffic function in the larger street network must be prioritised as early as possible in the planning process.

PARTS 3-6: DETAILED PLANNING: REQUIREMENTS FOR STREET DESIGN

Parts 3-6 present principles and requirements for the design of street elements. They describe the design of the street infrastructure – above and below ground. Requirements in Parts 3-6 apply to the construction of new streets and to the redeployment and modification of existing roads and streets.

PARTS 7, 8 AND 9: TOOLBOX, STANDARD SHEETS AND ANNEX

The toolbox gives examples of street design that are currently under review. Part 8 contains an overview of design dimensions for different groups of road-users and vehicles.

The Standard Sheets supplement the street design manual with examples of specific features.

The Annex contains a glossary and a list of references and governing documents.

1.2.1 Document display

Highlighting has been used to draw attention to elements in the street design manual.

Text in green boxes always relates to definitions.

Text in blue boxes provides information on the topic as a whole or specifically for Oslo.

MUST and **SHOULD** requirements are highlighted separately; see Table 1-1.

1.3 General Guidelines

The Municipal Plan for Oslo provides the framework for the physical planning of streets. Oslo aims to be *"a greener, warmer and more creative city with space for everyone."* Oslo has a goal of becoming a zero-emission city by 2030. The City of Oslo aims to develop the city in a way that reduces dependence on cars, provides good public transport and makes it safer and easier for anyone to walk and cycle.

The City also aims to reduce emissions from the building and construction sector. Shortage of space calls for solutions that support shared space. At the same time, the city needs to be equipped to handle climate change, including climate adaptation measures. This could include stormwater management with the aid of green structure to capture and retain water, or vegetation which helps to regulate the temperature in a densely populated city.

The physical design and development of the street network can influence the way in which people move around and use the city. The street network must be designed, operated and maintained in a way that allows the need for transport to be addressed in a safe and environmentally friendly way.

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The following are key points related to mobility in the Climate Strategy that has been adopted:

- Walking, cycling and public transport should be the preferred choices for journeys in Oslo. Car traffic should be reduced by a third by 2030 compared with 2015.
- All cars on Oslo's roads should be emission-free by 2030. Public transport should be emission-free by 2028.
- All commercial vehicles should be emission-free. All heavy transport in Oslo should be emission-free or use renewable fuel by 2030.
- Building and construction projects in Oslo should be fossil-free, and then emission-free by 2030.
- Oslo should have a circular process for waste and sewage handling based on reuse, recycling and energy recovery, which does not produce any greenhouse gas emissions.

OSLO TO PLAN FOR ZERO EMISSIONS OF GREENHOUSE GASES

In 2030, Oslo aims to be a city almost without any emissions of greenhouse gases. The transformation of Oslo into a climate-adapted zero-emission society will help to create a healthy, pleasant and efficient cityscape without extensive social differences and with cleaner air and water. Oslo is an arena for innovation, testing and commercialisation of new climate solutions, where climate policy and economic policy support each other. Oslo is leading a major shift in climate and energy policy at a national and global arena. Oslo will contribute to larger and earlier emission cuts in other cities and countries by passing on our solutions and experience. From 2030 at the latest, Oslo will be a "carbon-negative" city, which means that it will help to reduce the amounts of greenhouse gases in the atmosphere by both biological and industrial carbon capture and sequestration.

Oslo has the following goals:

- Oslo's greenhouse gas emissions in 2030 will be reduced by 95 per cent compared to 2009.
- Nature in Oslo will be managed in such a way that natural carbon stores in the vegetation and soil can be exploited and the absorption of greenhouse gases in forests and other vegetation increases to 2030.
- Oslo's total energy consumption in 2030 will be reduced by 10 per cent compared to 2009.
- Oslo's ability to withstand climate change will increase by 2030, and the city will be developed in such a way that it is equipped to face the changes that are expected in the years to 2100.
- Oslo's contribution to greenhouse gas emissions outside the City will be significantly lower in 2030 than in 2020.
- Climate Strategy for Oslo to 2030, adopted May 2020.

1.3.1 A greener and more attractive city

Oslo must be an attractive metropolis and capital city. The design of the streets should reinforce the role and identity of the urban fabric. The dense and multi-purpose city should be extended into new areas. The streets constitute a large part of the urban public spaces. They are integral elements if we are to achieve the goals adopted in the Municipal Plan and the Climate Strategy (City of Oslo 2019 and 2020).

As stated in the Architecture Policy adopted in 2020, the street should be recognised as one of the most important communal spaces of the city. A city that prioritises good city life will prioritise street areas for pedestrians, cyclists, public transport and public spaces. Furthermore, adequate space must be set aside for deliveries and transport of people with disabilities.

Oslo aims to be a green city. Green spaces are important social arenas with a big influence on public health. Green spaces can support biodiversity, provide important carbon stores in the vegetation and soil, clean the air and assist in stormwater management and temperature regulation.

Green spaces must therefore be incorporated into plans and projects more extensively than in the past. The design of the streets has a major bearing on the quality of life for the people moving through- and spending time in the City of Oslo.

WHAT IS A STREET AND WHAT IS A ROAD?

Streets and roads differ in both function and design. A road joins places together, and the design is governed by the traffic it carries and the terrain it passes through.

A street acts as a transport artery, meeting place and public space. A street has a more rigid geometry than a road, and is often lined with buildings which form a visual boundary.

Roads are transport arteries and have a higher speed limit than streets with mixed functions. Streets often provide better access for all road users than roads.

1.3.2 Climate adaptation and stormwater management

The effects of climate change call for major changes in the way the city is planned, built and managed. The City of Oslo aims to strengthen the city's ability to withstand climate change by to 2030, and ensure that the city is developed in such a way that it is equipped to face the changes that may be expected in the years to 2100. The City of Oslo has guidelines for climate adaptation and stormwater management which are set out in the following documents:

- Climate Strategy for Oslo to 2030 (City Council proposition 214/19), adopted 6 May 2020.
- Strategy for stormwater management in Oslo, 2013–2030.
- Action plan for stormwater management (City of Oslo 2019).
- Guide to stormwater management for the City of Oslo (in revision).

The most important measure for improved climate adaptation in street planning is improved stormwater management. In the City of Oslo, stormwater management should:

1. Meet the climate challenges and minimise injury and damage to people, buildings and infrastructure.
2. Safeguard the environment and maintain good ecological and chemical conditions in water.
3. Be used as a resource in the urban landscape.

1.3.3 Streets accessible to all

People moving around the city have different needs and capabilities. These different needs and capabilities can be best addressed when the solutions are based on universal design. When the standard solutions meet the needs of as many people as possible, there will be few non-standard solutions. Good, holistic solutions that make it easy for people to find their way around and provide cohesion and 'readability' can encourage participation in the life of the city.

1.3.4 Noise and air pollution

Investment in mobility and the design of the transport system must reduce the negative environmental effects of conventional transportation. Limitations in noise pollution and environmentally hazardous pollution from traffic are defined in national goals, regulations and guidelines. *The "Guideline for handling noise in land-use planning" (T-1442)* deals with outdoor noise and must be used to assess whether there is a need for mitigating measures when planning and constructing streets and roads. *The "Guideline for handling air pollution in land-use planning" (T-1520)* provides concrete recommendations for measures that maintain and improve air quality in populated areas or public space. T-1520 contains recommendations for reducing nuisance from airborne particles and nitrogen dioxide.

1.3.5 Road safety

Investment in mobility and the design of the transport system must help to reduce the number of accidents. It should feel safe and secure to travel around Oslo, by whatever means. The streets must be designed to minimise the risk of accidents for pedestrians, cyclists, passengers on public transport and other road-users. Solutions to promote road safety must be incorporated into the planning, implementation and follow-up of all street projects.

1.3.6 Public safety and civil protection

Public safety and civil protection must be considered in the planning and implementation of measures in the street network. The City's overall risk and vulnerability analysis should form the basis for design of the streets.

One aim is to avoid placing bollards on public pavements, squares and park areas in front of security-sensitive buildings and installations. Safety measures should not pose obstacles to the emergency services, pedestrians, wheelchair users and cyclists. Necessary safety measures in urban spaces must be integrated into the design of these spaces.

1.3.7 Shortage of space

Lack of space raises a need to prioritise. In most street projects there is limitation on space to satisfy all the requirements for adequate mobility, infrastructure and urban quality.

To achieve the goal of sustainable and climate-friendly solutions, it will be necessary to set aside larger areas for vegetation and stormwater management than before, whilst more areas need to be prioritised for 'soft' road-users (pedestrians and cyclists). There is also a need to prioritise passability for public transport to provide people with environmentally friendly transportation alternatives. Urban logistics (deliveries, refuse disposal, tradespeople) also require space in the urban fabric.

The width of an average Oslo street often makes it impossible to prioritise all groups of road-users together with areas for stormwater management and vegetation in the same street. In practice, this necessitates a consideration of whether the needs of different groups can be best met by shared space and reduced speed limits, or whether some road-users should be moved to accommodate the spatial needs for blue-green infrastructure, passability, and safety for all.

1.3.8 Quality of experience and historic monuments

The city's streets are spatial links which connect different areas together, where the character of the different streets is shaped by their surroundings. The City aims to create and develop differentiated streets with different functions and characteristics, to improve the experience of the city's users (from the Architecture Policy).

The depth of time that can be felt along the historic communication arteries is essential to any understanding of Oslo. Large parts of Oslo's street network bear traces of the past and are marked by the long history of the city.

1.4 Responsibility for the Design and Management of the Municipal Street Network

The City's agencies have different areas of responsibility in the design and management of the municipal street network, while the Norwegian Public Roads Administration is the competent authority for a number of areas affecting the design of the street network.

1.4.1 Areas of responsibility

The **Agency for Urban Environment** manages and monitors streets, squares, parks, outdoor areas, sports facilities, and the Marka and Inner Oslofjord areas. The Agency for Urban Environment is also responsible for air quality, noise, water and soil.

The **Agency for Planning and Building Services** is responsible for the overall landuse planning in the municipality, plan and project processing (including stormwater management), map management and mapping and division proceedings in the municipality.

The **Agency for Water and Wastewater Services** is responsible for the management, maintenance and renewal of the city's treatment plants, pipe network and pumping stations for both drinking water and waste water.

The **Agency for Waste Management** is responsible for collecting, storing, and transporting household waste.

The **Heritage Management Office** works to ensure that the city's historic monuments are preserved as a natural part of all land-use planning, construction works, and management of the physical environment.

Ruter plans, coordinates, orders and markets public transport in Oslo and parts of Viken.

Sporveien owns, develops and manages the infrastructure associated with the underground and trams.

The **Norwegian Public Roads Administration** has sectoral responsibility for following up on national actions for the whole of the road transport system. The administration has sectoral responsibility for road safety, climate, and environment and general urban policy. The administration also has a national coordination role for public transport, urban growth agreements, city packages and toll financing, along with public safety and civil protection.

The **Norwegian Water Resources and Energy Directorate** is the national sectoral authority in the fields of flood, erosion and avalanche risk and general interests related to watercourses and groundwater, and facilities for energy production and transmission of electric power. The directorate is also responsible for assisting the municipalities in preventing damage from stormwater through knowledge of run-off in populated areas (urban hydrology).

1.4.2 Waivers

The Norwegian Public Roads Administration, through the Directorate of Public Roads, has the ability to approve waivers of requirements in the street and road design manuals for national roads; county administrations have the same powers for county roads, and municipalities for municipal roads.

Requirements based on acts, rules and regulations, and matters which are clearly not open to discussion, cannot be waived.

The Director of the Agency for Urban Environment has the ability to approve waivers of the "Street and road design manual for municipal streets and roads in Oslo" (Delegation decision on Section 13 of the Roads Act, from City Council proposition 1046/16, and decision of the Vice Mayor for Environment and Transport of 21.06.2016, proposition 02/2016).

Requests for waivers should be sent to the Agency for Urban Environment: postmottak@bym.oslo.kommune.no

TABLE 1-1 Waivers.

Verb	Meaning	Waivers
MUST	**Requirement**	**Mandatory ("must") requirements** cannot generally be waived.
SHOULD	**Requirement**	Waivers of **desirable ("should") requirements** must be justified with a detailed explanation regarding the reasons for why the requirement cannot be met. Implications of the solution for which a waiver is sought must be documented.

Table 1-1 shows the requirements for waiving elements of the street design manual.

In a development planning process, requests for waivers should be submitted and processed as early as possible in the planning process, and before the development plan is circulated for public scrutiny. If a deviation from an already adopted development plan is requested, the possibility of a waiver will be limited by the land-use and other provisions in the development plan. In these cases, the Agency for Urban Environment may require the applicant to seek a dispensation from the development plan or propose a new development plan before it can handle the request for a waiver. There must be an approved waiver request in place before construction can start.

The Norwegian Public Roads Administration must approve waivers for:

- Standards in the 300 series (N300 Signs, N301 Work on and near roads, N302 Road marking, and N303 Traffic signals) which are based on Section 35 of the Signage Regulations pursuant to the Roads Act and the Road Traffic Act.

2. Principles of Street Design

The function of the street in the city's street network, its cross-section and the level of ambition for mobility, urban quality, and infrastructure impose constraints on the way a street is designed. Sections 3-6 of the street design manual show spatial needs and technical requirements for major functions.

In certain projects, particularly in development areas where the street structure can be changed, the functional requirements may determine the design of the street. In these areas, the cross-section can be adapted to the requirements for the planned functions in the area.

In existing street structures, the cross-section is generally a given, and the functions of the street have to be addressed within a defined area. Changes to streets in the existing street structure also need to take account of spatial needs and technical requirements for the different functions. Changes to a street may mean that some functions have to be moved to surrounding streets; for example, parking spaces, cycle lanes, trees, public transport routes, commercial traffic or large-scale facilities for stormwater management may have to be moved to another street nearby.

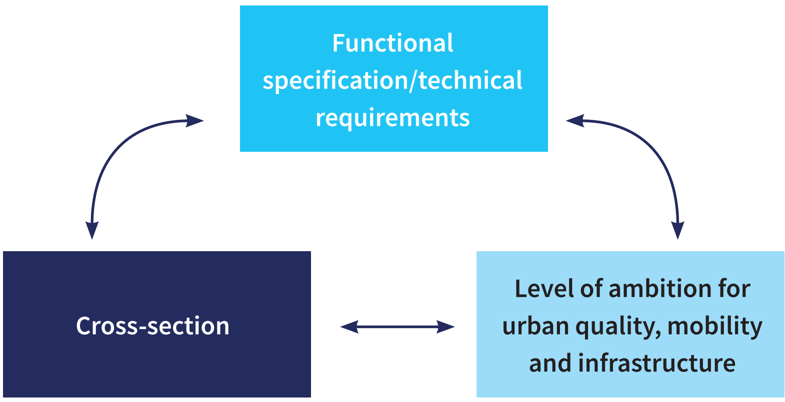

FIGURE 2-1 Parameters to be assessed in planning and designing street infrastructure.

CROSS-SECTION

A section at right angles to the street showing the width of the different elements, e.g. pavement, cycle path, green space, stormwater solution and carriageway.

2.1 Context and System

The commencement of a street project must start by defining the role of the street in the city structure. The function of a street may be defined in a plan drawn up under the Planning and Building Act (municipal plan, district plan, area zoning scheme, planning programme, detailed zoning scheme), an indicative plan for public spaces (VPOR) or a street use plan. If there is no overall plan defining the functions of the street, a strategic analysis of the street network (system analysis) may be carried out.

Relevant aims for such an analysis could be to:

- Identify major features and landmarks of the current design of the street and others around it: functions, buildings, and open public spaces.
- Identify major destinations such as residential areas, workplaces, educational institutions and businesses, in order to understand the mobility and movement pattern of users of these streets.
- Identify any future needs the street needs to meet and determine how they can be prioritised and addressed within the available cross-section.
- Assess and discuss the implications of several alternatives.
- Quality of experience, aesthetics and amenity value.

Along with their mobility function, the streets compose important public spaces, that can add quality to the surroundings, by enhancing and improving the local environment and provide local stormwater management, for example. The results of such a system analysis or high-level network analysis could include:

- Plan for different groups of road-users (trunk networks for pedestrians, bikes, public transport and deliveries, and main road network).
- Plan for flood corridor network.
- Plan for charging infrastructure.
- Plan for urban spaces.
- Plan for green structure.

This system analysis can be used as the basis for plans drawn up under the Planning and Building Act such as municipal plans, area zoning schemes or detailed zoning schemes.

Alternatively, the analysis could be based around a “choice of concept study” (KVU), an indicative guideline plan for public spaces (VPOR), an action list for public spaces (TOR), an outline plan for cables and pipes (VPKL) or a street use plan.

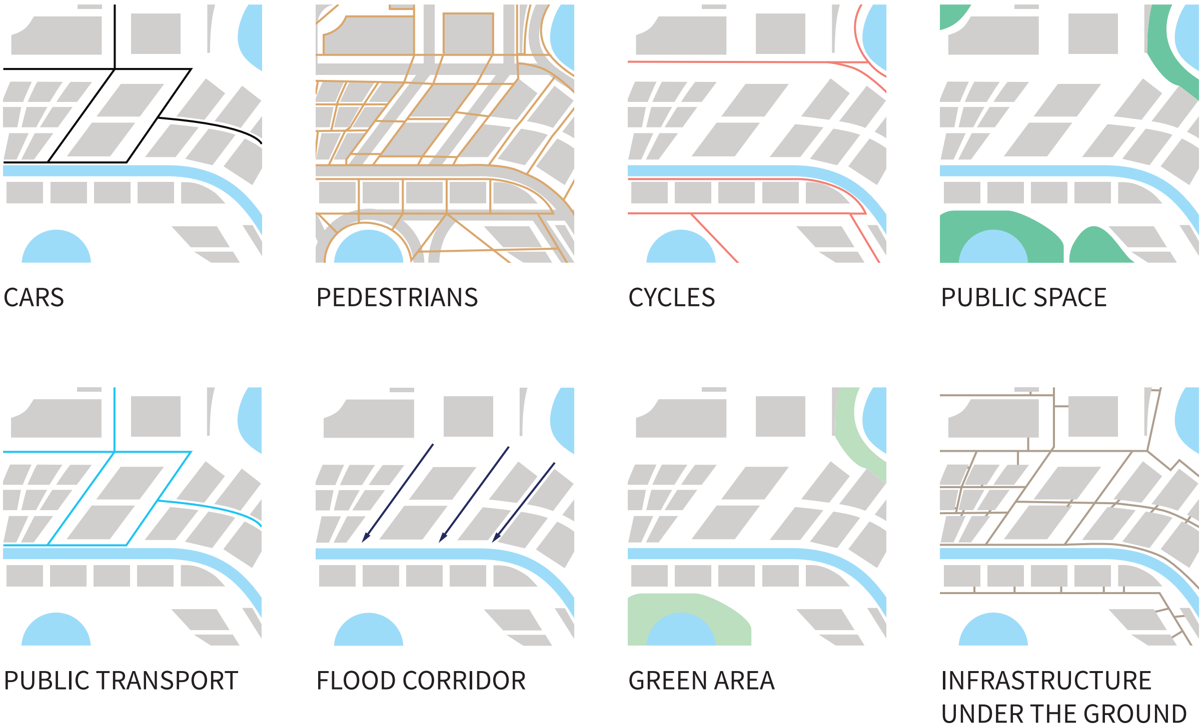

FIGURE 2-2 General network for different functions.

CHECKLIST FOR ASSESSING THE ROLE OF THE STREET IN THE URBAN STRUCTURE:

- Municipal Plan
  - **A.** Are we in the inner city or a development area in the sub-urbs?
  - **B.** Are we in the suburbs?
- What does the zoning area of the municipal plan state about the street? Is the street defined as a future shopping street?
- Has an area zoning scheme been adopted for the area?
- Is there a VPOR/TOR/VPKL for the area? Plan for cycle network? Other plans? Street use plan?
- Can the street be managed and maintained through climate-friendly drift?
- What function does the street have within the flood corridor system?
- Does the street have any historic monuments or cultural heritage elements that need to be preserved?

2.2 Description of Functions and Needs

Streets have to be adapted to their surroundings and the needs of the community for e.g. mobility, urban quality, infrastructure, safety and environment.

Identifying the functions that satisfy the city's needs for mobility and urban quality is a prerequisite for deciding how to plan and build infrastructure. Street design of high quality can contribute to achieve environmental targets and goals relating to inclusion, improved quality of life and better public health, while stimulating economic activity, promoting urban development and providing cultural meaning.

Road-users can be divided into the following groups/types of mobility:

- Pedestrians.
- Cyclists.
- Public transport.
- Emergency services and refuse disposal.
- Commercial transport (taxis, goods and services).
- Private cars.

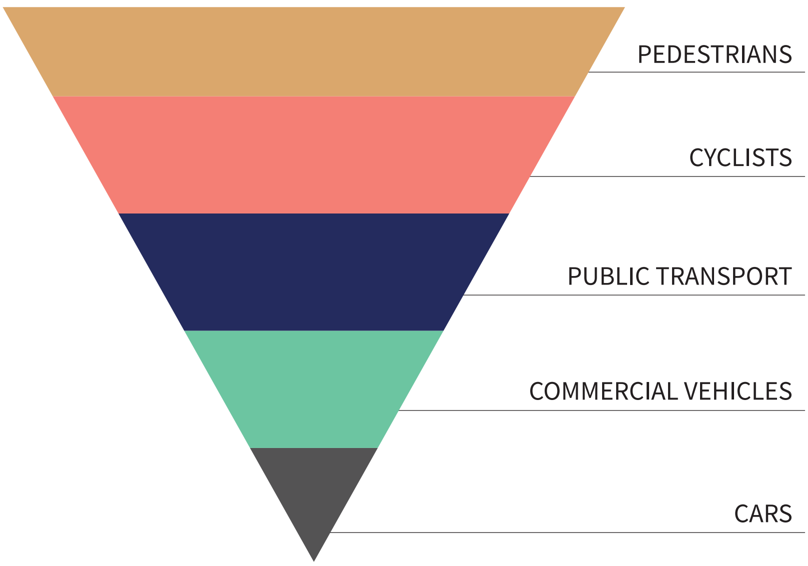

FIGURE 2-3 Green mobility.

The street network must be able to cope with the effects of climate change, including an increased risk of flooding.

Streets have a variety of functions, that in turn fulfill different user-needs. The functions to be covered by the streets can be roughly divided into the following categories:

- Mobility: Needs of road-users for transport, universal design and road safety. Emergency services and refuse disposal must always be considered.
- Urban Quality: Surroundings, vegetation and environment.
- Climate: Infrastructure for handling stormwater/flooding, cables/pipes and lighting.

2.2.1 Mobility, universal accessibility and road safety

Streets compose essential transport arteries for road-users, that contribute to the overall mobility. Streets provide for accessibility and connect the city together. Universal design contributes to inclusion and accessibility for all. It should be easy, safe, secure and pleasant to move around the streets, while their design should drive us to make smart and environmentally friendly choices of transport.

MOBILITY

What sort of mobility should the street facilitate?

- Do the road-users differ in size and speed? (hard/soft, fast/slow etc.)
- Can the different road-users adjust to one another with shared speed limits and operate within shared space?
- Are there some types of transportation that are favorable? Should some forms of mobility be prioritised at the expense of others?
- Who needs access to the destinations along the street?
- Which groups of road-users do not need a clear road or high capacity?
- Which groups of road-users should be prioritised in terms of space and ease of movement?
- Are there user that utilise the street that require particular facilitation?
- Should someone be able to stop or park in the street for a short or a long time?

MOBILITY

Mobility describes the way in which people, goods and services move around in an efficient and accessible system.

GREEN MOBILITY

Green mobility/green modes of travel are journeys on foot, by bike or on public transport.

- Is it appropriate to provide better lighting, vegetation or seating?
- If any, how does the applicable guidelines from high-level strategies and plans apply, such as the *Cycle Strategy* or the *Plan for the Cycle Network for the City of Oslo*?
- Does the street carry public transport, or should it have this role in the future?
- Are refuse disposal and deliveries catered for?
- Is it appropriate to arrange for electric charging infrastructure?
- Is it important to provide greater capacity because of congestion?
- An Important task of the street, if it is difficult to orient oneself in the area, is to reinforce wayfinding and make the surroundings more comprehensible.
- Is this a street where excess stormwater needs to be diverted in the event of a cloudburst?
- Does the street need to be sized for modular road trains (e.g. going to the Port of Oslo or recycling facilities)?
- Have all surrounding buildings been provided with access points after legal basis?
- Have the needs of neighbours for removal vans, large deliveries etc, been addressed?
- Is the street an emergency route?
- Do the emergency services have access to objects/buildings?
- Have disabled parking and access to institutions, such as day centres, nursing homes, medical practices etc. been addressed and secured?

UNIVERSAL DESIGN

- Does the design of the street provide universal accessibility?
- Are there any conditions that limit the possibility for universal design, such as the gradient?
- Is there an alternative route that supports universal design, if this cannot be achieved in the street?
- Are there natural guidelines in the planned design or do guidelines need to be established?
- How is universal design addressed in adjacent streets? It is important to provide coherence and readability.

ROAD SAFETY

- What are the principal challenges with regard to road safety?
- Have any road accidents been recorded on this section or at an intersection?
- Are there school routes within the vicinity?
- Does the area contain stretches with road-user conflicts or areas with high risk probability, and have these been reported?
- Are the speed limits on the stretch and through its accompanying intersections too high?
- Is the visibility adequate between the different road-users?
- Does the section offer good visibility and is the traffic system understandable and intuitive for all groups of road-users travelling in the area?
- Is the current behaviour of road-users at the site consistent with what the design is trying to achieve? For example, are there frequent stops outside areas intended for parking and deliveries? Do pedestrians cross where there is no crossing? Do road-users use the correct lane? Are there many cyclists on the pavement?
- Is the lighting good enough?

ROAD SAFETY

Absence of accidents and injury on the roads. How safe the traffic is can be calculated from the number of accidents and injuries relative to the volume of traffic.

SENSE OF SECURITY

The sense of security (subjective safety) is the feeling of safety that road-users have; in other words, how they perceive the risk of accidents.

2.2.2 Urban quality: surroundings, vegetation, and environment

The *Municipal Plan for Oslo* stresses that pedestrians, cyclists, and urban quality should be prioritised over cars. The Municipal Plan suggests that squares and meeting places, green structure and pedestrian and cycle paths contribute to city life, quality of life and recreation.

The *Guide to densification and transformation with urban quality in the urban corridor* (City of Oslo, 2019) establishes six dimensions describing important attributes in urban development: efficient use of space, multi-functionality, social contact, green mobility, nature and local identity, and the quality and character of the buildings.

Streets must add urban qualities to their surroundings. The urban qualities transforms streets into spaces for recreation which encourage interaction and social functions as well as transport and travel.

Streets can contribute to better urban quality by acting as attractive urban spaces when:

- The street is efficiently used to accommodate the needs of the neighbourhood.
- They include social functions.
- They prioritise ‘soft’ road-users – pedestrians and cyclists.
- They possess green and blue qualities and minimise air and noise pollution.

URBAN QUALITY IS ACHIEVED BY:

- Efficient use of space.
- Multi-functionality.
- Social contact.
- Green mobility.
- Vegetation and local features.
- Quality and character of the buildings.

PUBLIC SPACES (SOCIAL FUNCTION)

Is the street an arena for social contact?

- Can the street contribute to city life with businesses extending retail and catering out into the public realm?
- Can the street act as a meeting place and a place for play and activity?
- Can the street have active facades?
- Can it give the feel of an active and safe urban environment?

STREET FURNITURE ZONE

- What needs have to be met in the street furniture zone?
- How wide can the street furniture zone be, and how can it be combined with other needs in the street?
- What fixed installations arise out of priority needs?
- How can the street furniture zone provide stormwater management and/or give the street a green and vibrant aesthetic?
- Can the street furniture zone act as a speed-reducing measure or help to separate the traffic?

PUBLIC SAFETY

- Are there objects in and along the street that need to be protected against unwanted events in the interests of public safety?
- Is the street furniture adequately sized and fixed to perform any necessary public safety functions?
- Can speed-reducing measures be established for vehicles passing close to objects that need to be protected?
- Can any safety functions be managed in the area to be secured and not on the public street?
- Have the needs of the emergency services for rapid access and stopping places been addressed? Have emergency routes been provided for?
- Should speed-reducing measures be avoided in order to achieve this?
- Has the risk of flooding been considered?

GREEN SPACES AND TREES

- Can flood run-off be reduced by retaining and infiltrating the stormwater in green spaces?
- What is the state of the local environment; is there a need to reduce airborne particles and dust, safeguard privacy or screen the area from traffic with the aid of vegetation?
- Are there green spaces nearby that contribute to biodiversity, wellbeing or social interaction?
- What sort of green spaces can be established in the street: rain gardens, grass, bushes, trees or other planting? Can asphalt areas be reduced in size?
- Are there existing/well-established trees in the street? If so, will the project preserve these trees?
- Can indigenous species be used?
- In new streets and new development areas, has sufficient space been provided (above and below ground) for trees or other vegetation in the street furniture zone(s)? Are private front gardens planned?
- When a street is upgraded, is it possible to remove or relocate traffic functions to side-streets to create more space for vegetation? If so, the side-streets must be included in the project.

- Can the street be changed from two-way to one-way traffic in order to establish vegetation in one lane? Can parking areas be removed to create space for vegetation?
- If trees are planned along the pavement, cycle path, or carriageway, have the species of tree been evaluated for unwanted debris like falling seed pods or fruit (e.g. chestnuts)?

NOISE AND VIBRATION

- Will the measure alter the noise profile?
- Can mitigating measures be taken if the street is already exposed to noise?
- Will the measure cause vibration in nearby buildings?

AIR POLLUTION

- Will the design of the street help to reduce the number and speed of motorised vehicles?
- Is it possible to avoid allergenic vegetation?
- Can public spaces be planned in such a way that smoking can be avoided at bus and tram stops and other places where people gather?

2.2.3 Climate and Infrastructure: Stormwater, Cables and Lighting

The street network must be able to cope with the effects of climate change, including an increased risk of flooding, while the street itself should help to minimise greenhouse gas emissions in the development and operational phases and through its effect on travel patterns. Technical infrastructure above and below ground needs to be well coordinated.

CLIMATE

- Will the design of the street help to achieve the City's goal of reducing Oslo's emissions of greenhouse gases by 95% to 2030 compared to 2009?
- Can solutions offering zero emissions be used in development projects?
- Can solutions be used that provide for more efficient operation and maintenance without any greenhouse gas emissions?
- Does the street design contribute to a city that is more resilient to extreme climatic events and other effects of climate change?
- Does the street design promote and facilitate climate-friendly forms of transport?
- Does the project affect the stores of carbon in the vegetation and soil?

STORMWATER AND SNOW PILES

- Is the urban run-off from properties adjacent to the street managed within the confines of the site?
- Can multi-functional green spaces be established to handle stormwater?
- Is there an outline plan for cables and pipes (VPKL) for the area?
- How should the stormwater be handled: above or below ground, in a separate system, or in shared drains together with waste water?
- How well does it provide for natural infiltration of rainwater and use of permeable materials?
- Can the measure address the problem of excess water from flooding?
- What is the flood situation upstream and downstream?
- Is there a need for measures to ensure that polluted stormwater is not discharged into watercourses?
- How is it intended to manage snow-clearing and snow piles? How will meltwater be taken away from the snow piles?

3-STEP STRATEGY

The three-step strategy is a method to be used for stormwater management.

Step 0: Planning:

Step 1: Collect, infiltrate and (if necessary) clean rainwater;

Step 2: Retain and delay run-off from heavy rain;

Step 3: Provide secure flood channels and flood areas in case of extreme rainstorms.

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BLUE-GREEN STORMWATER FACILITIES

Blue-green stormwater facilities involve multi-functional use of green structure to delay and remediate run-off by retaining, infiltrating and evaporating the stormwater locally. Blue-green stormwater facilities help to restore and maintain the hydrological cycle in the city as well as being a resource.

CABLES AND PIPES

- Is there an outline plan for cables and pipes (VPKL) for the area?
- What pipe and cable owners need to be involved in the street planning?
- Where should the various pipes and cables be placed in the street?
- If any, have tunnels, culverts and other underground infrastructure been taken into account?
- Can conduits for infrastructure in the ground be co-located and separated from sections with trees?

2.3 Categorisation of Streets

Ambitious goals for urban development call for a new approach to street planning and good coordination between different specialist groups. The Municipal Plan for Oslo has a map with an overview of squares and meeting places, green structure and footpaths and cycle routes. This map shows where it is important to ensure mobility for pedestrians and cyclists, and where spatial functions need to be prioritised (local/urban quality). The latest map can be found on the City of Oslo website.

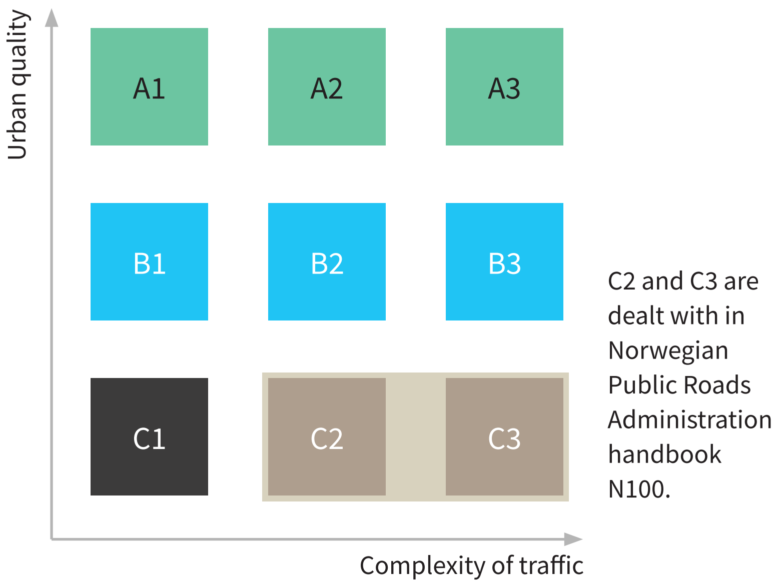

FIGURE 2-4 Categories of street, viewed as a matrix.

As well as categorising mobility and urban quality as shown in Figure 2-4, we must determine where infrastructure for climate adaptation and public safety, such as flood channels, cables and pipes, should be placed.

The categories describe the relation of the street to its surroundings, and its complexity in relation to traffic management and road safety. The complexity of traffic is rated on a scale from low (1) through medium (2) to high (3). In streets with complex traffic patterns, there is a need to separate the groups of road-users to provide for safety, comfort and ease of passage. Urban quality is similarly ranked on a scale from high (A) and medium (B) to low (C). Type A areas should be organised for city life, prioritising social interaction and movements of soft road-users. In type B areas, considerations of mobility and local functions have to be balanced. Type C are areas where the transport function is more important than social interaction.

These combine to produce street and road categories, two of which (C2 and C3) must be planned with the aid of the Norwegian Public Roads Administration handbook N100 “Road and Street Design.”

In this overview, category C1 covers residential streets in the suburbs, which should be planned with the aid of requirements and solutions in the street design manual.

Most A and B areas are now in the inner city. The Municipal Plan aims to further develop the suburbs through densification projects with more urban city structures, as for example is evident at the neighbourhoods of Løren and Ensjø. The categories shown in Figure 2-4 and suggestions for design and requirements given in section 4 should be used for planning in transformation areas in the suburbs.

The street design manual contains requirements and suggestions for prioritising pedestrians, cyclists, public transport, road safety, social interaction, vegetation and floodwater.

2.3.1 Type A streets

Type A streets are streets in the inner city where there is a lot of activity and life. One or two groups of road-users have clear priority and are given special preference over others. Type A streets have a lot of pedestrians.

Type A1 Streets are streets for pedestrians. Pedestrian streets are examples of streets where these road-users are given a high priority and the most space. In most type A1 streets, pedestrians will have the highest priority. The surroundings and the activity on the street play a major role in the street scene. The facades generally face the ‘audience’.

Type A2 Streets or squares have low speed levels and do not invite through traffic. They may be side streets off a type A1 street where motor vehicles also have access to the street but where speeds and traffic volumes are low, harmonised with the speed of pedestrians and cyclists.

Type A3 Streets prioritise passability for public transport as well as soft road-users, and high urban quality.

FIGURE 2-5 Karl Johans gate is an example of a type A1 street.

FIGURE 2-6 Torggata between Bernt Ankers gate and Hausmanns gate is an example of a type A2 street.

FIGURE 2-7 Thorvald Meyers gate is an example of a type A3 street.

2.3.2 Type B streets

Type B1 Streets are streets with low amounts of traffic and are mostly used by residents. The speed limits are low and soft road-users have top priority, e.g. residential streets in the inner city with other functions in addition to transport.

FIGURE 2-8 Deichmansgate is an example of a type B1 street.

Type B2 Streets have a transport function beyond just access to properties, and are designed for low speeds. The cycle and public transport network may be part of these streets.

FIGURE 2-9 Torshovgata is an example of a type B2 street in the inner city. Lørenveien and Ensjøveien are examples of type B2 streets in the suburbs.

Type B3 Streets are streets that allow people to travel at distinctly different speeds. They are often wide streets with a need to separate the different groups of road-users. Type B3 streets prioritise passability for public transport, but they may also have an important role to play in the main cycle network.

FIGURE 2-10 Kirkeveien is an example of a type B3 street in the inner city. Grenseveien, Vækerøveien, Ekebergveien and Slemdalsveien are examples of type B3 streets in the suburbs.

2.3.3 Type C streets

Transport arteries in residential areas in the suburbs are defined as type C1 streets. These transport arteries generally carry little traffic, with little or no separation between groups of road-users. Low speed is a given. Where such streets are built new, they should be designed to suit soft road-users. This is especially important on school routes.

TYPE C2 AND C3 ROADS

The national road network managed by the Norwegian Public Roads Administration contains examples of type C2 and C3 roads. The planning of this road network must follow the requirements in Norwegian Public Roads Administration handbook N100. N100 is also applicable to the road network in Marka.

FIGURE 2-11 Sandåsveien is an example of a type C1 street.

Photo: Geir Anders Ørslien/City of Oslo

3. Detailed Planning I. Division of the Street, Principles, and General Requirements

3.1 Spatial Division of Streets

Streets can be divided into zones for activity, street furniture and transport. The street design manual defines these areas as the frontage zone, pedestrian clearway zone, street furniture zone, kerb zone, buffer zone, carriageway, central divider and cycle path. Vegetation and areas for handling stormwater may form part of the central divider, street furniture zone or frontage zone.

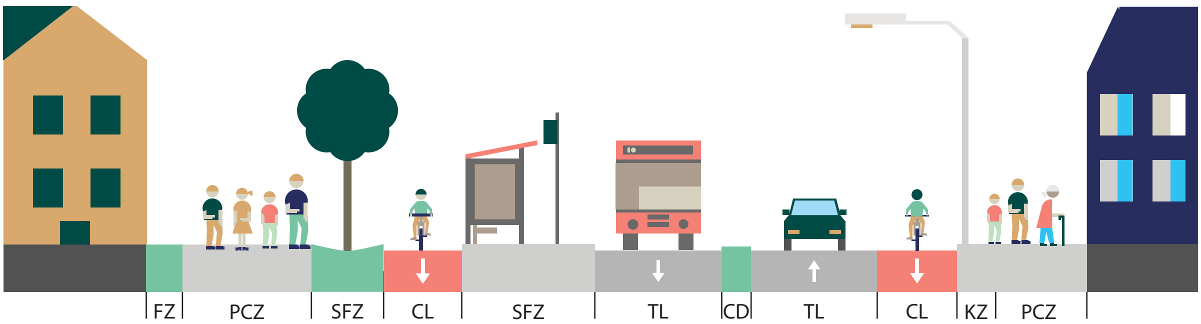

FIGURE 3-1 Example of the structure of the street.

FZ: frontage zone
PCZ: pedestrian clearway zone
SFZ: street furniture zone
KZ: kerb zone
TL: traffic lane
CD: central divider
CL: cycle lane

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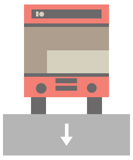
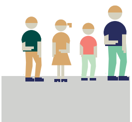


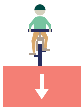
LANE (TL)
The width of the lanes will depend on the function of the street and which group of road users will be prioritised. (See 4.5.1 Lanes and Carriageways).

CENTRAL DIVIDER/GREEN STRIP (CD)
A central divider separates two or more carriageways. A central divider may be an area or a physical element placed between the carriageways. This area may be used as a traffic island or for vegetation, stormwater management and snow piles. (See section 5.1.1 Roundabout, traffic barrier/central divider, section 6.1 Stormwater and section 6.2 Area for snow).

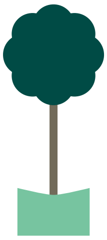
FRONTAGE ZONE (FZ)
The frontage zone is the area from the front of buildings out to another zone such as the pedestrian clearway zone. In streets with facades up to the pavement, there should be a frontage zone. The functions in the facade help to determine the width of the frontage zone. The frontage zone can provide space for stormwater, green spaces and snow piles. (See section 5.2 Street furniture zone).



PEDESTRIAN CLEARWAY ZONE (PCZ)
Pedestrian clearway zones should allow pedestrians to move unobstructed. The width of the pedestrian clearway zone may vary because the frontage zone and activities along the front of the buildings vary along a street. (See section 4.2.1 Pedestrian clearway zone).



CYCLE LANE (CL)
Cycle lanes are marked transport arteries with no barriers for cyclists. (See section 4.3 Facilities for cyclists).



STREET FURNITURE ZONE (SFZ)
The street furniture zone may contain benches, trees, bushes, rain gardens, stormwater solutions, snow piles, cycle racks and shelters. The zone may vary in width according to the needs of the street. Not all streets have a street furniture zone. The street furniture zone may be in front of the facade or between the pedestrian clearway zone and the kerb. (See section 5.2 Street furniture zone).

KERB ZONE (KZ)
This zone is the outer part of the pavement and borders on the lanes in the street. The kerb zone includes the area bordering the lane with signs and lamp-posts. The kerb zone must be at least 0.5 metres wide. Where signs and lamp and signal posts have to be placed, the kerb zone will be widened as necessary.

3.2 Principles for Street Planning

At the start of projects it will be necessary to determine the priority of mobility functions, urban quality and other functions such as stormwater management or other infrastructure.

In several streets it will be given to prioritise pedestrians and cyclists in line with the goals and ambitions set out in the Municipal Plan for Oslo 2018 and the "Climate Strategy for Oslo to 2030." In other streets, passability for public transport should be prioritised.

MUST Passability and accessibility for emergency vehicles must be assured on all streets.

3.2.1 Public areas

Public areas must be prioritised for public travel, city life, and social interaction. All new building projects must fulfill the spatial requirements for management and drift of the building within the confines of the property, without appropriating public space. This applies to stormwater management, deliveries, buses and taxis to hotels, refuse disposal, fire-fighting etc.

3.2.2 Public safety

Major goals for public safety are laid down in the Norwegian Government's overall objectives for public safety in the transport sector:

- To avoid large unwanted events that cause injury or damage to persons, the environment or equipment.
- To reduce the impact of such events, if they should occur.
- To ensure reliability and passability in the transport and communication network, both under normal conditions and in extreme situations.

3.2.3 Building boundary and building line

The purpose of building boundaries and building lines is to take account of road safety and the environment along the street, set aside an area for operation, maintenance and improvement of the street, and provide the necessary space to develop the street. A building line and structures close to the street could make it expensive and difficult to expand and improve the necessary infrastructure in the future.

In Oslo, building boundaries or building lines are often adopted through development plans. Where no building boundary or building line is defined for a street, the Roads Act will determine how close to a cycle path or a street one can build. If the building boundary is not shown on the development plan, it is necessary to find out what road type and which Roads Act was in place when the development plan was adopted.

Here is an overview of the building boundary to roads and streets in the different Roads Acts:

TABLE 3-1 Development of distance requirements.

Period	Distance to municipal road	Distance measured from
1912–1931	3.5 metres	regulated road edge
1931–1938	5.0 metres	regulated road edge
1938–1964	7.5 metres	regulated road edge
1 January 1964 – 30 June 1996	12.5 metres	regulated centre line of road
1 July 1996 – 31 December 2009	15.0 metres	regulated centre line of road
1 January 2010 – now	15.0 metres	regulated centre line of road

3.2.4 Universal design

Universal design is the design or layout of the physical environment, including infrastructure, transport and information and communications technology, to enable usage of transport networks by all types of users.

Universal design helps to improve everyday life for all groups of users. A disability is an aspect of a person, but the design of the surroundings will determine whether a disability becomes a handicap.

Obstacles to the use of the transport system may be linked to:

- Movement.
- Orientation.
- Environment.

UNIVERSAL DESIGN

Universal design refers to the design or organisation of the main solution in terms of physical aspects, including information and communications technology (ICT), so the normal function can be used by as many people as possible, regardless of disability.

NORWEGIAN PUBLIC ROADS ADMINISTRATION HANDBOOK V129

Norwegian Public Roads Administration handbook V129 “Universal design of roads and streets” provides a good overview of how to take account of different groups of users in the transport system.

The handbook is accompanied by a guide and report with up-to-date examples and suggestions for how the solutions can be used by all, so special solutions can be avoided. The recommendations in the guide are based on requirements in Norwegian Public Roads Administration handbooks and the Building Code (TEK 17).

Basing the design around the group with the greatest needs will ensure that the needs of the greatest possible number of people can be met. Some groups may have conflicting needs. For example, kerbstones may act as a guide line to help people with impaired vision to find their way around, but be a hindrance to people with reduced mobility.

People with asthma and allergies react to substances in the environment. In urban spaces and streets, people with allergies or asthma may have problems with:

- Smoking at bus and tram stops.
- Dust (airborne particles) from vehicle tyres.
- Exhaust gases from vehicles powered by fossil fuel.
- Allergenic plants in the streets.

EQUALITY AND DISCRIMINATION ACT

The Act on equality and prohibition of discrimination (LOV-2017-06-16-51), Section 17, defines the framework for work on universal design.

3.2.5 Universal accessibility

Good universal design takes account of the specific needs of different groups of users.

TABLE 3-2 Universal accessibility.

Needs group	Adaptation
Persons with reduced mobility (because of age, hereditary disability, injury or illness)	This group needs step-free solutions, and even and firm surfaces with places to rest and the smallest possible gradient. Sufficient space must be set aside for manoeuvring manual and electric wheelchairs.
Blind and partially-sighted people	A logical layout of the surroundings will make it easier for blind and partially-sighted people to find their way around. Tactile or audible information signs are absolutely vital.
Deaf and partially deaf people	The surroundings should provide good visual information and be predictable and easy to read.
Persons with reduced ability to understand (mental impairment, dementia and reading difficulties)	Logical and simple layout of the street with a unified visual expression. The aim is that nobody should feel lost but should understand where they are and know where they can go without ever getting into danger.

ACCESSIBILITY

A product or service that facilitates use, preferably without assistance. This means that there are alternatives to the general solution aimed particularly at persons with disabilities.

ORGANISATION

Practical organisation of physical, social and pedagogical functions for individuals or specific groups. This differs from universal design in that the measures do not cover all users.

AGE-FRIENDLY CITY

A city which is inclusive and has an accessible urban environment promoting active and healthy ageing. It embraces the whole of life from childhood to old age.

Photo: Geir Anders Ørslien/City of Oslo

4. Detailed Planning II. Mobility, Universal Design, and Road Safety

4.1 General Requirements for Geometry

The overview in the blue boxes below show some general requirements for the design of streets, footpaths and cycle paths. Design dimensions, design driving modes, and track curves are shown in the Annex.

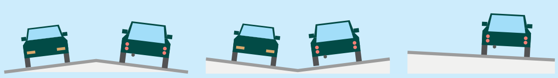
The rest of section 4 presents considerations and requirements for meeting the needs of different groups of street users.

GENERAL REQUIREMENTS FOR THE DESIGN OF STREETS, FOOTPATHS, AND CYCLE PATHS

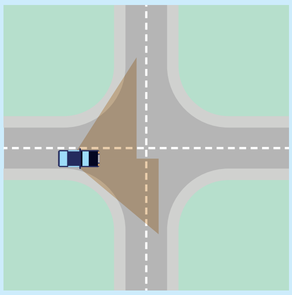
The gradient of the carriageway in streets must be no more than **8%**

The gradient of separate footpaths and cycle paths must be no more than **5%**

A transverse profile may be designed as either **a ridge profile**, **a V-profile** or **a fall to one side**. There should be a fall of **3%** on straight sections.



The visible distance along streets must be **at least equal to the stopping distance**



Where the stopping distance is to be maintained, the following requirements apply:

- **20 m** with a speed limit of **30 km/h**
- **30 m** with a speed limit of **40 km/h**
- **45 m** with a speed limit of **50 km/h**

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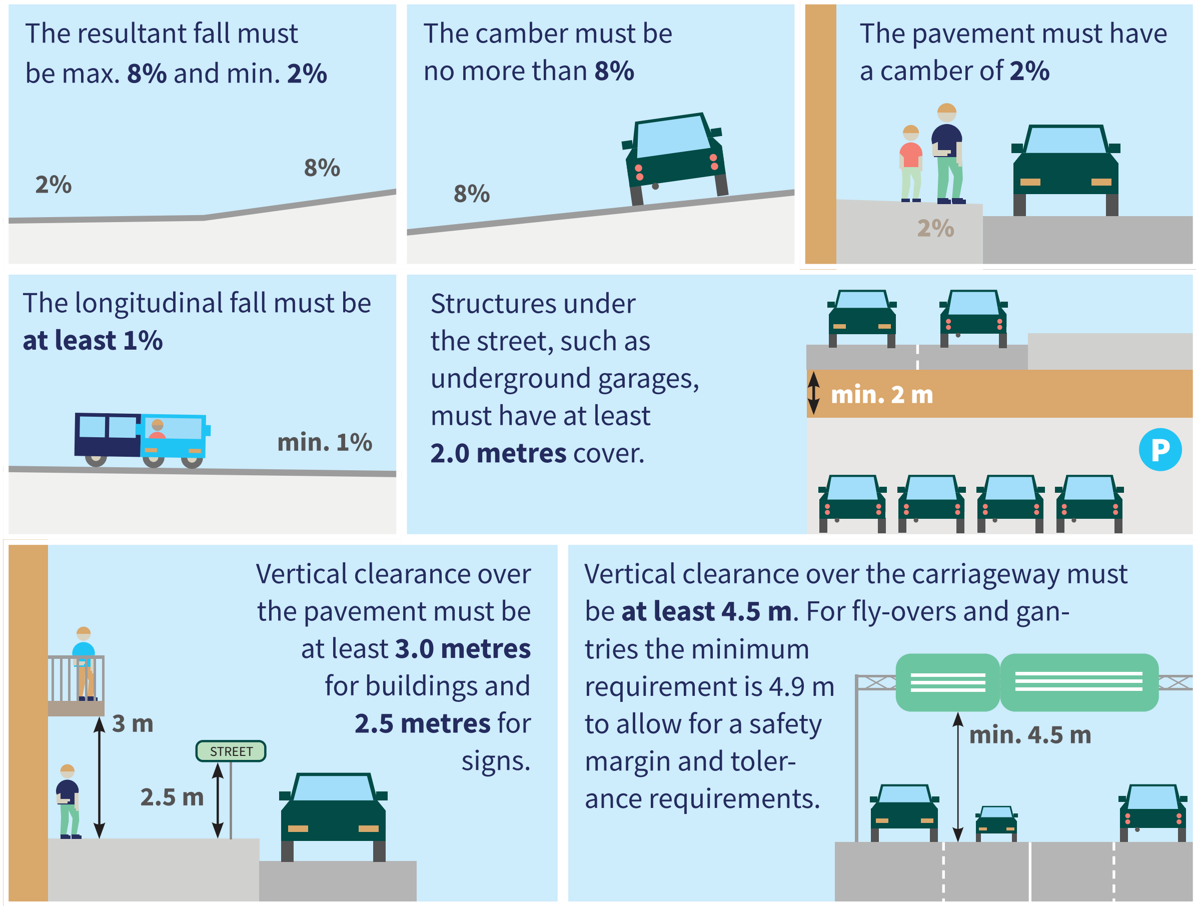

FIGURE 4-1 General requirements for the design of streets, footpaths and cycle paths.

4.1.1 Road widening on horizontal curves

On a bend a vehicle will take up more space than on a straight street. Parts of the vehicle will overhang the wheels and increase the width of the track.

To allow for this, the lanes are widened around curves. The degree of road widening is dependent on the design vehicles and horizontal curve radius. This widening should also ensure that large vehicles do not encroach on the cycle lanes or the lane coming in the opposite direction.

MUST Road widening for street sections must follow Table 4-1 and Table 4-2.

TABLE 4-1 Road widening on 2-lane streets up to 6.5 metres wide depending on the curve radius.

Horizontal curvature (m)													
Radius	20	30	40	50	70	100	125	150	200	250	300	400	500
Road train	6.0	4.0	3.0	2.5	1.8	1.3	1.1	0.9	0.7	0.6	0.5	0.4	0.4
Bus	5.4	3.6	2.7	2.1	1.5	1.2	1.0	0.8	0.7	0.6	0.5	0.4	0.3
Truck	3.6	2.4	1.8	1.5	1.1	0.8	0.7	0.6	0.5	0.4	0.4	0.3	0.3
Small truck	1.8	1.3	1.0	0.8	0.7	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2
Car	1.1	0.7	0.5	0.5	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2

TABLE 4-2 Road widening for buses with 3.5 metres lanes.

Horizontal curvature (m)													
Radius	**20**	**30**	**40**	**50**	**70**	**100**	**125**	**150**	**200**	**250**	**300**	**400**	**500**
Bus	4.9	3.1	2.2	1.6	1.0	0.7	0.5	0.3	0.2	0.1	0	0	0

Where the lane width is > 3.25 m, the requirements in Table 4-1 are reduced with the increase in width beyond 3.25 m. (E.g. lane width 2 x 3.5 m gives a reduction of 0.5 m).

Streets with four lanes are treated the same as streets with two lanes.

Streets with one lane should be widened by half as much as a street with two lanes.

4.1.2 Kerbstones

Kerbstones are used to delimit areas for motorised traffic. For aesthetic reasons, it is recommended that the line of the kerb should follow the block structure and have a constant radius at intersections.

Kerbstones are also used to support stormwater facilities, particularly where we want to divert water into open solutions such as a rain garden, central divider, etc.

Barrier kerbstones should be used on pavements or other areas to be shielded from motorised traffic. Standard kerbstones should be used for areas that may need to be driven over occasionally, such as cycle paths with pavements.

MUST At bus stops, the kerb height must be 18 cm, and 30 cm at tram stops.

MUST In type A3, B3 and C1 streets, the kerb height must be 13 cm.

MUST In type B1 and B2 streets, the kerb height must be 10 cm.

MUST In type A2 streets, the kerb height must be 6-10 cm.

4.2 Facilities for Pedestrians

The streets must accommodate pedestrians of all ages and sizes and with differing physical and cognitive abilities. The needs of children and elderly and disabled people must be prioritised in the planning.

Not all disabilities have to do with physical health. People with sensory and cognitive impairment also require footways to be designed in an intuitive way. A readable design will make it easier to understand where they are and where they can walk.

4.2.1 The Pedestrian clearway zone

The pedestrian clearway zone is the area with priority given to pedestrians, and is clearly delimited on both sides to ensure intuitive directional guides to accommodate people with impaired vision. The pedestrian clearway zone is normally the pavement, except in pedestrian streets where the whole width is prioritised for pedestrians. The pedestrian clearway zone is defined in the paving in open spaces such as pedestrian streets, squares etc.

HIGH SEASON FOR PEDESTRIANS

The high season for pedestrians is the period of the year which normally has the greatest pedestrian traffic through the street. This usually is a normal weekend in the summer time. Major events or festivals such as 17 May are not considered here.

MUST The pedestrian clearway zone must be at least 2.0 metres wide and free from obstructions.

The width of the frontage zone and the kerb zone should be included when assessing the total width of the pavement. This should take account of activities and needs along the frontage and the distance to street furniture, signs, lamp posts and the like on the pavement next to the carriageway.

The width of the pedestrian clearway zone is also a measure of its capacity for pedestrians and the space for individuals to move.

On school routes it may make sense to widen the clearway zone.

SHOULD For an increased volume of pedestrians, the width should be increased according to the number of users, as shown in Table 4-3.

TABLE 4-3 Widening of the pedestrian clearway zone.

Peak hour in high season for pedestrians	Addition to the pedestrian clearway zone
800–1000	0.25 – 0.50 metre
1000–2000	0.5 – 1.0 metre
2000–5000+	1.0 – 3.0+ metres

FIGURE 4-2 A change from paving stones to asphalt works well as a natural guide line.

The natural guide line leads the user to the warning field before the pedestrian crossing.

The clearway zone should be planned and designed with clear markings in the paving. The following properties are recommended for the surface in the pedestrian clearway zone:

- Good base for small wheels.
- Firm and even surface.
- Sufficient friction to help prevent falls.

4.2.2 READABLE AND PREDICTABLE LAYOUT

A street that is accessible to all users has a clear and predicable layout. People with impaired vision in particular need a logical and readable layout for wayfinding. This calls for visual marking of the different zones of the street with visual and tactile contrasts. Deliberate use of visual contrasts helps to ensure readability and clarity for everyone using streets and outdoor spaces, and helps to prevent falls and hazardous situations in traffic.

Using different surfaces on e.g. the pedestrian clearway zone and the street furniture zone/frontage zone, or providing clear edges, will make the zones more distinct and more readable. Transitions should be indicated with both tactile and visual markings, and the tactile marking should be detectable with the feet.

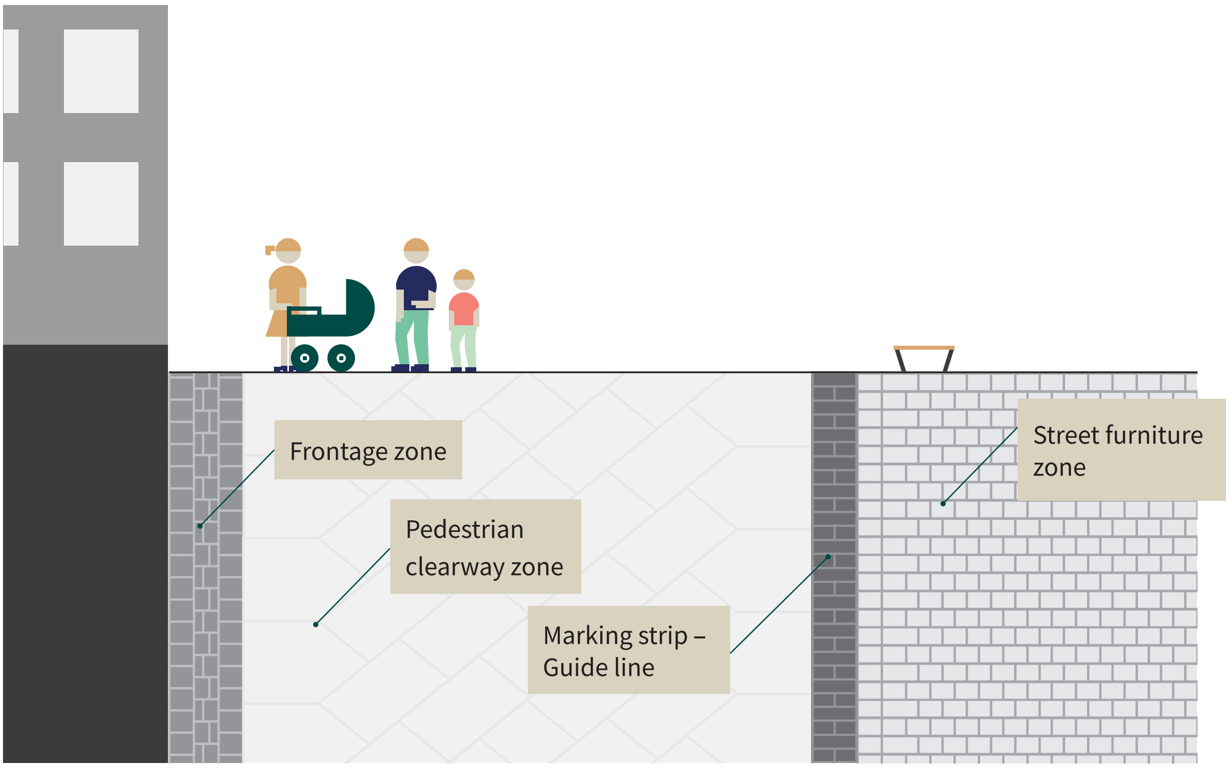

FIGURE 4-3 Different materials and contrasts make a clear demarcation in the road surface.

The transitions between surfaces can be used as natural guidelines for people with impaired vision. Natural guidelines should be included in the design of streets and of open spaces.

Patterns in the pavements must not mislead users with incorrect directional information. The pedestrian clearway zone can be laid along the walls around the outside of a square or laid straight across the square and defined in the paving.

SHOULD On open spaces and squares, the pedestrian clearway zone should be clearly visible in the paving.

4.2.3 Pavement

Pavements in city streets are divided into zones and areas: the kerb zone, the street furniture zone, the pedestrian clearway zone and the frontage zone. Barrier kerbstones are used to separate the carriageway from the pavement.

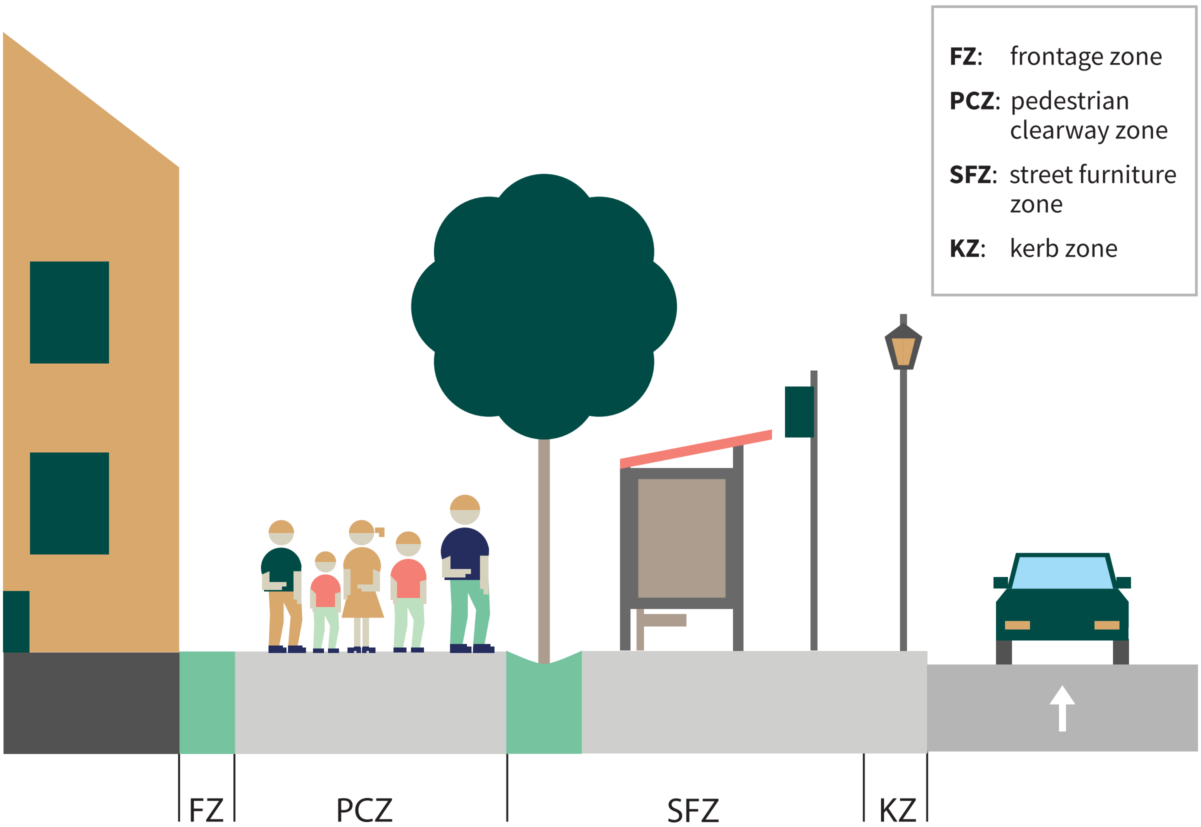

FIGURE 4-4 Division of the pavement.

The quality of the pavement depends as much on its width and gradient as on the choice of material.

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MUST Pavements must be provided for all street types in the inner city and urban development areas, except for pedestrian streets and shared space.

MUST The pavement width must be at least 3 metres for type A and B streets.

SHOULD The pavement width should be at least 2.5 metres for type C streets.

SHOULD Pavements should be laid on both sides of type A and B streets.

SHOULD The crossfall on the pavement should be 2%, and the projects can decide whether run-off should be towards side areas or towards the carriageway.

The gradient and changes of level should be viewed together. There should not be a steep slope immediately after a small step.

The crossfall on the pavement should be 2% in the interests of run-off. The crossfall should not be more than 2% in the interests of universal design.

4.2.4 GUIDELINES, ATTENTION FIELDS, AND WARNING FIELDS

Interconnecting pedestrian zones or guidelines are particularly important for partially-sighted and blind people. They can be created by providing continuity in the guiding elements.

Natural guidelines should generally be used. Where it is not possible to establish and use natural guidelines, artificial guidelines made of standardised tactile indicators should be used.

MUST Central and open spaces, squares, public transport hubs, pedestrian crossings, and bus and tram stops should have a system of guidelines.

The choice and placement of materials and colours helps to create areas that convey information and contribute to safety for blind and partially sighted people.

MUST Guidelines, attention fields and warning fields must meet the requirements in Table 4-4.

TABLE 4-4 Mandatory ("must") requirements for guidelines, attention fields and warning fields.

Transitions	The transition to the pedestrian clearway zone and guidelines should be indicated by tactile and visual markings. The tactile marking should be detectable with the feet. The creation of natural guidelines should follow Standard Sheet 6-05.
Visual marking	The visual marking should have a visible contrast with a luminance contrast of 0.4 with the background. Guidelines in dark materials should be combined with materials around them which are sufficiently light.
Where artificial guidelines are needed	Where it is necessary to use artificial guidelines, metal indicators should be avoided because they will become slippery in the winter. Concrete or stone should be used.
Horizontal clearance along an artificial guide line	People with impaired vision should be able to walk on both sides of an artificial guide line. The pedestrian clearway zone should be at least 0.9 metres wide on either side of the artificial guide line, measured from the centre of the line, and should be free from obstructions.
Warning of steps and pedestrian crossings	Warning fields and attention fields around steps should be designed according to the requirements in the current Building Code. Refer to Standard Sheet 6-02. Warning fields at pedestrian crossing should be designed as shown in Standard Sheet 6-03.
Posts for traffic signals	Posts for traffic signals should be placed right next to the tactile warning fields, so blind people can find the push-button when they are standing on the warning field at the end of the footway.

Intuitive guidelines

Intuitive directional guidelines are composed by different street elements that indicate the direction and intersections of a street, most typically paving patterns that especially accommodate people with impaired vision. Intuitive or natural guidelines should be planned and constructed in such a way that they can be followed along a continuous route. An intuitive guideline may be a combination of different elements, such as fencing, raised edges of various kinds, kerbstones, fronts of buildings (without projecting steps) and clear differences in the surfacing.

Artificial guidelines

Artificial guidelines are tactile indicators combining directional and attention indicators. The detailed design of direction indicators and warning indicators is described in V129. It is recommended that guidelines should have a uniform appearance.

SHOULD In addition to the mandatory requirements, guidelines, attention fields, and warning fields should meet the requirements in Table 4-5.

TABLE 4-5 Desirable ("should") requirements for guidelines, attention fields and warning fields.

Intuitive guidelines	Intuitive guidelines should be used where they can be included in the design of streets and open spaces.
Continuous guide line	At an entrance, the natural guide line may be interrupted. To avoid this, a continuous guide line should be established across the open area. Continuity can be provided by kerbstones that are 0-4 cm high, depending on stormwater management and other local conditions.

4.2.5 Gradients

Ease of movement for all means that the gradients should be as shallow and short as possible.

SHOULD Footpaths should not have a gradient greater than 1:20.

SHOULD The gradient on the ramp down from pavement to carriageway level should not exceed 1:12 (8%).

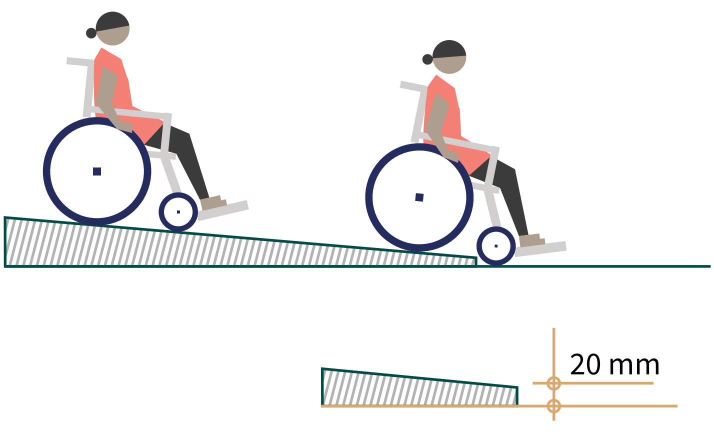

FIGURE 4-5 Ramp with change of level.

4.2.6 Changes of level

The gradient and changes of level should be viewed together. There should not be a steep slope immediately after a small step. A steep ramp combined with a small step is hard to push up, and the step could be dangerous because the wheelchair might tip over.

A rise of 2 cm is a good compromise in that this difference is manageable for people with impaired vision and wheelchair users.

MUST The edge of the kerb must be between 0-2 cm at street crossings and other transitions between different zones for pedestrians.

Where there is a difference of more than 0.5 m, this should be secured and/or marked with tactile and visual indicators.

MUST There should be a flat/smooth landing area at the end of the ramp, at least 120 cm long.

Figure 4-6 shows the need for an area to land on at the end of a downslope. This applies especially to manual wheelchairs which are difficult to use when there is a cross-slope.

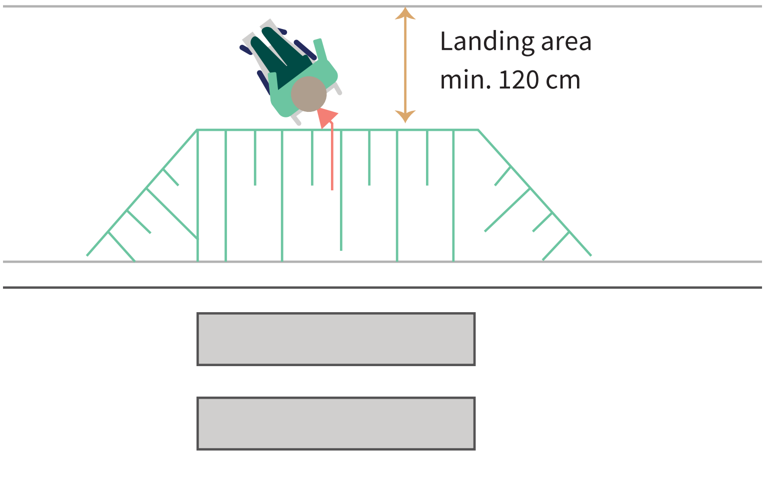

FIGURE 4-6 Landing area for wheelchairs.

Direction indicators

Direction indicators are artificial guidelines which give direction information and are laid with ridges in the direction of travel.

Attention indicators

Attention indicators are designed to mark changes, and are laid in ridges across the direction of travel. Several attention indicators form an attention field. Attention fields are intended to communicate important functions and are placed where they need to be aware of changes: pedestrian crossings, bottom of stairs, changes of direction, stopping places and information points.

Warning indicators

Warning indicators are placed where people need to be aware of danger, and are formed of parallel and diagonal rows of humps. Several warning indicators placed together form a warning field. Warning fields are placed ahead of pedestrian crossings(not on the down ramp), on stairs and by push-buttons.

4.2.7 Steps

Steps are not for everyone, but provide for ease of movement and may be a shortcut for many people. Requirements for steps are set out in the Building Code.

MUST Steps must be designed according to the requirements in the current Building Code. Refer to Standard Sheet 6-02.

SHOULD Steps should not be the main solution.

4.2.8 Resting places and benches

Many people need to rest when walking and/or waiting. Resting places can be designed in various ways.

On slopes, ‘landings’ can be created for people to rest by establishing a flat section which is large enough for someone to stop and stand quietly, or sit down. The resting place should be adapted to the relevant situation.

MUST Benches must have seats that are at least 45 cm high, but ideally 50 cm. Access to the bench and the flat area it stands on must have a level and smooth surface.

MUST For every 0.6 m of ascent, there must be a resting area at least 1.6 m x 1.6 m in size.

SHOULD Where 300 persons per hour pass through in the high season, resting places should be provided every 200–300 metres.

SHOULD Benches should have armrests and backs and have space underneath to make it easier to get up.

SHOULD Benches should be accessible and placed at natural resting points. Benches should be placed outside the pedestrian clearway zone with extra space for the legs.

4.2.9 Sufficient space for passage and access

Wheelchairs for outdoor use often need a larger area than those designed for use indoors.

MUST There must be a manoeuvring area for wheelchair users which allows for a 160 cm turning circle.

4.2.10 Pedestrian crossings

A pedestrian crossing is a marked area for crossing the carriageway. A pedestrian crossing may be an ordinary marked crossing or a raised crossing, and should be placed where there is a demand for pedestrians to cross.

See section 4.2.4 Guidelines, attention fields and warning fields.

Guidelines and warning fields should be designed as shown in Standard Sheet 6-03.

SHOULD Pedestrian crossings should be established and designed in accordance with Norwegian Public Roads Administration handbooks V127, “Criteria for pedestrian crossings” and V128, “Speed reducing measures.”

4.2.10.1 Width and Length of Pedestrian Crossings

The width of pedestrian crossings is specified in Norwegian Public Roads Administration Handbook N302.

Where there are a lot of pedestrians, it may be appropriate to widen the crossing. Pedestrian crossing markings have the same status whether the crossing is on black or red asphalt.

It is recommended that the crossing length should not exceed 8 metres.

SHOULD Pedestrian crossings should be planned to be as short as possible to minimise the exposure of pedestrians to other traffic.

4.2.10.2 Distance of Pedestrian Crossings from Intersections

Pedestrian crossings should adjoin the pedestrian clearway zone or other natural walking routes in type A2 and B1 streets. This principle should also be considered in type B2 streets. In streets where traffic management is a priority, such as type A3 or B3 streets, pedestrian crossings may be placed 5 m into side-streets. This will allow a car to stop for pedestrians without obstructing traffic behind it.

4.2.11 Shared space

The reason for establishing a shared-use area in a street is to improve the interplay between groups of road-users and improve the urban environment. A shared-use area is designed with very few controls in the form of signs, physical separation and road markings.

The street is designed in such a way that motor vehicles have to move slowly and on pedestrians' and cyclists' terms. The principle is that, when traffic volumes and speeds are low, there is no need to separate groups of road-users from each other. The aim is for road-users to negotiate who should give way and who should go first instead of having clear rules and controls.

Shared-use areas can be established where there is little traffic and no buses.

Type A1, B1 and C1 streets can be designed as shared-use areas where they have an AADT < 1,000 and a speed limit no higher than 30 km/h, and are not close to schools or senior centres. No shared-use areas should be established in the cycle network.

4.2.12 Pedestrian streets

Pedestrian streets are usually located in shopping streets and streets with other public-facing businesses. These streets fall into category A1.

Pedestrian streets must be marked with sign 548. Strict conditions apply to the use of this sign. Provisions for the design of pedestrian streets are laid down in Norwegian Public Roads Administration handbook N300. The Agency for Urban Environment is not empowered to waive these provisions.

Pedestrian streets are not suitable thoroughfares for emergency vehicles, as there is a serious risk of running into pedestrians and cyclists. No pedestrian streets should be established in the cycle network.

MUST The width of the central pedestrian clearway zone must be at least 4.0 metres. Any side pedestrian clearway zone must be at least 3.0 metres wide, and the crossfall must not be more than 2%.

SHOULD The crossfall in pedestrian streets should be 2%.

SHOULD Streets with considerable amounts of shops and food service, which require delivery from the street, should be at least 6 metres wide over a length of 20 metres, so delivery vehicles can pass each other.

Fixed elements should not be placed where they could cause an obstruction to emergency vehicles. Emergency vehicles are classed as vehicle type L.

4.2.13 Cycle streets

Cycle streets are designed to prioritise cycle traffic, but they should also be good for pedestrians, so they should have pavements on both sides like other streets. (See 4.3.4. Cycle streets)

4.3 Facilities for Cyclists

Cyclists are a very varied group with different ages, abilities and needs, and the bikes themselves differ widely. The use of cycle trailers or cargo bikes requires more space than traditional bikes.

Many cycles have also been developed for people with disabilities or other special needs. In recent years, various types of micro-mobility, such as self-balancing vehicles and electric scooters, have become part of the cycle population. Users of these forms of transport have the same rights and obligations as other cyclists.

Cycle paths have to allow for speed differences and different skill levels among cyclists. Because cyclists vary in experience and knowledge of the rules, cycle paths should be designed so users intuitively know where to position themselves and who has to give way.

The term “micro-mobility” includes small and light conveyances covered by the same rules as cycles with regard to the highway code and the Road Traffic Act. These are used for short distances and are often part of a journey by public transport. Electric scooters are an example of micro-mobility.

4.3.1 Statutes and procedures

The Agency for Urban Environment approves the choice of design and principles for cycling solutions. The City’s Cycle Strategy and *Plan for the cycle network* should guide the planning of cycling facilities. The Cycle Strategy expresses the City’s wishes and visions for its investment in cycling.

The *Oslo Standard for Bicycle Planning* show alternative design principles and provides additional information on bike-friendly design.

4.3.2 Red road surface

MUST All routes reserved for cyclists must have red surfacing, whatever the speed level and traffic volume.

This means that red surfacing must be used on all cycle lanes, including raised cycle lanes and cycle paths.

In streets where asphalt cannot be used for aesthetic reasons, the cycle route can be laid with red wheel-friendly paving stones, e.g. in cycle passages.

4.3.3 Choice of measure for cyclists on roads and streets

Section 2 describes a simple approach to prioritising the different functions in a gate. Figure 4-7 shows a way of deciding which cycle solution to choose according to the traffic volume and road situation.

4.3.3.1 Cycle Lane Solutions

A cycle lane is a lane reserved for cyclists. Marked cycle lanes are separated from other lanes with marked dividing lines, while raised cycle lanes are separated with barrier kerbstones.

Cyclists can only use cycle lanes on the right-hand side in their direction of travel. In one-way streets, cycle lanes may be laid in the opposite direction to other traffic. Solutions using cycle lanes can be adapted to different volumes of traffic, with more or less need for physical separation or width.

Figure 4-7 shows a way of deciding which cycle solution best suits cyclists of differing ages and skills. The cycling solutions should be assessed against factors such as the traffic volume and road situation and the plan for the cycle network.

CYCLE SOLUTIONS IN THE SYSTEM

A section of road may encompass different solutions with cycle lanes and still be perceived as the same end-to-end system. The variant solutions with cycle lanes address the challenges of streets with both narrow and varied cross-sections.

Cycle lanes are appropriate where the traffic and use of the street are complex and/or the road-users are moving at different speeds with large and small vehicles together.

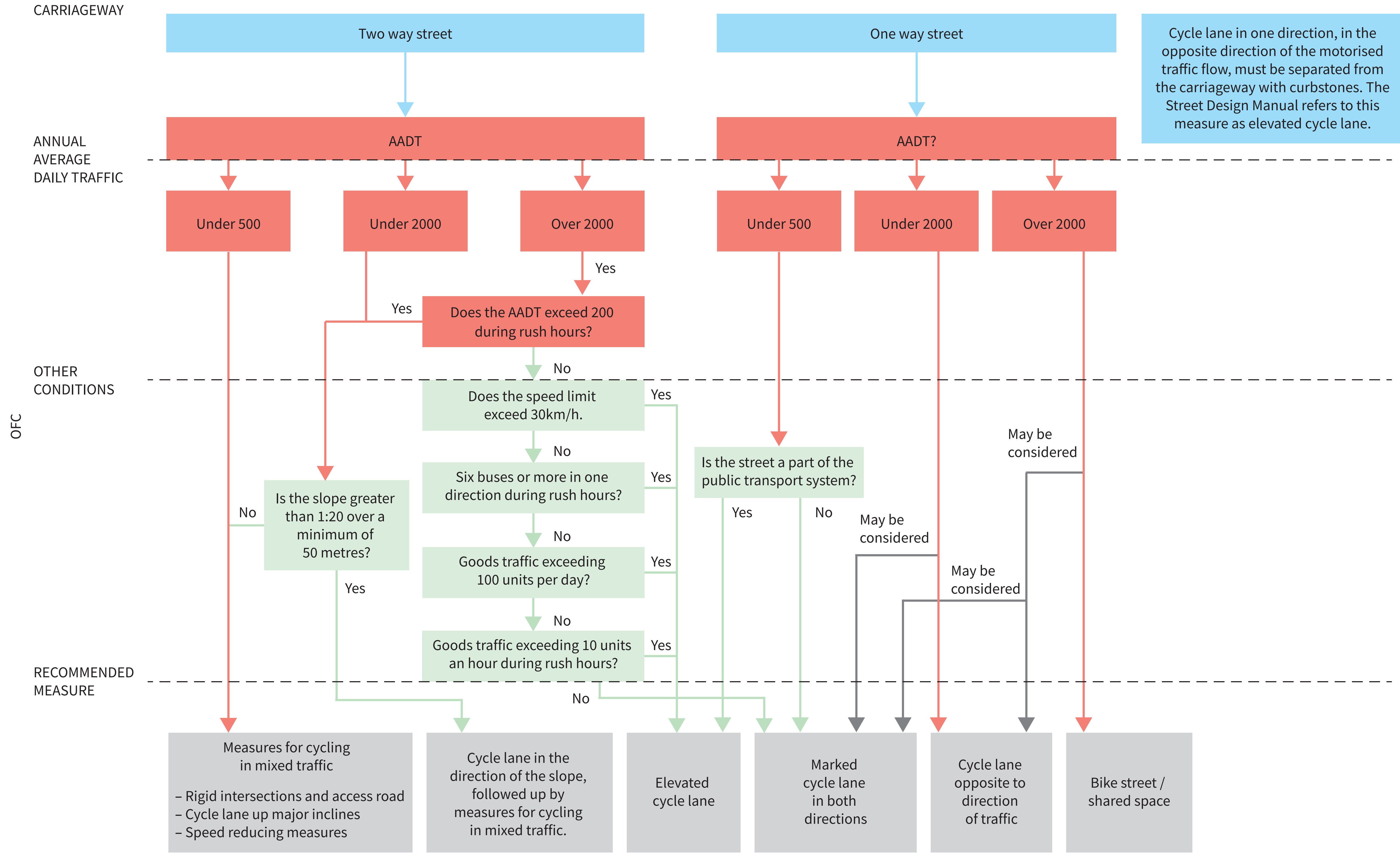

FIGURE 4-7 A way of deciding which cycle solution is best for cyclists of different ages and skill levels. The cycle solutions should be viewed in the light of the traffic volume and traffic situation.

4.3.3.2 Elevated Cycle Lanes

Elevated cycle lanes are separated from other lanes and from the pavement with kerbstones. Elevated cycle lanes are suitable for cycling at different speeds and have ample capacity.

Because of their physical separation from motorised vehicles, they also work well in streets with public transport, large traffic volumes and speed limits of 40 km/h or more. The width of the elevated cycle lane should allow cyclists to pass other cyclists moving at lower speeds.

MUST Elevated cycle lanes must be at least 2.2 metres wide.

MUST Elevated cycle lanes must end at the same elevation as the intersection or the circulation area at a roundabout.

SHOULD Up and down slopes at intersections should be at least 2 metres long.

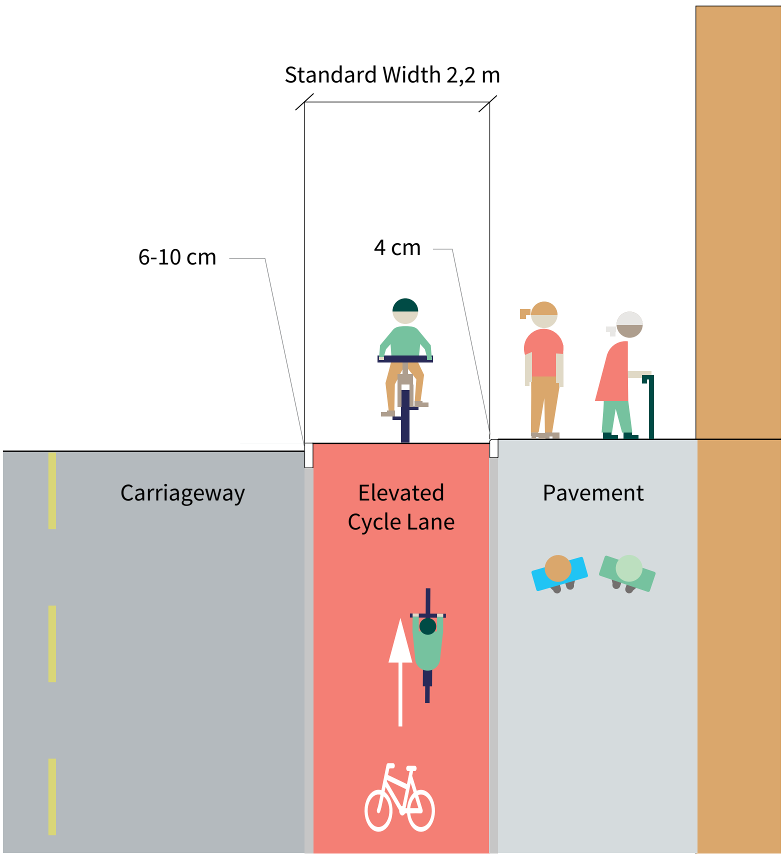

FIGURE 4-8 Standard dimensions for raised cycle lanes.

4.3.3.3 Marked Cycle Lane

Marked cycle lanes are on the same level as the carriageway. The cycle lane is separated from the carriageway with a dotted line. The cycle lane may be physically protected in exposed places and on short sections. This solution is suitable for streets with moderate traffic and low speeds; see Figure 4-9.

The cycle lane should be wide enough to give the cyclist sufficient clearance from motor vehicles and space to pass other cyclists.

SHOULD Cycle lanes should be 2.2 metres wide.

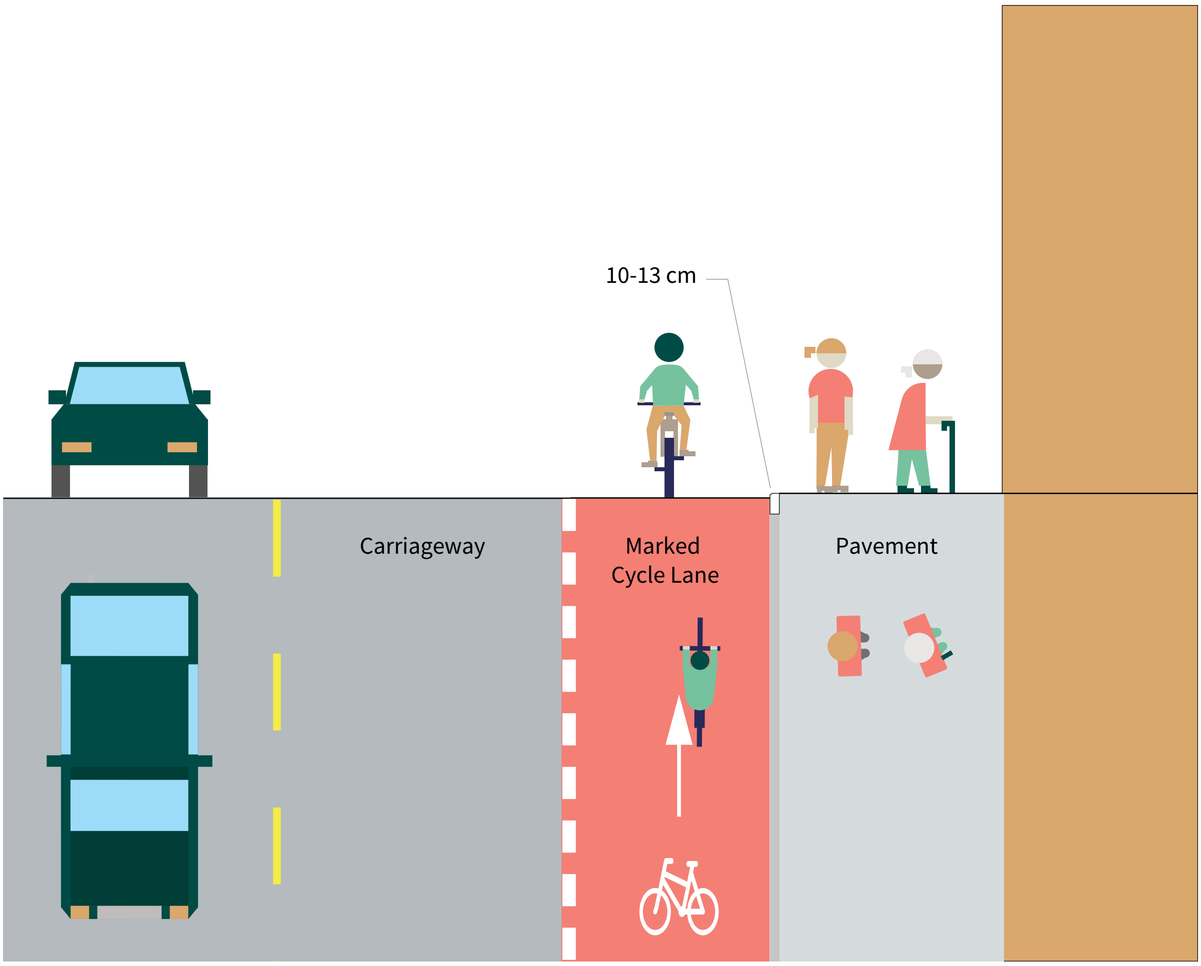

FIGURE 4-9 Marked cycle lane.

4.3.3.4 Cycling Against One-Way Traffic

Cycling against one-way traffic is suitable in streets with AADT < 2,000 and a measured speed level below 25 km/h.

Cycling against one-way traffic alters the competitive balance with cars by making it easier for cyclists to progress.

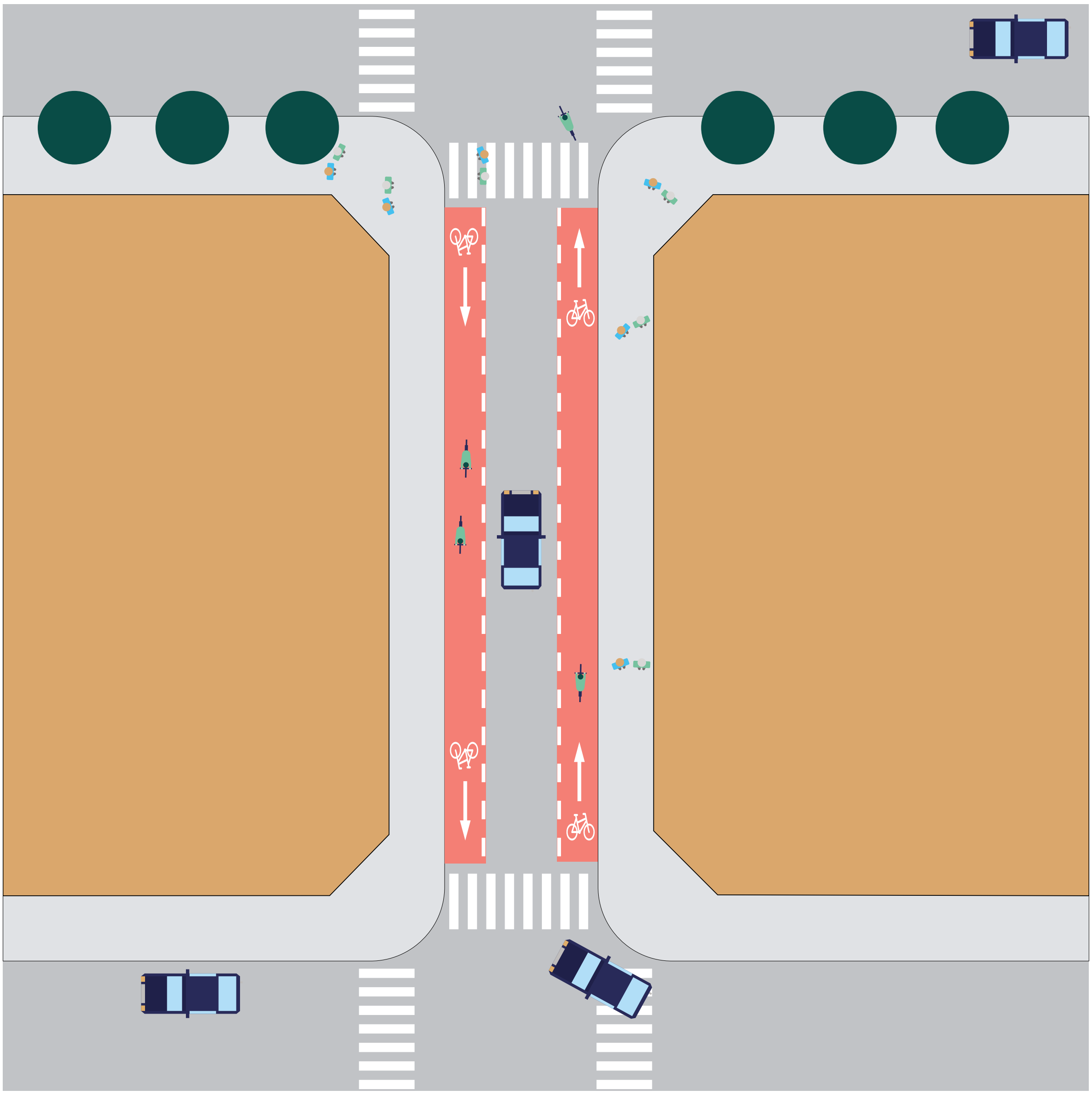

FIGURE 4-10 Cycling against one-way traffic with cycle lanes in both directions.

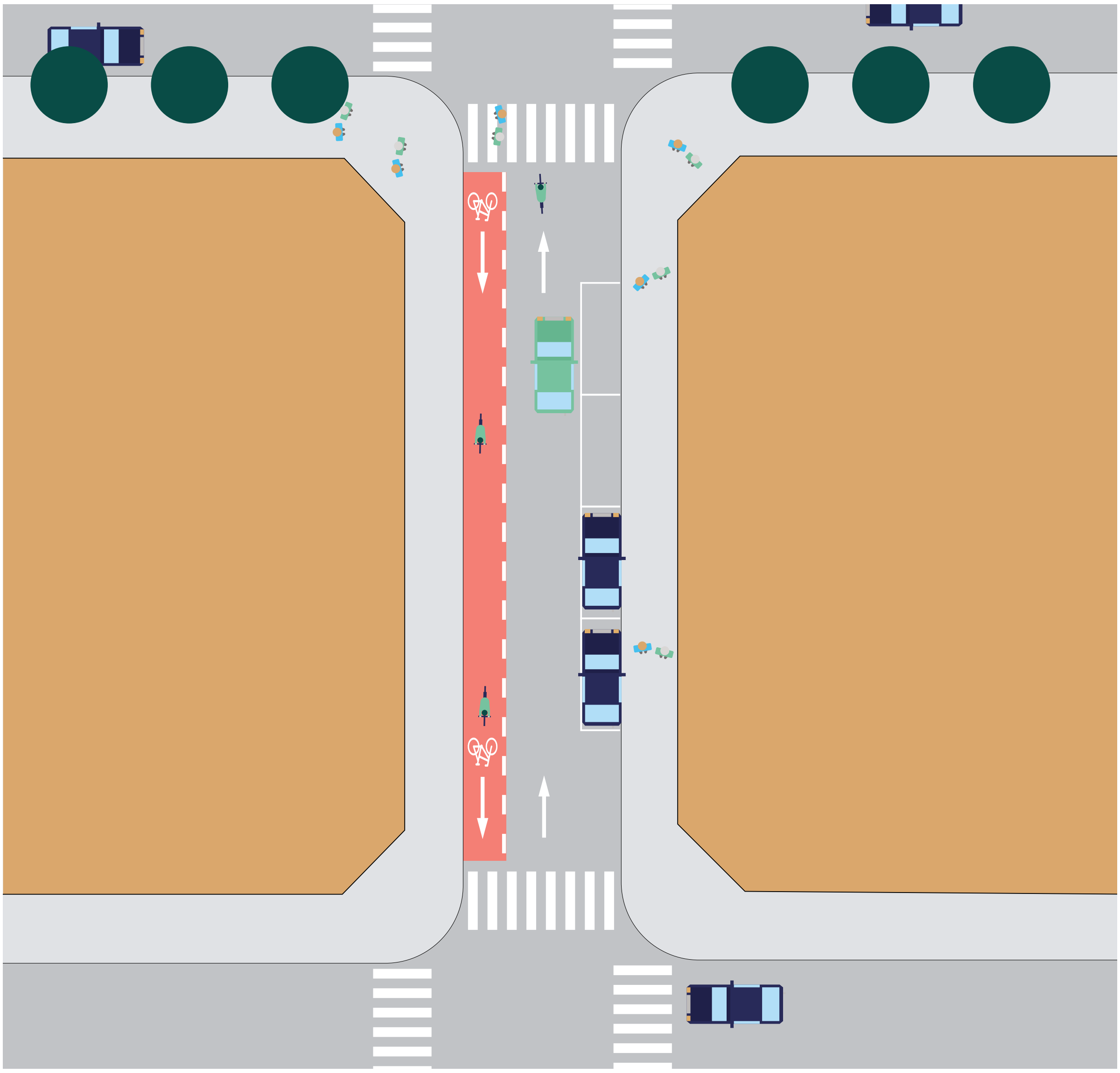

FIGURE 4-11 Cycling against one-way traffic.

Any parking should be placed on the right-hand side in the direction of the traffic.

4.3.3.5 Protected Cycle Lane

In areas with high probability for accidents between road-users it is recommended to sheltered the cycle lane from the roadway and/or public transport lane.

Physical protection may be provided by differences of level, verges, tactile elements or traffic islands. The need for protection is greatest in streets with public transport, a high proportion of large vehicles or high speeds.

MUST The design must allow for the use of the cycle lane (minimum clearance 2 m.).

4.3.3.6 Cycle Lanes in Streets with Trams

Trams and bikes should only follow the same route where there is space for a separate area for bikes. Wide marked cycle lanes will work well on tram routes. There must not be on-street parking next to the cycle lane and there must be plenty of space around tram stops.

MUST Cycle lanes must not overlap tram tracks or overhangs for trams on bends.

It is difficult to cross tram tracks where the crossing is at a sharp angle to the rails. Where cycle lanes cross tram tracks, the cycle lane should cross at as close to 90 degrees as possible.

SHOULD The crossing angle should not be less than 60 degrees.

SHOULD Crossing areas should not coincide with points.

4.3.4 Cycle Street

A cycle street is a street which prioritises pedestrians and cyclists. Deliveries, access to properties and similar traffic may be allowed in one direction if necessary.

Cycle streets are suited to urban cycling at moderate speeds (15–25 km/h), and work well in shopping streets where speeds have to be kept low.

Cycle streets work best where the traffic volume for motor vehicles rarely exceeds an AADT of 500, traffic is one-way and actual speeds are below 20 km/h.

Very few streets meet these criteria, but speeds and AADT can be regulated with speed-reducing measures and traffic patterns that discourage through passage, for example. Torggata between Badstugata and Hausmanns gate is an example of this.

Cycling streets are not suitable through routes for emergency vehicles, as there is a serious risk of running into pedestrians and cyclists. If deliveries are restricted to specific times, these should be outside peak times for cyclists.

MUST The width of the carriageway must be between 4.0 and 4.5 metres.

SHOULD Delivery bays should be provided to avoid blocking the carriageway.

SHOULD Pavement widths should be adapted to the number of pedestrians.

SHOULD The boundary between the pavement and the carriageway should be marked with kerbstones 6 cm high.

4.3.5 Cycle path with pavement

Cycle paths with pavements are a separate facility for pedestrians and cyclists signposted as a cycle path and separated from other traffic by a kerb, gutter, verge, fencing, railings or the like. Cycle paths with pavements are best suited to sections with few intersections and entrances.

Cycle paths with pavements have good capacity and work well for cycling at differing speeds, including high speed (over 30 km/h).

The width of the pavement and cycle path must be adapted to the number of pedestrians and cyclists. The following dimensions should be applied:

TABLE 4-6 Width of cycle path.

Hourly volume of cyclists (peak hour)	Cycle path m	Pavement m (minimum)*
< 400	3.0	2.5
400–700	3.5	2.5
700–900	4.0	2.5
> 900	5.0	2.5

*The pavement width should increase with the number of pedestrians/hour as shown in section 4.2.1

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MUST The pavement area must be separated from the cycle area with standard kerbstones.

MUST The centre line must separate traffic in the two directions. This sort of centre line must be yellow.

Where a cycle path with pavement is used in a street, the normal requirements for pavement width must be met. The width of the divider between the street and the cycle path should be governed by the speed limit in the street.

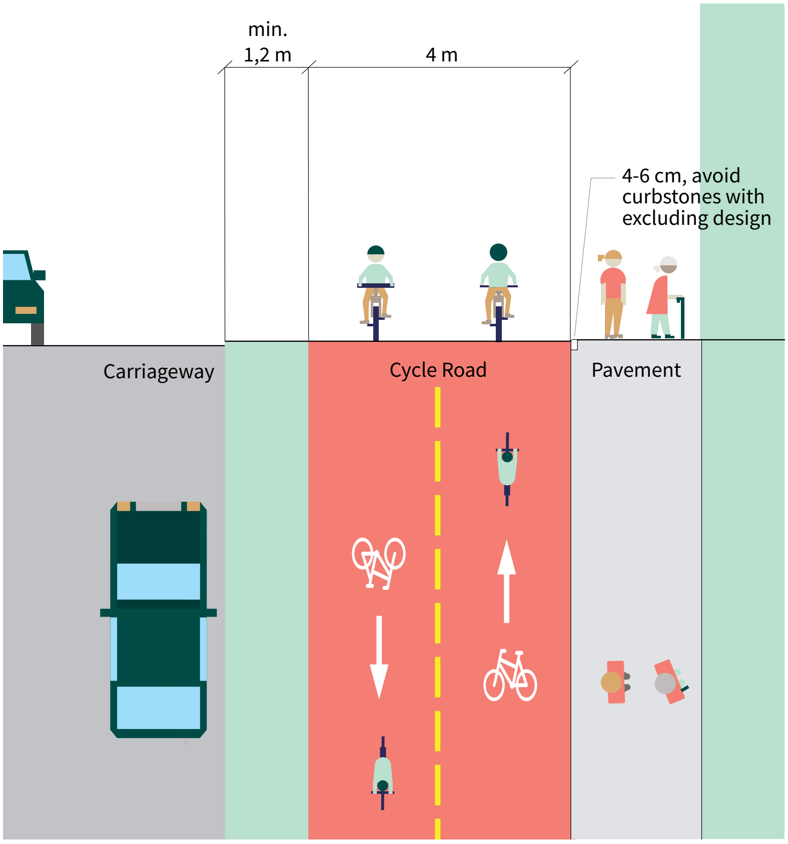

FIGURE 4-12 Cycle path with pavement.

FIGURE 4-13 Cycle path with pavement on Tvetenveien.

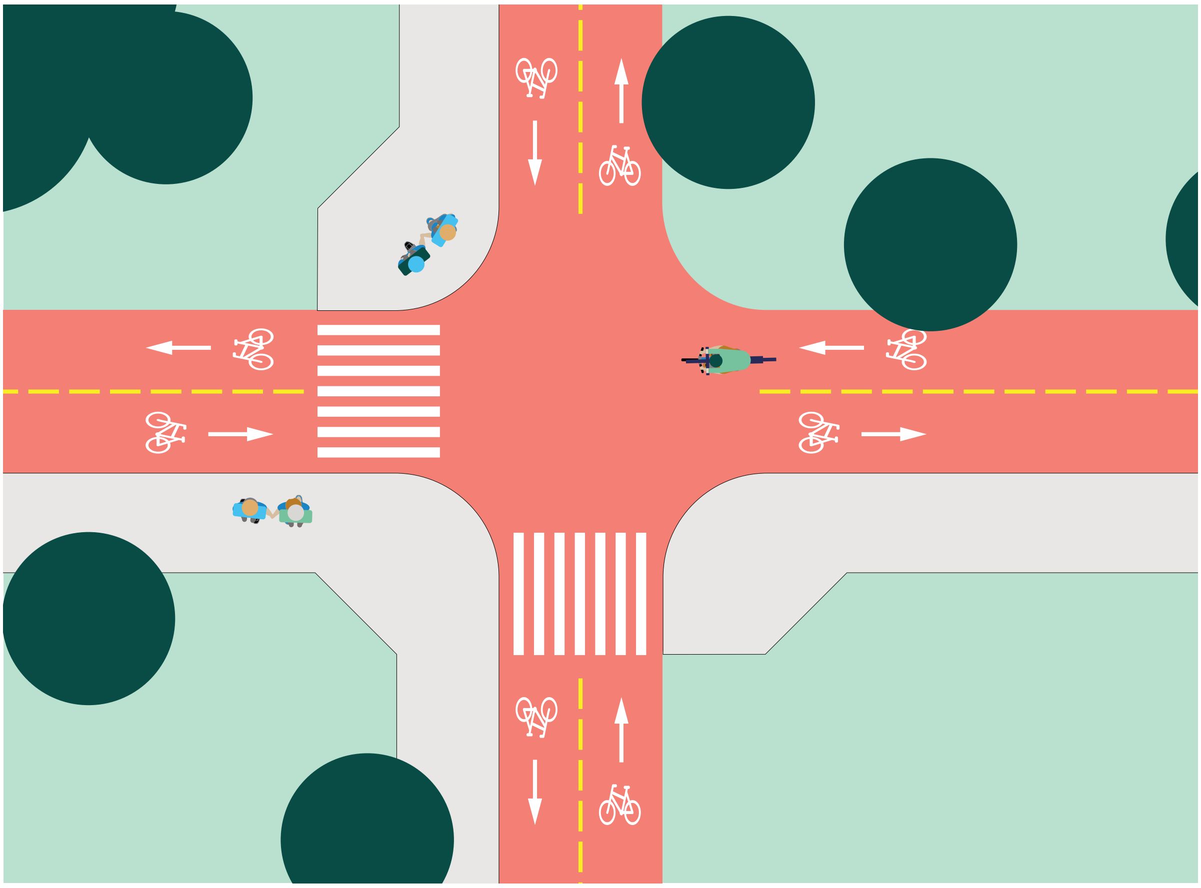

FIGURE 4-14 Intersections between cycle paths with pavements and pedestrian crossings.

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4.3.6 Cycle expressway

Cycle expressways are solution described in *V122 "Cycling Handbook."* The solution can be used on municipal roads

Cycle expressways are recommended on sections to be laid out for fast cycling (over 30 km/h) over long distances. Extra width makes the cycle expressway safe and comfortable for many groups of users.

MUST Cycle expressways must be at least 4 metres wide.

MUST Cycle expressways must allow people to cycle non-stop. This can be achieved by prioritising the cycle path and building split-level crossings.

4.3.7 Cycle passage

Cycle passages give cyclists easy access to many streets and connections in the city. The design should be viewed from end to end.

SHOULD In dead-end streets or where one arm at an intersection is closed to motorised traffic, a cycle passage should be established.

FIGURE 4-15 Examples of cycle passages.

4.3.8 VISIBILITY REQUIREMENTS BETWEEN FOOTPATHS AND CYCLE PATHS

SHOULD At an underpass between two footpaths/cycle paths, visibility should be as shown in Figur 4-16.

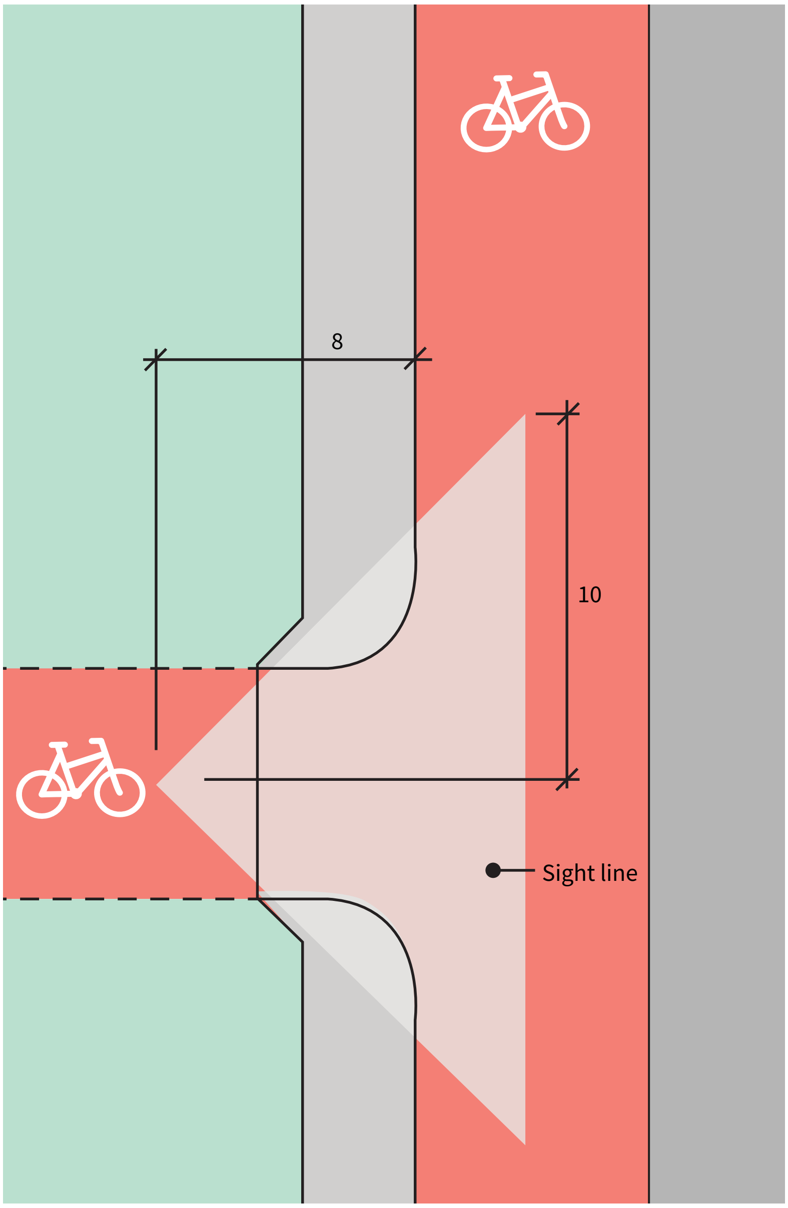

FIGURE 4-16 Visibility between two footpaths/cycle paths at an underpass (dimensions in metres).

4.3.9 Cycle lanes in streets with parking

Parking along cycle lanes creates challenges for cyclists. Safety should be prioritised when laying out cycle lanes with parking.

Cycling next to parked cars could feel uncomfortable and it increases the probability of accidents. The cycle lane should be protected with an adequate buffer zone to allow for opening doors. This will provide better protection for the cyclists and reduce the risk of mistakes and accidents. It also protects the pavement area better against cars.

Cycle lanes should be taken behind bus and tram stops. This is described in section 4.4.3.6.

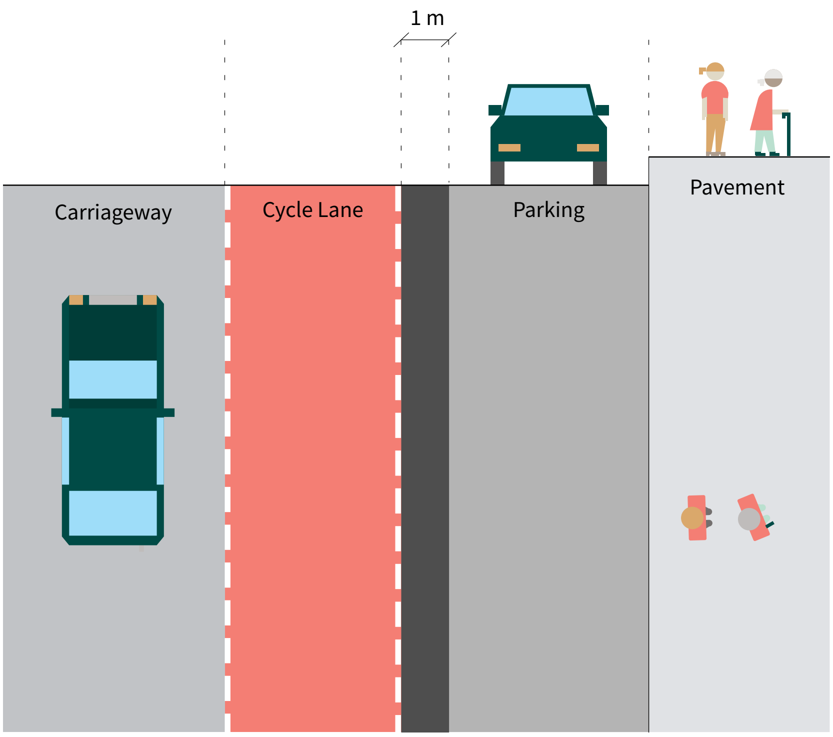

FIGURE 4-17 Buffer between parking and the inside of a cycle lane.

MUST In existing streets with parking on the inside of cycle lanes there must be a buffer of at least 1.0 metre between the cycle lane and the parking area.

MUST Where the width of the street does not allow space for a buffer, the on-street parking must be removed altogether. Where there has to be on-street parking along a cycle lane, it should be placed between the roadway and the cycle lane, with a 0.5 metre buffer in between.

MUST Where the parking is on the inside of the cycle lane, the parking spaces must be separated from the buffer zone with a line.

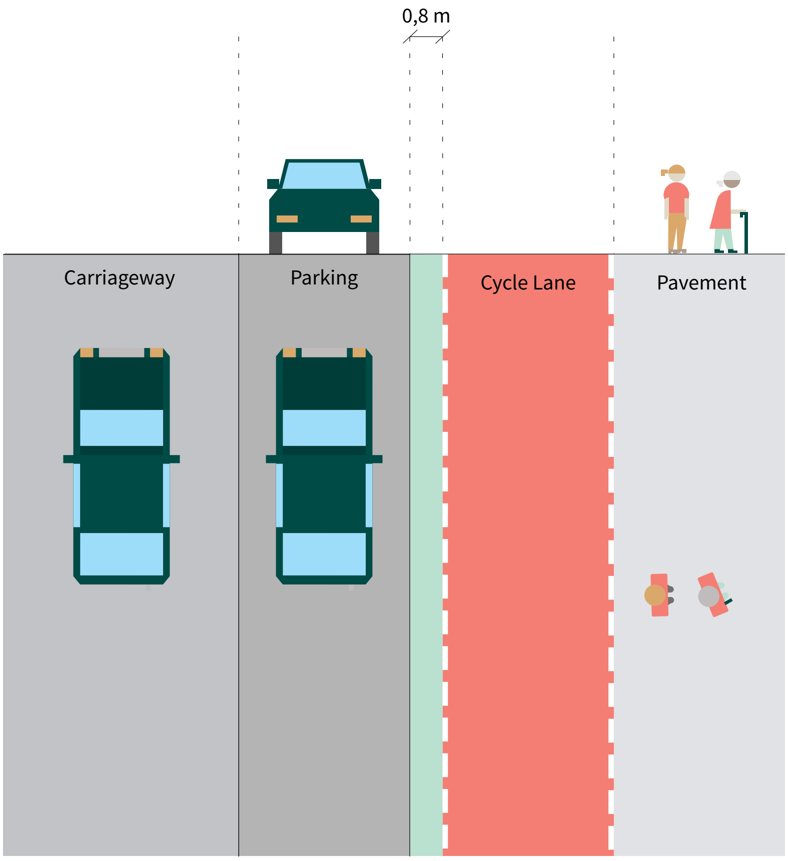

FIGURE 4-18 Buffer between cycle lane and parking.

MUST Where a cycle lane is created for cycling against one-way traffic, any parking must be on the opposite side from the cycle lane, i.e. on the right in the normal direction of travel.

MUST If it is necessary to allow for deliveries and disabled parking in a new street with a cycle lane, the parking must be placed between the roadway and the cycle lanes, with a 0.8 metre buffer in between.

There must be room for vans to open their rear doors in delivery bays.

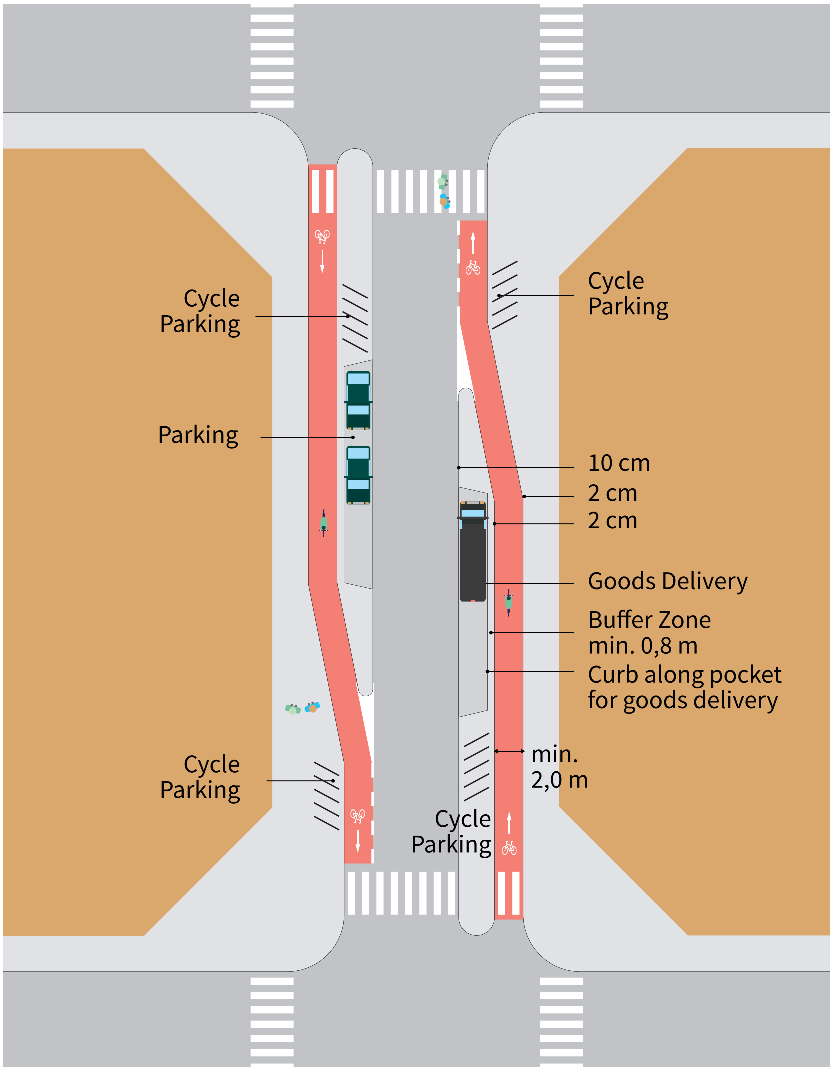

FIGURE 4-19 Cycle lane routed behind and delivery bay.

4.4 Facilities for Public Transport

An attractive public transport service is one with high frequency, short journey times, good punctuality and few deviation. Space must be reserved for tram and bus stops, waiting areas and turning places both centrally and at the edge of the city. On the main routes, public transport must be prioritised. Passability for public transport will reduce possible delays and ensure reliability.

All public transport users are pedestrians, possibly in combination with private cars, cycles or other forms of micro-mobility before and after taking public transport. It is important to provide for good accessibility to and from stops.

4.4.1 Statutes and procedures

The Agency for Urban Environment approves the principles for the design of streets with public transport in consultation with Ruter and Sporveien. On routes used by trams, technical rule from Sporveien will apply. Tram operation, including the management of tramway infrastructure, is covered by the Railways Act and associated regulations, which ensure requirements for safety management and risk analysis in relation to changes to existing infrastructure or building new facilities for trams.

GUIDANCE FOR PLANNING OF PUBLIC TRANSPORT

Ruter will be producing a guide to infrastructure for public transport. The guide will present design principles and provide detailed information on bus and tram-friendly design.

Ruter is working on its own manual for bus and tram stop design. This manual will contain information about the design of stops above and below ground, including street furniture and information.

Ruter will also produce its own manual on hubs.

Refer also to Norwegian Public Roads Administration handbooks N100 “Road and street design” and V123 “Public transport manual.”

4.4.2 Passability

Passability for public transport is affected by the design of the street and the volume of traffic in it. Measures that promote passability for public transport are:

- Wide streets.
- Routes for public transport.
- Signal priority at intersections with traffic lights.
- Filter lanes.
- Approach control.
- Signage with priorities
- High quality public transport stops.
- Hubs.
- The quality of the surface is important for the passability for buses and for passenger comfort.

4.4.2.1 Lanes for Public Transport

To prevent conflict with oncoming traffic, a two-way street with public transport should be at least 3.25 metres wide on straight sections. This applies regardless of the speed limit for the street.

MUST On a one-way street with buses, the carriageway must be at least 4.0 metres wide on straight sections.

MUST There must be road widening on bends used by buses. Road widening must follow the measurements shown in Table 4-2.

MUST The lane used by buses in a two-way street must be at least 3.25 metres wide on straight sections.

SHOULD The width of the bus lane on type A3 and B3 streets should be 3.5 metres. Other streets should also have a 3.5 metre wide lane where the frequency of buses is more than 10 departures an hour in each direction.

4.4.2.2 Public Transport Lane

Public transport lanes may be constructed to prioritise buses and trams. Public transport lanes are designed to be used exclusive by buses or trams. Public transport lanes should be created:

- Where there are 8 or more buses an hour in one direction during peak hours.
- Where the delay to the bus or tram is more than 2 minutes per kilometre.

It will normally be appropriate to establish public transport lanes where the AADT is > 8,000, but it is worth considering whether there is a need to prioritise public transport with lower traffic volumes too. Where space is limited, public transport lanes may also be established on short sections. A public transport lane must be at least 3.25 metres wide, but it should be 3.5 metres.

Public transport lanes may be in the middle or at the side of the carriageway. An issue with public transport lanes at each side of the carriageway is conflicts with other road-users at intersections, where the public transport lane has to be terminated before the intersection. Intersections also pose a challenge where central public transport lanes are used. Signal control can be used to reduce conflicts with other road-users.

A central reservation for public transport can be separated from the other lanes with a central divider. The central divider can be used as a waiting area for pedestrians crossing the street, or as a green verge and retention area for stormwater.

Public transport lanes or physically separate routes for trams are normally placed in the middle of the street, but other positions are possible.

Physically separate trams routes could be integrated with green space, water features, and are most often separated from traffic through raised lanes, kerbstones, traffic islands or fencing. Tram routes can pass through parks and other areas completely closed off from other forms of traffic.

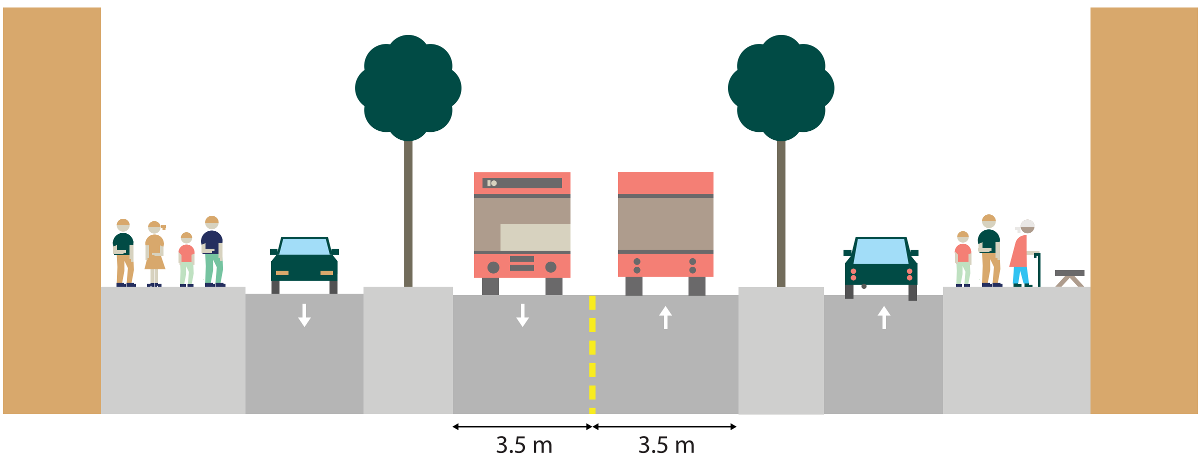

FIGURE 4-20 Example of central public transport lane.

4.4.2.3 Public Transport Street

A public transport street is a street where the carriageway is reserved for public transport.

MUST On a two-way public transport street, the carriageway must be 7.0 metres wide.

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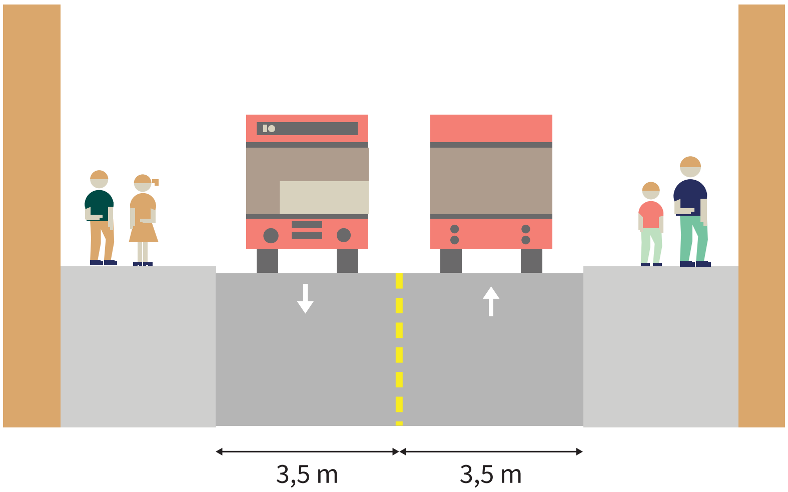

FIGURE 4-21 Example of public transport street.

4.4.2.4 Trams in Pedestrian Streets or other Pedestrian Areas

Tram routes can pass through pedestrian areas, such as open squares, or through streets reserved for pedestrians and trams. It is important to ensure that the tracks are visible, with the aid of surfacing or other markings. Rådhusplassen in Oslo is a good example of a tram route across an open square where pedestrians can move freely. The tram track is marked with slightly rougher stones than the rest of the square.

4.4.3 Bus and tram stops

Bus and tram stops must ensure safe loading- and off-loading of passengers and provide facilities of high quality for transfer times. Their design and placement influence safety and accessibility for passengers. Crossing points adjacent to the stop has to take account for the desire lines of pedestrian users of the area and public transport system. Stops and access to them must conform to universal design.

Stops must be placed where they cause the least possible hindrance to traffic. This is especially important at intersections. At traffic-light controlled junctions, bus and tram stops should be positioned so public transport can be prioritised in the signal system. Stops right before traffic lights should be avoided. In Oslo, bus and tram stops are kerbside stops, not bus bays.

Bus boxes should be clearly marked where there is longitudinal parking before and/or after the stop, or where there is a cycle lane.

FIGURE 4-22 Trams in a pedestrian area.

For every stop, designers should consider whether to provide for open, local stormwater management.

The position and design of bus and tram stops in general is described in more detail in *Norwegian Public Roads Administration Handbook V123 "Facilities for Public Transport on Roads and Streets."*

MUST Access to bus and tram stops must be planned in conformity with universal design. Artificial guidelines at stops must be planned according to Standard Sheet 6-04.

MUST Where there is to be a shelter, the platform/pavement must be made wider, at least 3.0 metres. The minimum distance between the shelter and the kerb must be 2.0 metres.

MUST Stops must not be placed where the bus has to stop closer than 5 metres to a pedestrian crossing or 1 metre after the crossing (back of the bus).

SHOULD Stops for buses and trams should be placed on straight sections with no vertical curvature.

SHOULD The kerb zone in bus bays should be at least 0.7 metres.

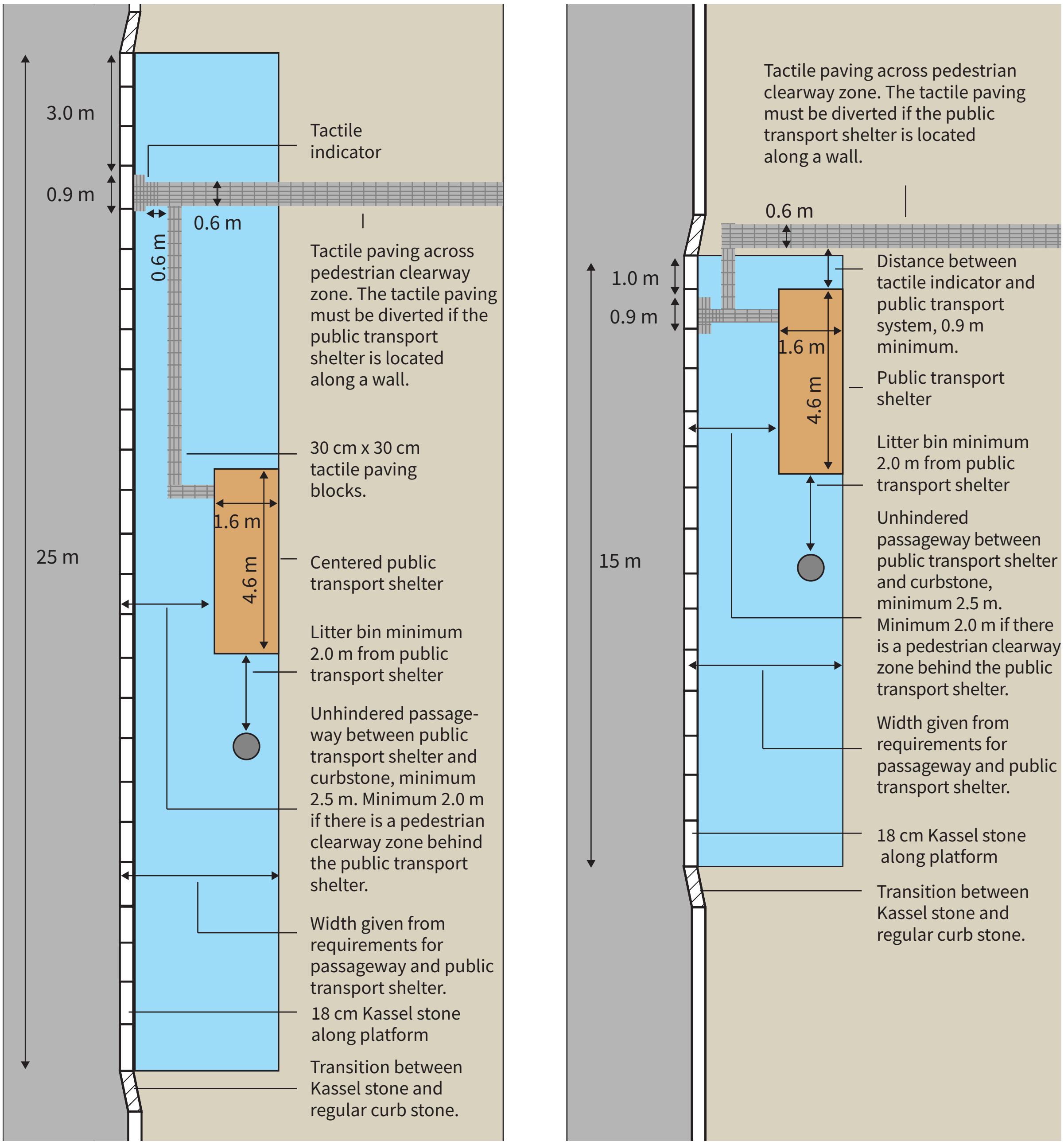

FIGURE 4-23 Requirements for the design of stops for articulated and normal buses.

TABLE 4-7 Requirements for the length of stops for articulated and normal buses.

MUST

Bus category	Length of stop with space for one bus	Length of stop with space for two buses	Length of stop with space for three buses
Articulated bus	25 metres	55 metres	85 metres
Normal bus	15 metres	35 metres	55 metres

At bus stops there should be a crossfall of 2% to the traffic area except where water is to be diverted into local stormwater facilities.

SHOULD The crossfall at bus and tram stops should be 2%.

A bus platform should have an 18 cm high kerb: see Figure 4-24. Kassel stones make it easier for the bus driver to manoeuvre the bus up to the platform. At shared stops for buses and trams, designers should consider what type and height of kerbstones to use to satisfy universal design.

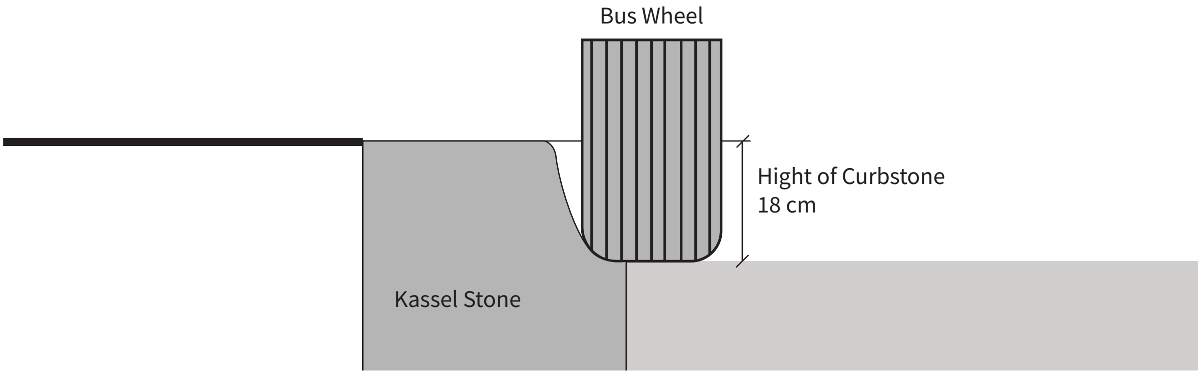

FIGURE 4-24 Example of kerb with Kassel stones.

MUST The platform must be 18 cm high and use Kassel kerbstones. Where the vehicle needs to turn in or out, the height of the kerb must be 13 cm.

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SHOULD The platform should be at least 3 metres wide, and have an even non-slip surface with level differences smaller than 2 cm.

4.4.3.1 Kerbside Stop with Partially Extended Platform

A kerbside stop with a partially extended or bulb-out platform is the most common solution for stops in streets with no parking: see Figure 4-25. This solution is formed by extending the line of the kerb 20 cm out into the carriageway at the stop. This makes it easier for the bus to enter the platform and passengers have more space in which to wait. This stop design can act as a speed-reducing measure by reducing the width of the street and increasing the height of the kerb.

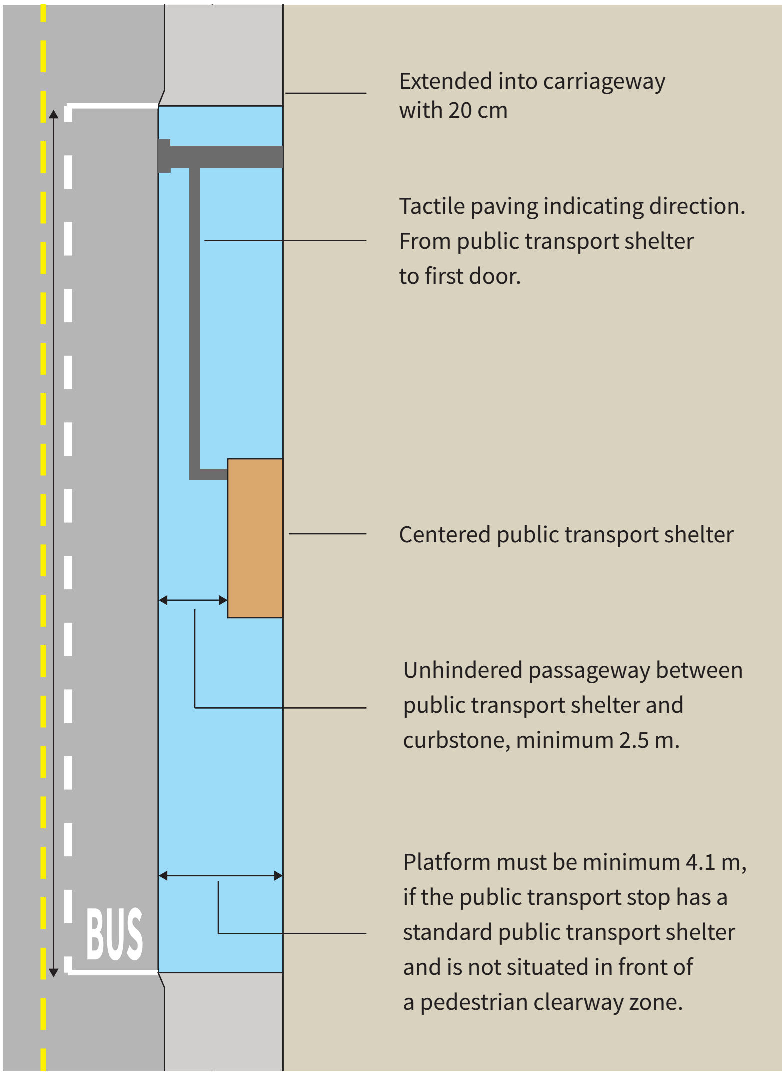

FIGURE 4-25 Kerbside stop with partially extended platform.

4.4.3.2 Kerbside Stop with Extended Platform

A kerbside stop with an partially extended or "bulb-out" platform is planned as shown in Figure 4-26. This type of stop can be used in streets with parking or where there is a need to reduce speeds in the street.

The shift in level is also achieved with an increase in height from the usual street level to the 18 cm platform elevation.

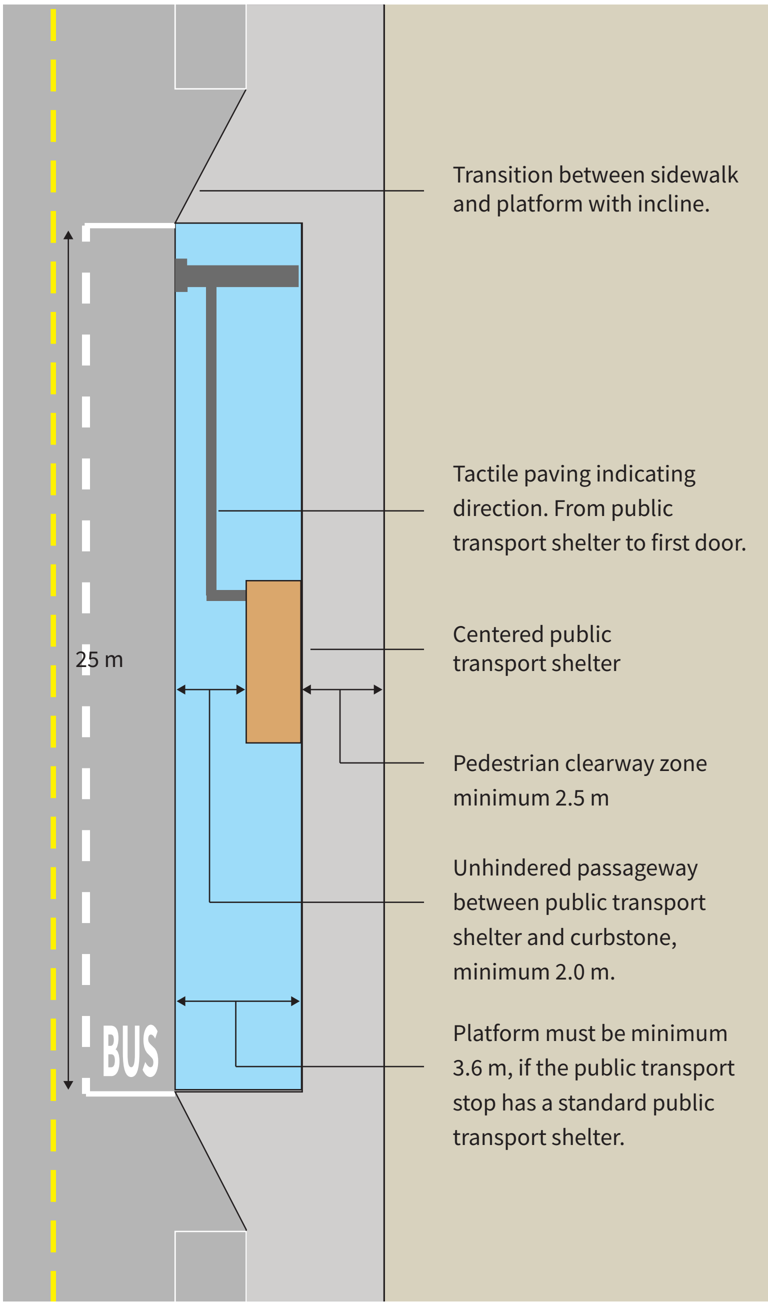

FIGURE 4-26 Kerbside stop with extended platform.

4.4.3.3 Kerbside Stop

A kerbside stop (without an "bulb-out" or extended platform) is planned as shown in Figure 4-27.

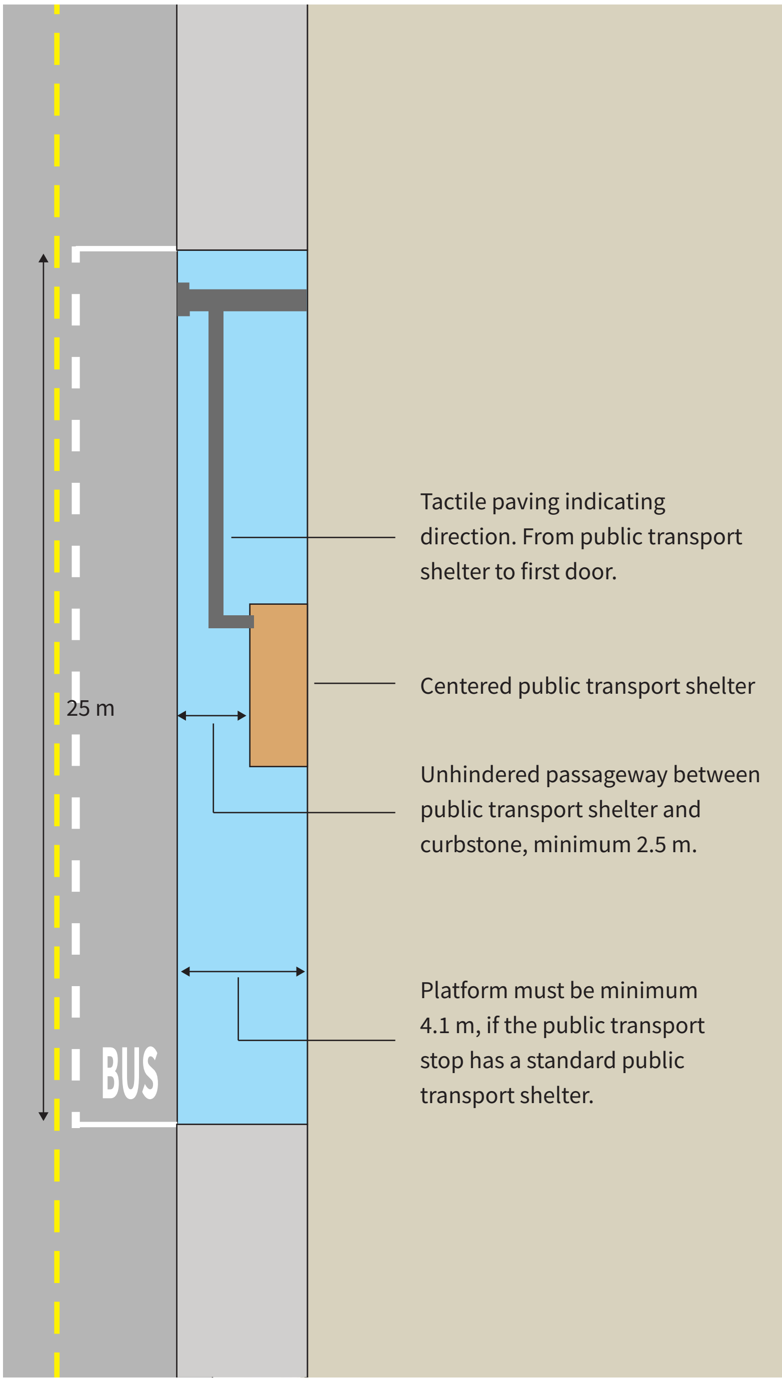

FIGURE 4-27 Kerbside stop for buses.

4.4.3.4 Public Transport Stop for Centered Public Transport Lane

Stops for bus and tram routes in streets with public transport lane centered in the overall carriageway are planned as shown in Figure 4-28. The platform must be fenced off from the carriageway and be at least 3.1 metres wide.

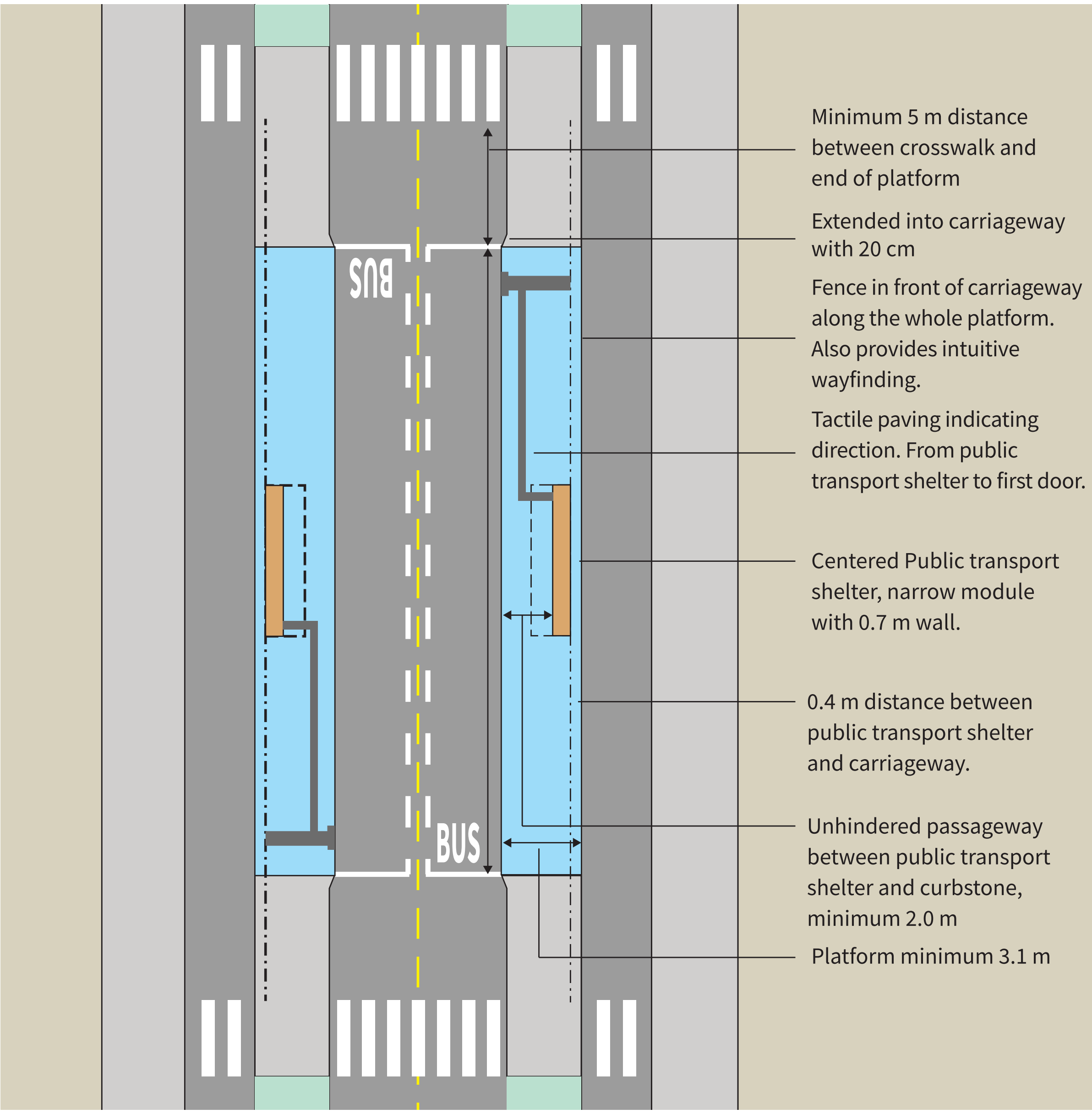

FIGURE 4-28 Stop on a central bus or tram route.

4.4.3.5 Tram Stops

The requirements for tram stops are ensured in the Regulations for tramways, underground railways, light rail etc. (Requirements Regulations), *Section 11-3 Platforms etc.* Tram stops must be designed in accordance with Sporveien's technical regulations and approved by the Agency for Urban Environment before construction starts.

MUST Stops must not be placed where the tram has to stop closer than 5 metres to a pedestrian crossing or 1 metre after the crossing (back of the tram).

SHOULD At signal-controlled intersections, the stop should be placed 20–50 metres after the intersection, depending on the AADT.

4.4.3.6 Stopping Places in Streets with Cycle Lanes

Where there are facilities for cyclists on a public transport route, the cycle lane should be placed behind the stop. Figure 4-29 shows how a cycle lane can be diverted behind a bus stop.

MUST Sight lines between cyclists and public transport users must be taken into account.

SHOULD Cycle lanes and cycle paths should be diverted behind bus and tram stops (with or without shelters), with a design that ensures that the cyclists uphold a low speed limit (around 15 km/h).

Sight lines between cyclists and pedestrians must be taken into account. Street furniture and railings can impede visibility between pedestrians and cyclists, but with comprehensive and tactical placement street furniture and fencing can be used to guide pedestrians to a suitable crossing point. The use of street furniture as obstacles and fencing may involve a detour for pedestrians and should be avoided.

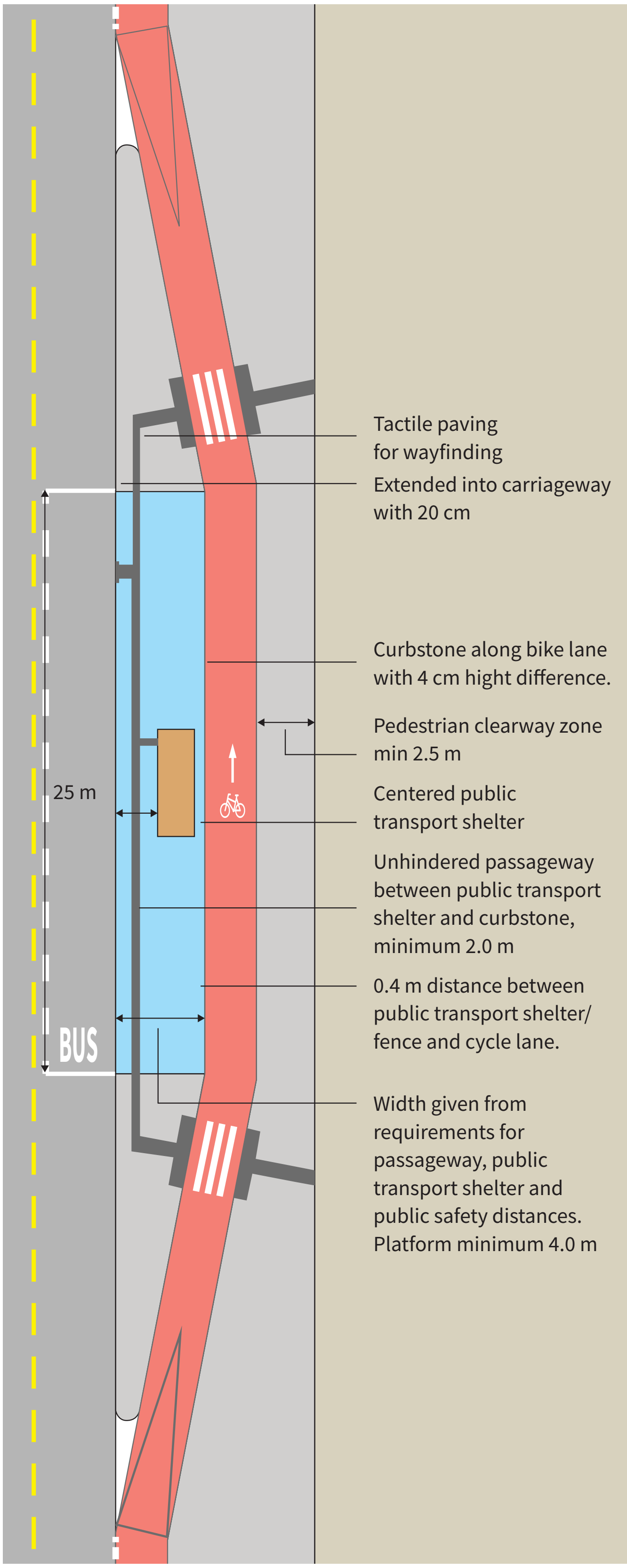

FIGURE 4-29 Cycle lane diverted behind a bus stop.

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4.4.4 Waiting places and facilities for regularity

For public transport waiting facilities/facilities for control of regularity and turnarounds are at least as important to the public transport system as the stops themselves. The public transport system has a fundamental necessity to manage buses that are used to provide extra capacity from central hubs, and vehicles must be able to turn around at the terminus.

4.4.5 Parking for micro-mobility and cycles at major stops

At major stops, parking places must be provided for cycles and micro-mobility in accordance with the latest cycling standard and guideline on public cycle parking.

4.5 Solutions for Other Vehicles

The prioritisation of groups of road-users in the street design manual also includes other vehicles. This section contains requirements for streets that are planned for low bus traffic. Refer also to section 4.1 “General requirements for geometry.”

Car traffic must be reduced and all passenger cars should be emission-free by 2030. Heavier vehicles should be emission-free or use renewable fuel. Access to adequate charging infrastructure is a prerequisite for the transition to electric vehicles. The *Strategic roadmap for charging infrastructure in Oslo* describes the ambitions of the Agency for Urban Environment in this area.

4.5.1 Lanes and carriageways

The width of the lanes will depend on the function of the street and which group of road users is to be prioritised.

MOTOR VEHICLES

A motor vehicle is a vehicle with an engine designed to travel on the ground without rails. Mopeds and motorcycles also fall within this definition.

MUST On a one-way street, the carriageway must be at least 4.0 metres wide on straight sections.

SHOULD The lanes should be 3.25 metres wide in streets with bus traffic.

SHOULD In streets with two lanes, the total carriageway between the kerb lines should not be narrower than 5.5 metres in two-way streets.

Requirements for lane widths are intended to ensure that cars can pass stationary or temporarily parked refuse trucks, service vehicles, emergency vehicles, vans and the like. Requirements for lane widths in type A and B streets with two-way traffic are shown in Figure 4-30.

Pavement — 5.5 m — Pavement	AADT < 4,000 Heavy vehicles < 100 Speed limit < 40 km/h
Pavement — 6.5 m — Pavement	< 50 km/h AADT heavy vehicles > 100
Pavement — 7.0 m — Pavement	50 km/h Or bus route with > 10 buses/hour in each direction

FIGURE 4-30 Requirements for width of carriageway on type A and B streets with two lanes.

4.5.2 Commercial traffic and refuse disposal

Commercial traffic can be divided into deliveries, freight and service transport. Service transport is transport for craftspeople and other service providers. Procedures for distributing goods are changing. Among other things, smaller consignments can be carried in small vans or trucks which have less need for special delivery bays, or with cargo bikes that can carry goods from central warehouses/distribution centres.

Networks for deliveries, freight and service traffic can be split into three different types:

- through transit network – general transport network for through traffic.
- distribution network – consignments to and from terminals and access to larger terminals, warehouses and stores.
- local networks – deliveries and refuse disposal.

Distribution and local networks for freight and service transport are fine-meshed, and in Oslo they will usually be conceived as streets. The network provides access for local distribution traffic and coincides with the local network for private cars. The speed limit is usually 30 or 40 km/h.

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MUST In new districts, deliveries and refuse disposal must be handled on private premises or below ground level.

SHOULD The network of freight traffic using trucks, trailers or modular trailers should have lanes that are 3.25 metres wide with a speed limit of ≤ 40 km/h.

4.5.3 Emergency vehicles

All streets in the municipality must be passable for emergency vehicles, firetrucks and fire engines. Special consideration shall be applied regarding the passability of emergency vehicles on priority emergency routes.

MUST Where humps are planned, the number must be limited and properly justified.

MUST Emergency vehicles must be sized as vehicle type L as defined in Norwegian Public Roads Administration handbook N100.

4.5.4 Cars

The development of the motor vehicles is accelerating all the time, with new types of vehicle coming into the market. This rapid development is a challenge to street planners. The City has a goal of planning streets to be resilient to the development of mobility solutions, including types of vehicle.

4.6 Speed-Reducing Measures

Low speed limits and physical speed-reducing measures can contribute to road safety and activate city life, as 'soft' road-users feel that they have priority with such measures. Moreover, reduced speed limits often results in lower noise levels and improved air quality in the surrounding area.

However, experience shows that speed limit signs are not sufficient to persuade road-users to maintain the correct speed. In such cases, there may be a need for physical measures. The Norwegian Public Roads Administration has drawn up a separate guide on possible measures, *handbook V128 "Speed-Reducing Measures."*

The choice of measures has to be viewed in conjunction with the functions of the street. In streets with high-frequency bus routes, speed humps and other measures that affect the comfort of passengers cannot be used. Suitable measures in streets with public transport could include "mini-humps" and narrowing of the carriageway.

Solutions that can help to reduce speeds and create space for other important functions, such as stormwater management, green spaces and bus and tram stops, should be prioritised.

MUST Speed humps or raised pedestrian crossings must cater for stormwater management.

MUST Speed humps must be avoided in places where they could cause vibration in nearby buildings.

SHOULD No speed humps should be placed in streets with bus traffic.

SHOULD Speed-reducing measures should be installed where more than 15% of people drive 5 km/h faster than the speed limit on that section.

SHOULD Road narrowing should be prioritised as a speed-reducing measure.

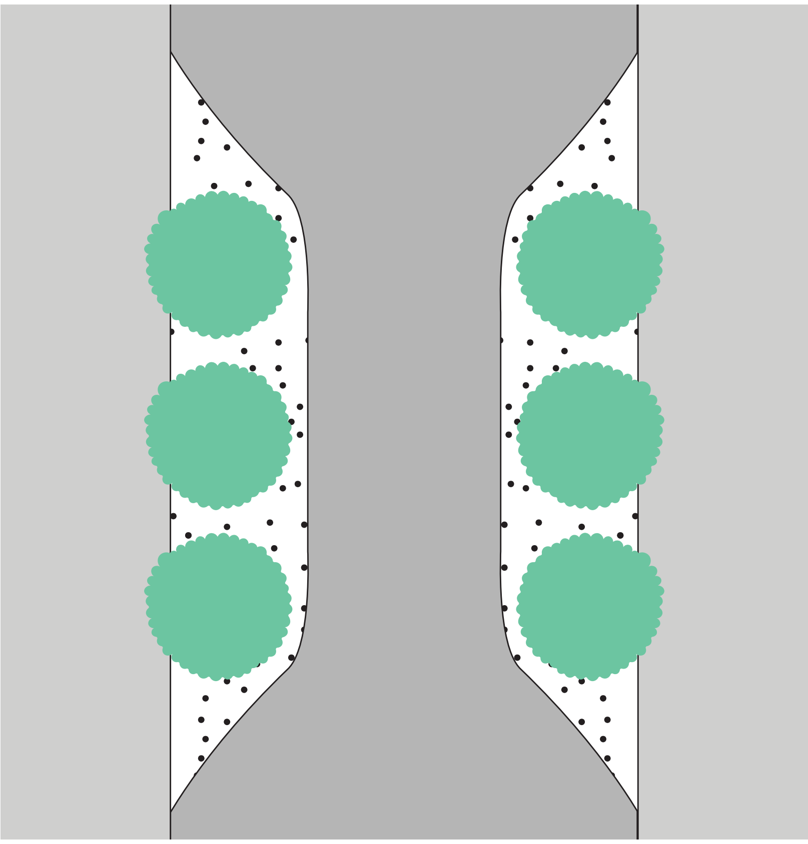

FIGURE 4-31 Road narrowing with blue-green function.

NEED FOR SPEED REDUCTION

Prior to any speed-reducing measures are implemented in a street, speed measurements should be taken. Continuous measurements should be taken over several days to document the necessity for speed reduction.

PROVISION FOR EMERGENCY SERVICES AND PUBLIC TRANSPORT

The needs of the emergency services and public transport should be addressed, to ensure passability and public health.

CYCLING AND NARROW LANES

Where narrow lanes are to be used a speed-reducing measure on streets with a lot of cycle and car traffic, a separate cycle path is recommended.

4.6.1 Design

The figure below shows some types of speed-reducing measure.

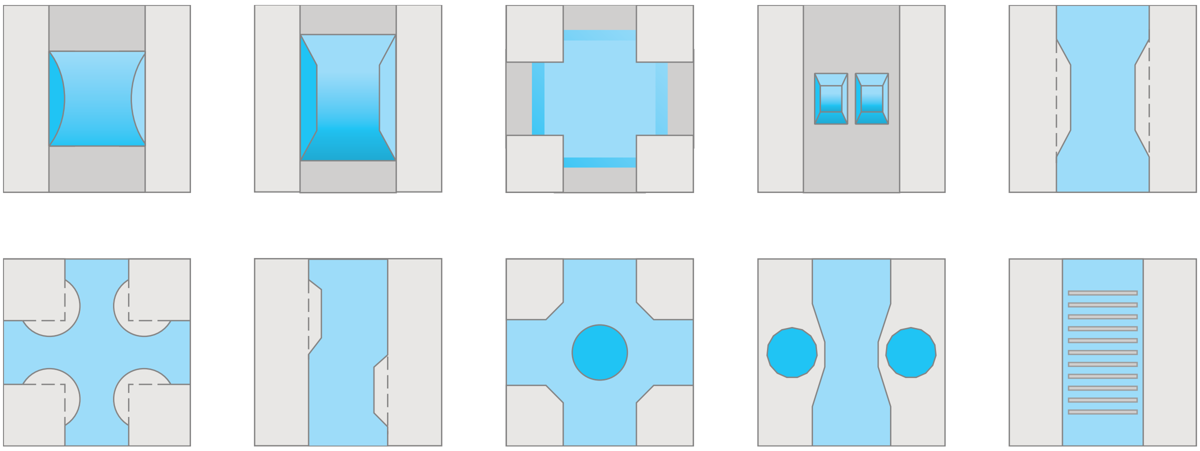

FIGURE 4-32 Different types of speed-reducing measure.

Examples of elements that can act as speed-reducing measures or barriers to access are:

- Edges (concrete barriers, kerbstones, low walls).
- Bollards.
- Street furniture.
- Raised planters – movable and built on site.
- Railings/fencing.
- Rain gardens and sunken planting with kerbstones.
- Speed humps.
- Narrowing of sections of street.
- Raised pedestrian crossings.
- Surface of rough paving/cobbles.
- Rumble strips – painting.

POSITIONING OF SPEED HUMPS

The aim is that at least 85 per cent of road-users should maintain an average speed that does not exceed the speed limit by more than 5 km/h over a given section after speed humps have been installed. The table below shows the recommended distance between humps with different speed limits:

TABLE 4-8 Distance between speed humps.

Speed limit	Recommended distance between speed humps
30 km/h	approx. 75 m
40 km/h	approx. 100 m
50 km/h	approx. 150 m

NOISE

Speed-reducing measures produce a slightly reduced noise level because of the lower speeds. Close to speed humps, slowing down and accelerating may offset the noise-reducing effect of lower speeds. Isolated speed humps may produce more noise than a series of humps at the recommended spacing.

GRADIENTS

For technical reasons, speed humps are not normally used on streets with a gradient steeper than 7%. On gradients between 5 and 7%, it may be appropriate to use humps designed for speeds up to 10 km/h over the speed limit, or to extend the ramps on trapezoidal humps.

In residential areas with a 30 km/h speed limit zone, limited traffic, no buses and insignificant numbers of other heavy vehicles, the recommendations on maximum speed around speed humps may be waived.

Source: *Norwegian Public Roads Administration. Handbook V128 "Speed-reducing measures"*

4.7 Intersections

Intersections should be designed with the smallest possible radius. Small corner radii lead to reduced speed for turning traffic and less risk of accidents with pedestrians and cyclists. Pedestrians can also keep to a straight line when crossing the street.

PRINCIPLES FOR PLANNING INTERSECTIONS

- The choice of solution and design of an intersection has a major significance on road safety, universal design and passability for pedestrians, cyclists and public transport.
- The design of the intersection should aim to reduce conflict points between flows of road-users.
- Signal-controlled intersections allow groups of road-users to be prioritised over others.
- Similar intersection types should be established along a given section, and the positions of these intersections should be planned together over longer sections or larger areas.
- Buildings, surroundings and different urban functions will determine the choice of intersection type, in addition to traffic management considerations.

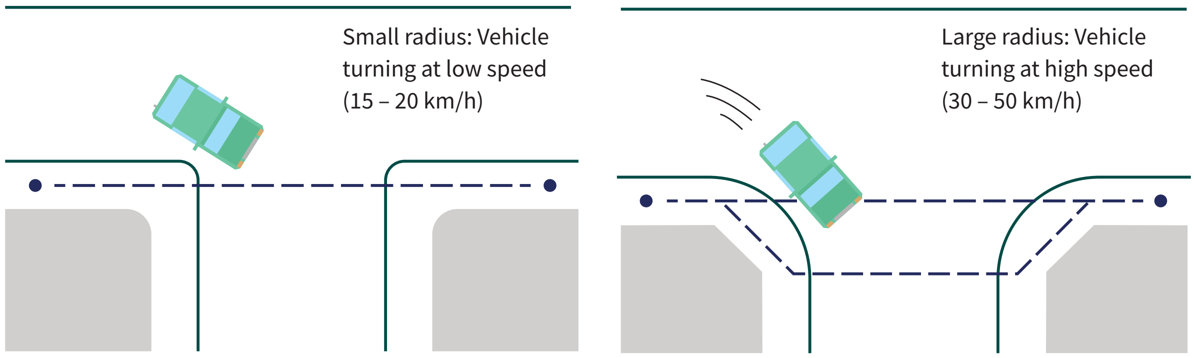

FIGURE 4-33 Radius and speed.

4.7.1 Uncontrolled and priority-controlled intersections

MUST Visibility at uncontrolled and four-way intersections must be provided for in accordance with Norwegian Public Roads Administration Handbook *N100 "Road and Street Design."*

When a street layout is designed for cars, particular thought should be given to access for fire tenders (trucks) and maintenance machinery.

Driving mode A should be used for the dimensioning of junctions on main bus routes.

Overhang on bends must be taken account for when planning and designing streets with trams, to ensure safe distances between incoming and outgoing tracks and the clearance profile area.

4.7.2 Signal-controlled intersections

Signal-controlled intersections can provide passability for public transport when the signal system is programmed to turn green for buses and trams.

Refer to Norwegian Public Roads Administration handbooks N303 and V322 for details of the design of signal-controlled intersections.

Signal-controlled intersections also work well for cyclists when the design is simple and ensures that cyclists can pass safely through the intersection on a par with other road-users. Intersections with heavy traffic and large vehicles often call for extra lanes and separate signals if they are to work adequately.

Cycle boxes or the use of an advance stop line are an effective way to prioritise cyclists at an intersection. Cyclists have a safe place in front of cars, and are better protected against right-turn accidents. The use of cycle boxes on arms with dwell phases should be carefully considered in terms of road safety.

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MUST Cycle boxes or advance stop lines must be established at traffic lights on sections with cycle lanes.

SHOULD Cycle boxes should not be used in streets where the traffic light dwells on green.

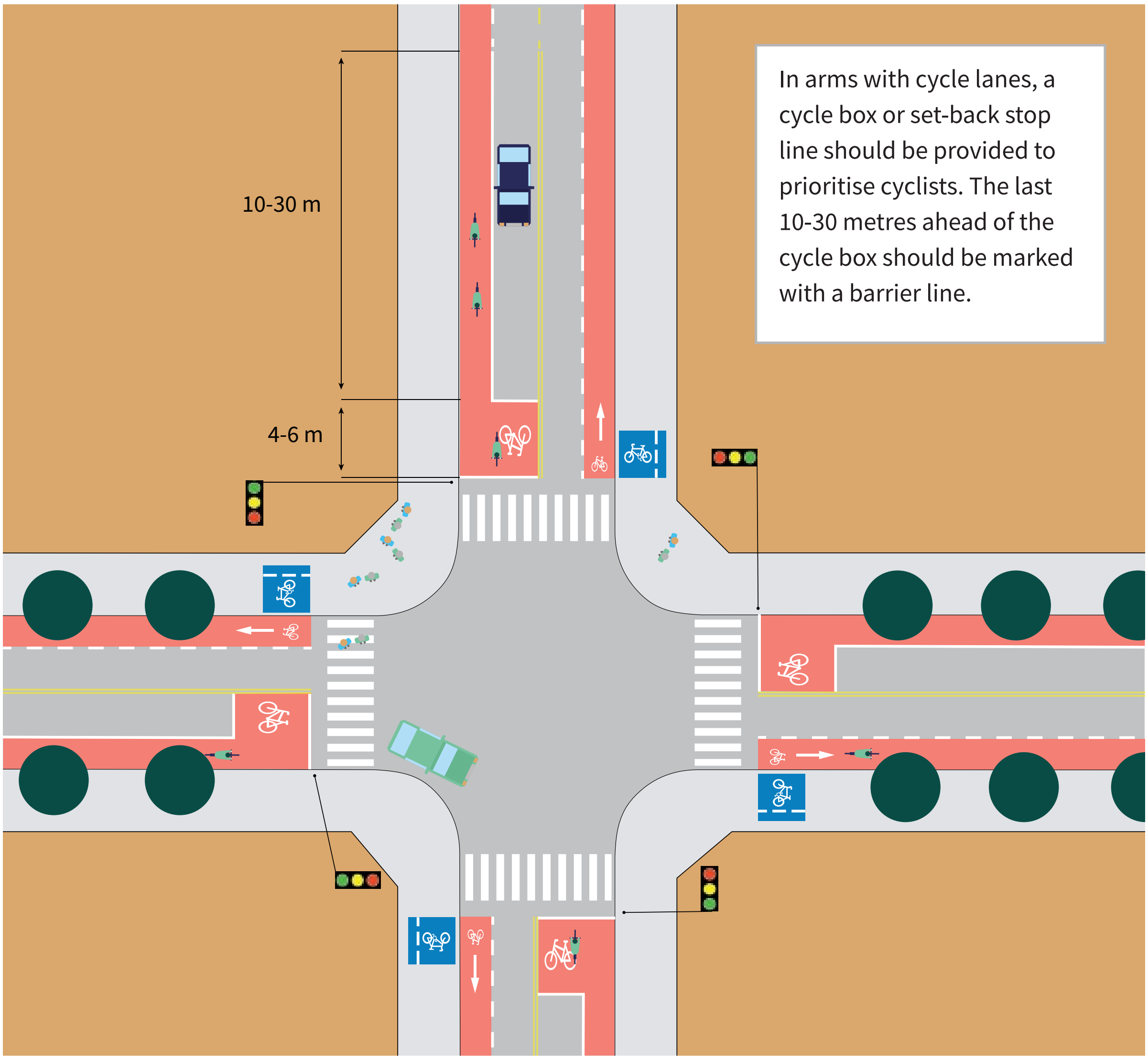


FIGURE 4-34 Signal-controlled intersection with cycle boxes.

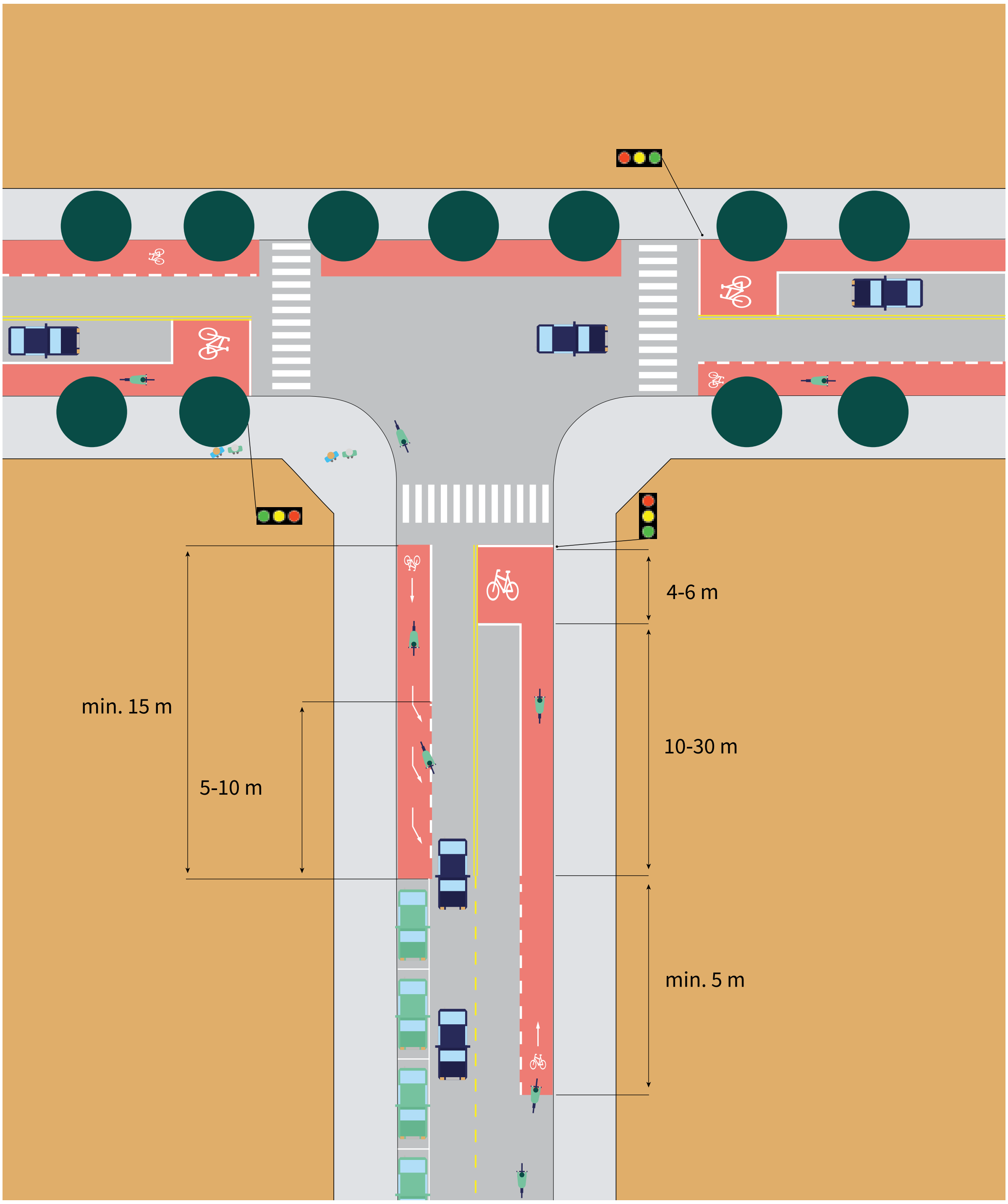


FIGURE 4-35 Cycle box with short and long cycle lanes, and reserved area at signal-controlled T-junction.

In streets without continuous cycle lanes, cycle lanes and cycle boxes may be established at intersections.

4.7.2.1 Stop Line

The stop line marks the stopping point for drivers or cyclists ahead of a signal-controlled intersection

MUST At a signal-controlled pedestrian crossing placed on its own on a straight section, the stop line must be placed at least 3 metres before the crossing. Increased distance to the stop line should be governed by visibility and AADT.

MUST At signal-controlled intersections the stop line for motor vehicles must be placed at least 2 metres before the pedestrian crossing.

MUST Where there is a cycle box or cycle lane, the stop line for cycles must be placed 0.5 m before the pedestrian crossing.

4.7.2.2 Wide Left Turn

A wide left turn is an intersection feature where road markings (waiting boxes) together with direction signs are meant to ensure that many cyclists opt to take a wide left turn through a busy signal-controlled intersection. Ahead of the intersection there will be a sign telling the cyclists about possible ways through it.

The use of a wide left turn is meant to ensure that more cyclists pass through the intersection in the same way, and provide for more predictable behaviour.

The measure can therefore contribute to a cycling culture and “legitimise” a legal, but to many people an unfamiliar way, of turning left. The waiting boxes are placed in front of waiting cars, so the cyclists have a head start when the light turns green,and are more visible to the drivers. The measure can thus contribute to greater comfort and safety for cyclists passing through intersections, especially those that are felt to be difficult to navigate because of the volume of traffic, public transport or the like.

A wide left turn is an intersection feature that is especially suited to large signal-controlled intersections that are felt to be difficult to turn left at. The measure should be used where there is a lot of cycle traffic, and where there are cyclists who need to cross the street. It is important to establish the infrastructure before and after the intersection, so it is perceived as a coherent system for the cyclists. The intersections must also have enough space for waiting boxes, to make them comfortable and safe to use.

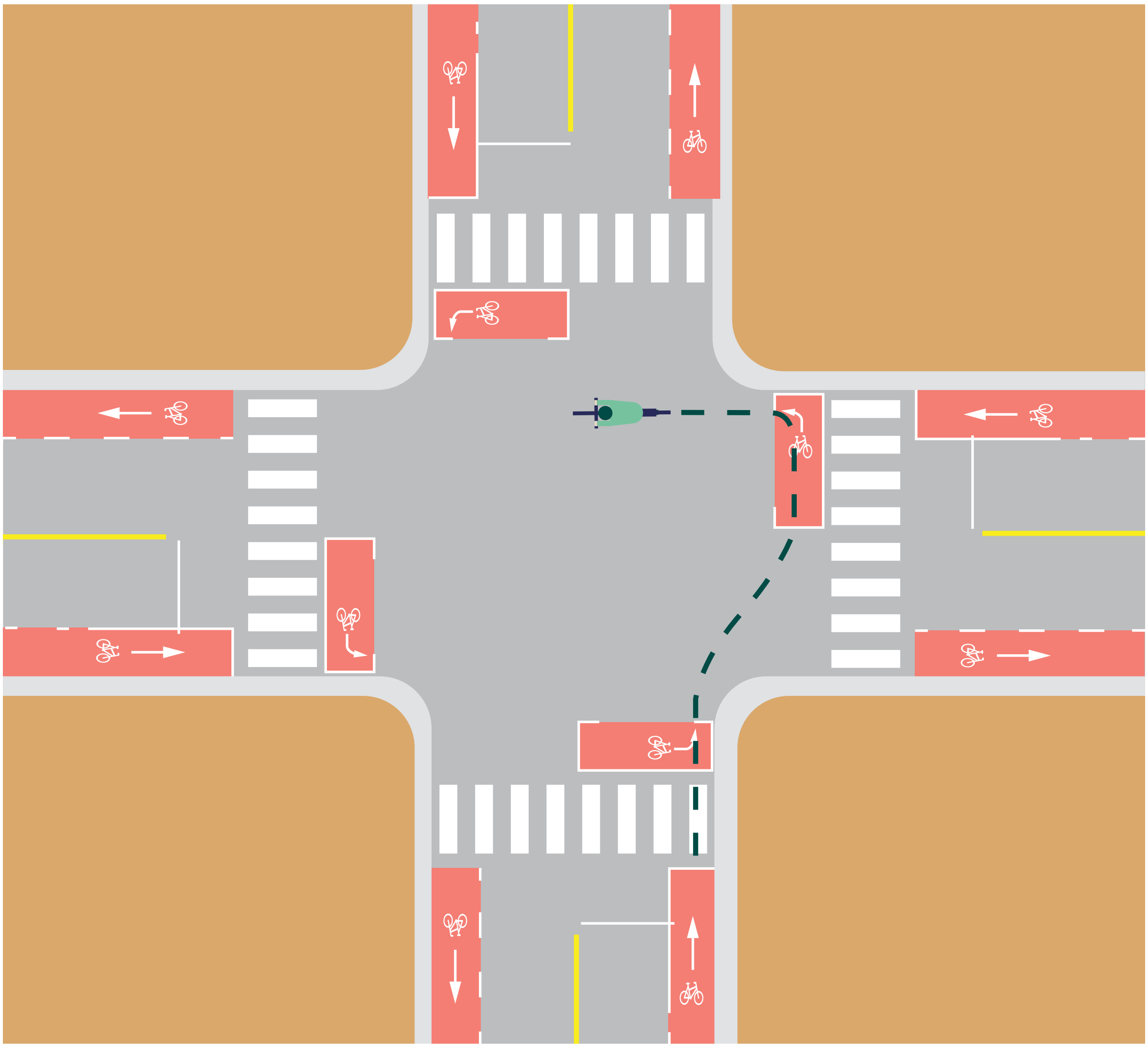


FIGURE 4-36 Signal-controlled intersection with reserved waiting area for turning left.

FIGURE 4-37 Solution with wide left turn at intersection in Lovisenberg.

FIGURE 4-38 Solution with wide left turn at intersection on Geitemyrsveien.

4.7.3 Roundabout

Roundabouts can provide good capacity at intersections where the flows of traffic in all directions are somewhat equal. Roundabouts normally prioritise capacity for cars and other motor vehicles. Examples of other designs of roundabout can be found in the toolbox.

PLANNING OF ROUNDABOUTS

The following questions must be considered when planning roundabouts:

- What implications will the roundabout have for pedestrians? Roundabouts generally lead to longer crossing distances.
- What implications will the roundabout have for cyclists? Roundabouts may feel challenging for cyclists and be less safe than normal crossroads and T-junctions.
- Where the centered traffic island at the roundabout is sunken, it can act as an LOD facility, where stormwater is diverted to the allocated area. Designers should always consider whether this solution is feasible.

What implications will the roundabout have for public transport? Roundabouts are generally undesirable for public transport because they present many issues for passengers and vehicles, including limited scope for prioritising trams and buses.

4.7.3.1 Roundabout with Trams

At roundabouts trams may have to pass through the centered traffic island because of curvature constraints. Roundabouts with a separate route into the intersection can have a good effect on passability for trams.

Trams have to give way into the roundabout, but they have priority when they are coming from the centered traffic island. Signal control at roundabouts is especially relevant at larger roundabouts and will work in the same way as ordinary traffic lights.

4.7.4 Design and speed reduction

The aim of intersection design is to make all road-users clearly visible, help to reduce speeds, provide for intuitive understanding of ‘give way’ priorities and promote awareness of the traffic conditions. Reduced speeds and awareness of the conditions can also be achieved with speed-reducing measures.

SPEED REDUCTION

At unregulated and priority-controlled intersections, the intersection must have a rigid design with tight turning radius and narrow lanes, to keep the crossing distance for pedestrians short and the speed of motorised vehicles low.

In some cases there may also be a need to reduce the speed of cyclists approaching the intersection, to reduce the risk of accidents. The design must also take account of the needs of public transport.

In new development areas, raised crossings can be constructed to prioritise pedestrians and cyclists. Raised crossings cannot be constructed in streets that are to act as flood channels, or in streets used by buses or a large proportion of large vehicles.

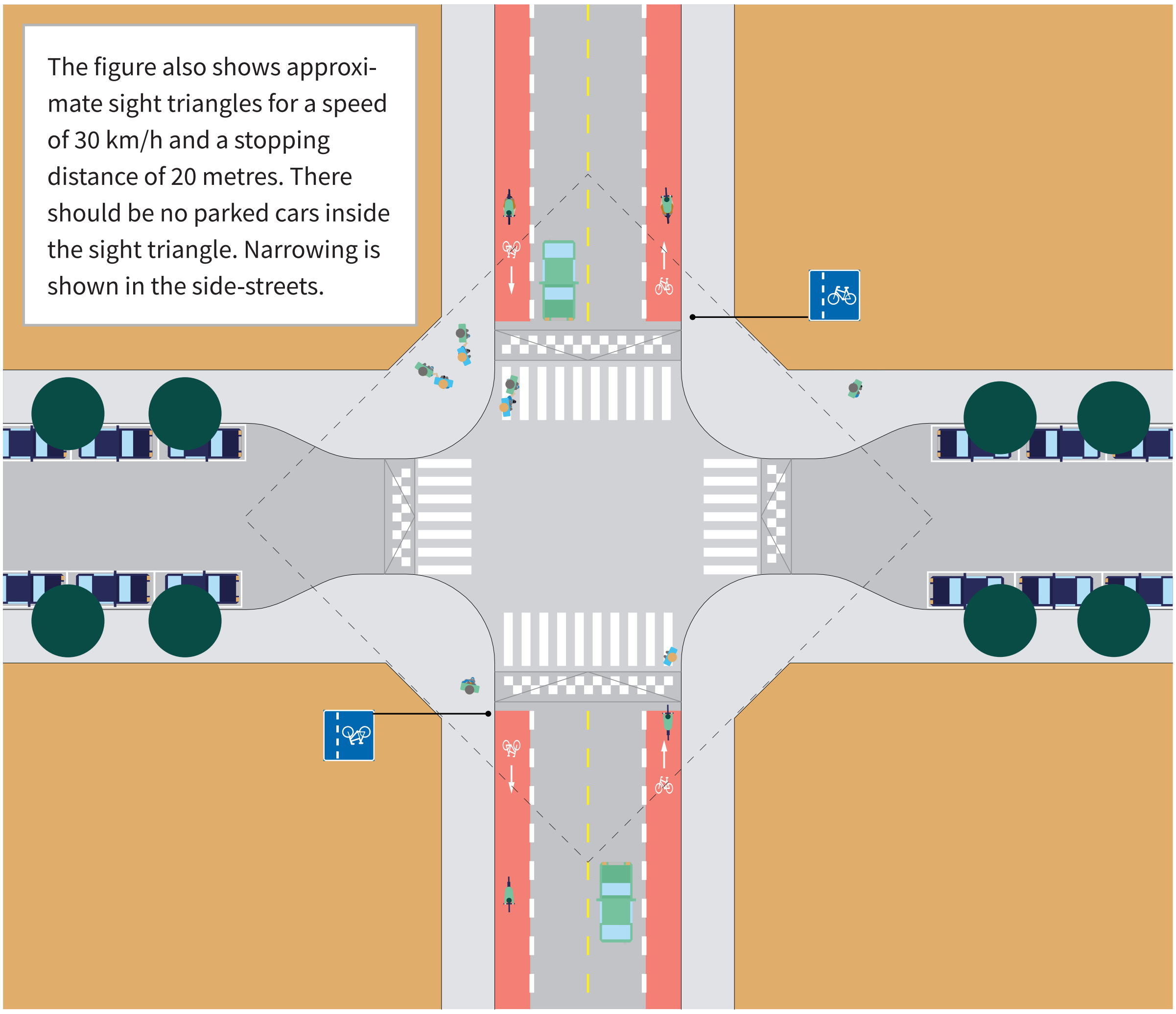


FIGURE 4-39 Raised intersection area between streets with and without cycle lanes.

4.8 Access

Accesses provide vehicular access to the public street network from a property or a limited number of properties. Their design and placement significantly affect passability and safety for all groups of road-users.

MUST The placement of the access must be agreed in the planning process and shown on the zoning map, together with clear sight zones.

MUST If a property has accesses on two different streets, the access must be placed on the street that creates the least possible conflict with road safety, traffic management and the environment.

Major streets are normally planned to be free from private accesses. The requirement for streets to be free from private accesses creates a necessity for the establishment of a local street network connected to the main street through intersections. When implementing large street projects, alternatives for redeveloping private accesses should be considered.

4.8.1 Design

The design of the access are significant for road safety and for people’s understanding of the ‘give way’ rules. The width of the access will depend on its function:

MUST The access must be laid out at right angles to the public street, and there must be a turningaround option to avoid the need to reverse onto the street.

MUST Where the street has a kerb, dropped kerbstones must be laid across the access to emphasise the ‘give way’ rules. At accesses the kerb height must be 4 cm.

MUST Pavements must be continuous with a fixed width the same as on the rest of the section. The access must not be designed with rounded corners (wider radius) to the back of the pavement.

SHOULD In residential areas, there should be 4.0 metres to the edge of the street. In industrial and commercial areas, the width may be increased to 8.0 metres if necessary.

SHOULD For the first 2 m from the edge of the road the access road should not rise or fall by more than 2.5%. For the next 3 metres, there should be a natural transition curve into the continued line of the access road. On the next 30 m, the access road should not rise or fall by more than 12.5%.

SHOULD Kerbstones 0-4 cm high should also be laid at the back of the pavement, to make a clear distinction between the pavement and the access.

4.8.2 Visibility requirements

Visibility requirements at accesses are defined as sight triangles, as shown in the figures in this sub-section.

The carriageway in the street, viewed from the access, must be visible over the whole of the sight triangle.

Refer also to the general requirements set out in section 4.1.

MUST Within the sight triangle any obstacles to visibility must not be higher than 1.0 m above road level in the primary street. Designers must also check that the plan between the viewpoint in the secondary road and the carriageway in the primary street is free from obstructions.

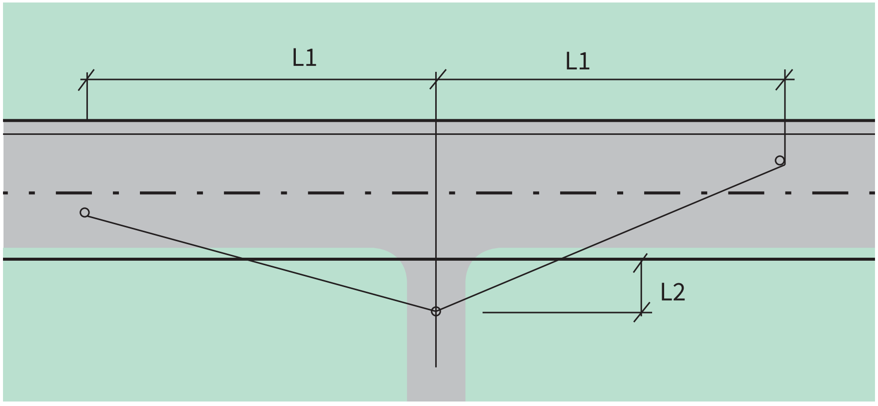


FIGURE 4-40 Visibility requirements at accesses in the suburbs. The visibility requirements should be measured from the existing road edge where the road does not conform to the development plan.

Individual trees, posts etc. may be present in the sight triangle, but the requirement for safety zones in Norwegian Public Roads Administration handbook N101 “Vehicle restraint systems and roadside areas” must be met.

Table 4-10 gives values for L1 and L2.

TABLE 4-10 Speed limits and visible distance.

Speed limit (km/h)					
	30		40		50
L1	L2	L1	L2	L1	L2
20 m	2.5 m	30 m	2.5 m	54 m	4 m

In residential streets with AADT < 500 and speed limit of 30 km/h, L1 may be reduced to 10 m.

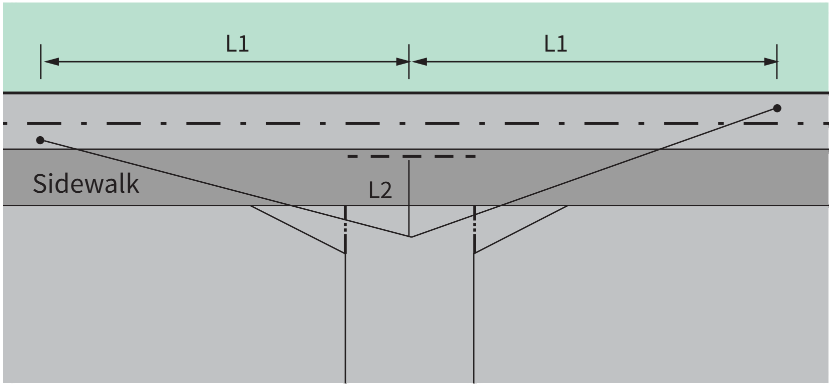


FIGURE 4-41 Visibility requirements at access in the inner city and in urban development areas (view from car to car).

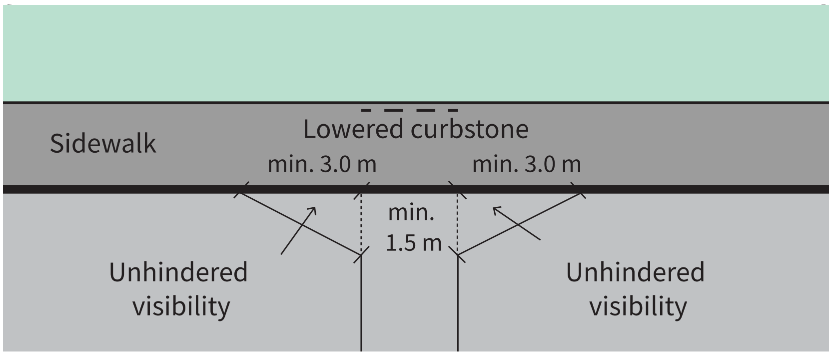


FIGURE 4-42 Visibility requirements at access (view from car to pedestrians).

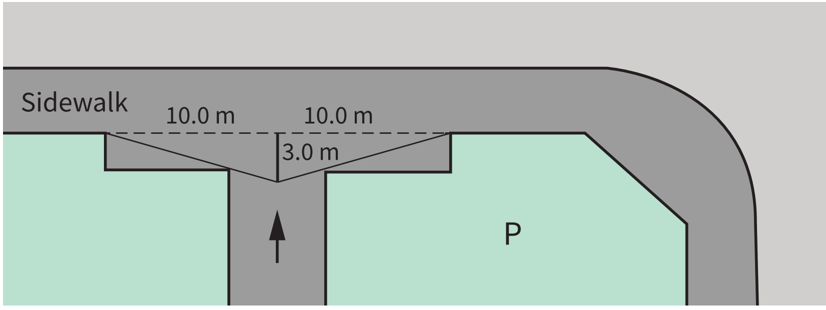


FIGURE 4-43 Visibility requirements at access in the inner city and in urban development areas (view from access to parking space).

4.9 Deliveries and Refuse Disposal

Deliveries and refuse disposal are normal functions on most streets.

MUST In all new buildings and urban development areas, deliveries and refuse disposal must be handled on the premises.

4.9.1 Deliveries

DELIVERIES FROM THE STREET TO EXISTING BUILDINGS

In existing streets and buildings where it is not possible to make deliveries on the premises, the delivery may be made from a parking bay or dedicated delivery bay or from the kerbside. Deliveries using cargo bikes should be considered.

MUST On streets with trams there must be a 0.7 metre buffer to the delivery bay.

SHOULD Deliveries should be moved to a nearby side-street if the street is an important cycle, bus or tram route.

The recommended maximum gradient at the stopping place is 4%.

TIME-LIMITED DELIVERIES

Deliveries away from dedicated bays are indicated by signs and should be limited to occasions with low traffic.

In special cases, it may be appropriate to allow time-limited deliveries from the right-hand lane in a 4-lane street. This is not a solution that can be guaranteed long term, and the facility for deliveries could disappear.

The design of places for deliveries by truck is shown in Figure 4-43. The design of bays for deliveries is shown in Figure 4-44. The design of bays for deliveries in streets with cycle lanes is shown in Figure 4-19.

Every effort should be made to combine delivery bays with stopping places for fire tenders. A stopping place for a fire tender must be 7 x 12 m and must be signposted.

MUST Stopping places for deliveries must comply with the geometric requirements in Figure 4-44 and Figure 4-45.

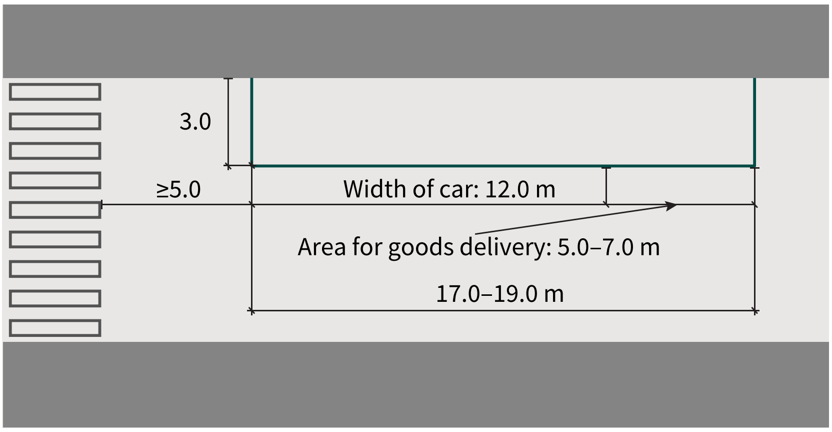


FIGURE 4-44 Deliveries from the kerbside (dimensions in metres).

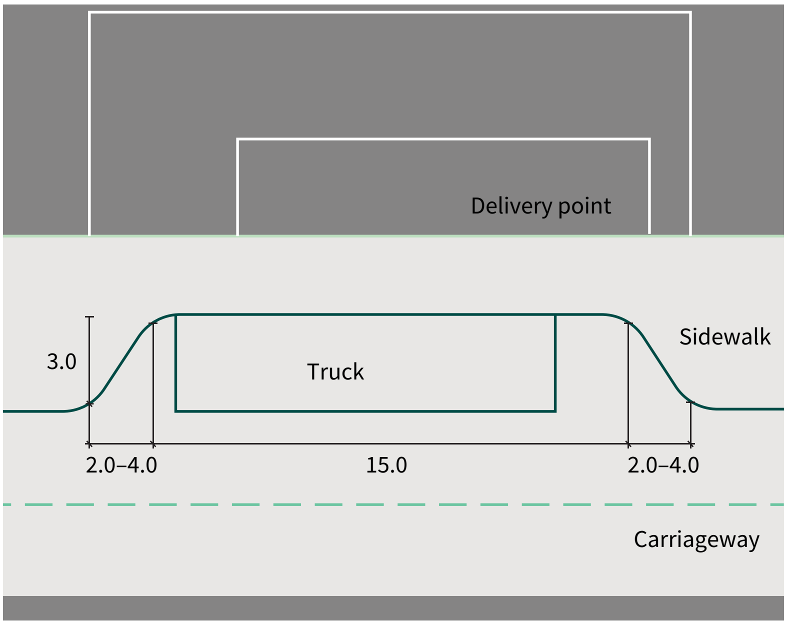


FIGURE 4-45 Deliveries from a bay (dimensions in metres).

4.9.2 Refuse disposal

MUST Streets used by refuse trucks must be able to withstand an axle pressure of 13 tonnes.

Waste bins (360 litres, 660 litres) or disposal into underground receptacles on public streets and squares must be avoided. Waste pits must not be placed less than 3 metres from the edge of the road (or pavement) without prior approval from the Agency for Urban Environment.

4.10 Parking

Necessary areas for deliveries and parking ares for cars and bikes must be assured in planning and construction projects.

4.10.1 Disabled spaces

Parking Areas for disabled people must be located close to the destination and the design must accommodate wheelchair users, to provide easy on-loading and off-loading options and a feasible universal entrance point to the destination.

MUST Parking spaces for disabled people must be longitudinal with a minimum length of 6 metres and width of 2.25 metres.

SHOULD Parking spaces for disabled people and access to these should have a flat and even surface. The slope should be less than 2%.

SHOULD Parking spaces for disabled people should not be placed in streets with a gradient of more than 5%.

4.10.2 Cycle parking

The provision of good cycle parking requires a knowledge of cyclists' needs and behaviour.

GUIDELINE FOR PUBLIC CYCLE PARKING

As a supplement to the "Oslo Standard for Bicycle Planning", the Agency for Urban Environment has drawn up a guideline for public cycle parking. The guideline presents design principles for the choice of cycle racks and the design of the cycle parking area. The guideline caters for changes in use and needs for cycles today and in the future and shows how cycle parking should be positioned in different public situations.

MUST In new projects where cycle parking is planned into a section of street, cycle racks must be placed on the carriageway and not on the pavement.

SHOULD Cycle parking should be placed in a visible position as close as possible to the destination, where it fits into cyclists' movement patterns.

SHOULD In new projects, cycle parking should be established with 25% excess capacity, and with scope to increase this capacity.

FUNCTIONALITY OF CYCLE PARKING

Quality

Good cycle parking means better access for pedestrians and persons with disabilities, and can have a positive effect on the visual expression of the city.

Social control

Positioning the cycle parking in a visible and well-lit place increases social control and so reduces the risk of bike theft.

Positioning

The placement of parking spaces should be driven by considerations of universal design, obstacles to efficient pedestrian routes and opportunities for social interaction.

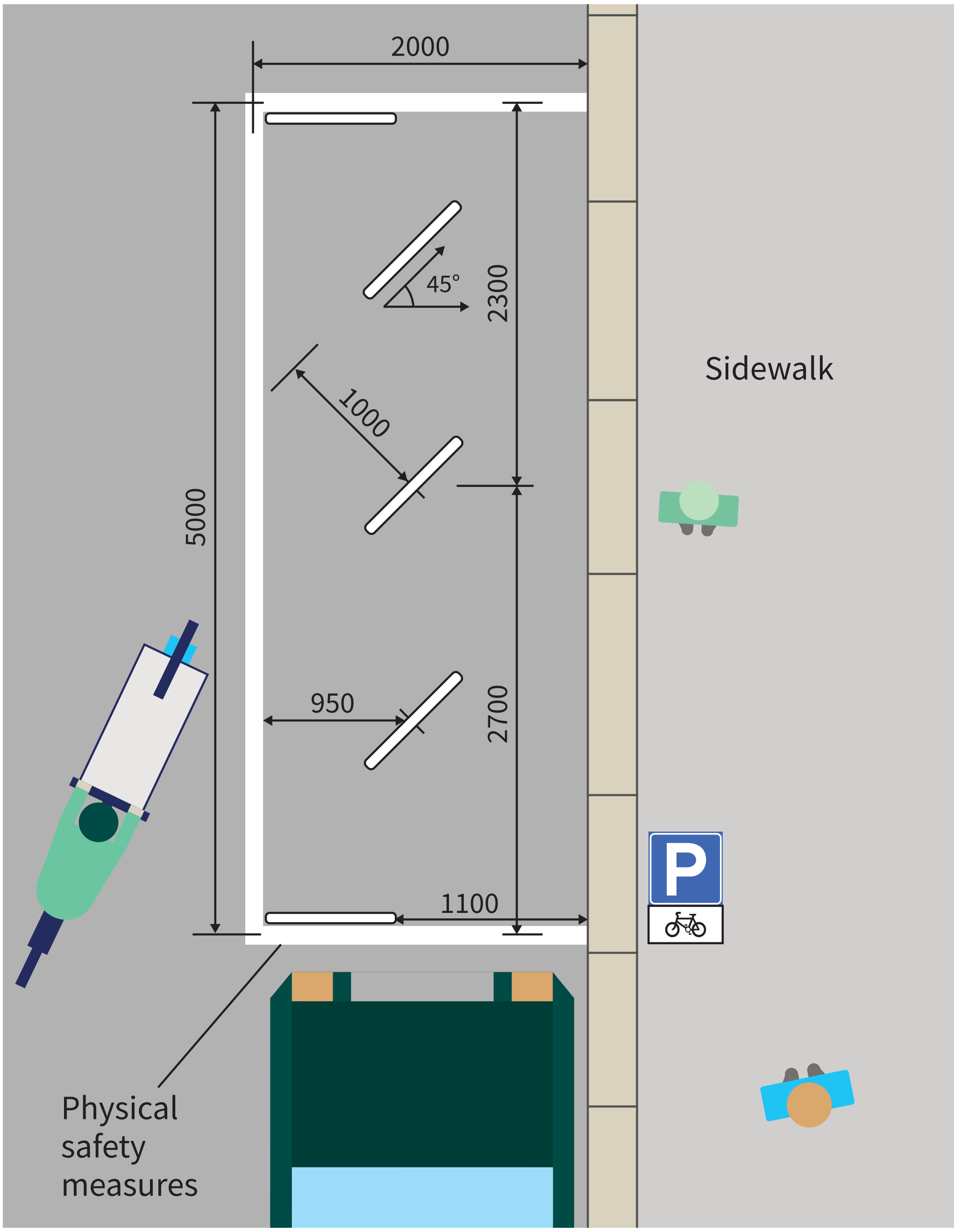
Provision must be made for parking cycles and scooters at hubs and bus and tram stops to make it safe and easy to change from one to the other.

Functionality for all

Cycle parking should be planned with easy access to the parking area, without any steep ramps, steps of narrow doors. Sufficient distance between racks or stands generally means at least 100 cm.

Good racks are easy to manage

Good design of racks allows for snow ploughing and sweeping around the facility. This is often achieved by choosing a rack with few attachment points.



A type A cycle rack placed at a 45 degree angle provides easy access and offers a solution to suit normal bikes, electric bikes and cargo bikes.

A type B cycle rack is placed at one end to give greater protection from parked vehicles.

FIGURE 4-46 Street parking for cycles on previous on-street parking area for cars.

4.10.2.1 City bikes

New city bike stands should be placed in collaboration with the Agency for Urban Environment according to the agency's overall plans for cycle use in the city. The city bike system is an important alternative and addition to the public transport system. An assessment of the potential usage of city bike racks must therefore be included in all urban development and construction projects. In streets with trams separate requirements for the placement of city bike racks apply; see standard NEK 900.

One-sided city bike racks are 2 metres wide, and double-sided racks are 3 metres wide. An average rack is 18–20 metres long.

MUST The racks must have access to electricity and be accessible to small vans to operate the rack and move bikes around.

4.10.3 Kerbside parking for buses

Longitudinal parking for buses should be designed as shown in Figure 4-47. Where there are more than 2 spaces, 5 metres manoeuvring space should be allowed for every other space.

MUST Parking for private buses (e.g. at hotels) must be provided on site.

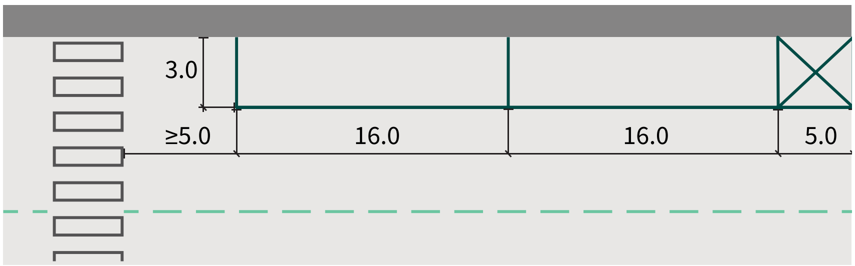


FIGURE 4-47 Kerbside parking for buses (dimensions in metres).

4.10.4 Motorcycle parking

Spaces for motorcycles may be at right angles or diagonal.

SHOULD Where separate spaces are marked for motorcycles, they should be 3.0 metres long and 1.5 metres wide.

4.10.5 Taxi stands

REQUIREMENTS FOR TAXI STOPS

The following requirements apply to taxi stops:

- Placed centrally.
- Placed a short distance from a public transport hub.
- Location self-explanatory and easy to understand.
- Well signposted and distinct from bus stops.
- Charging infrastructure.

SHOULD The surface should be even and non-slip. They may have a different surface to make the stand more visible.

SHOULD There should be artificial guidelines, on the same principle as for bus stops, and there should be access to benches with arm and back rests.

SHOULD A space of at least 1 metre wide should be allowed for queueing, and it should be possible to board the taxi in a wheelchair from the stand.

SHOULD There should be a ramp down to road level, as taxis adapted for wheelchairs often have a rear entrance via a ramp. The gradient should be no more than 1:12.

4.10.6 Car parking

Where parking is at street level, the following deign should be used:

MUST Parking must be longitudinal.

SHOULD The length of a space for a car should be 5 metres. Where there are more than two spaces, 1.5–2.0 metres manoeuvring space should be allowed for every other space.

SHOULD Longitudinal kerbside parking should be avoided where there are cycle lanes, trams and major bus routes. Where one of more of these elements are present, a 1-metre safety zone should be incorporated between the parking and the carriageway.

[1. INTRODUCTION] [2. PRINCIPLES OF STREET DESIGN] [3. DETAILED PLANNING I.] 4. DETAILED PLANNING II. [5. DETAILED PLANNING III.] [6. DETAILED PLANNING IV.] [7. TOOLBOX] [8. ANNEX] [9. STANDARD SHEETS]

SHOULD Parking areas should have a permeable surface where the subsoil allows this. The type of surface will be determined by the situation. Grass reinforcement should not be used unless the space is only in occasional use, e.g. for fire tenders.

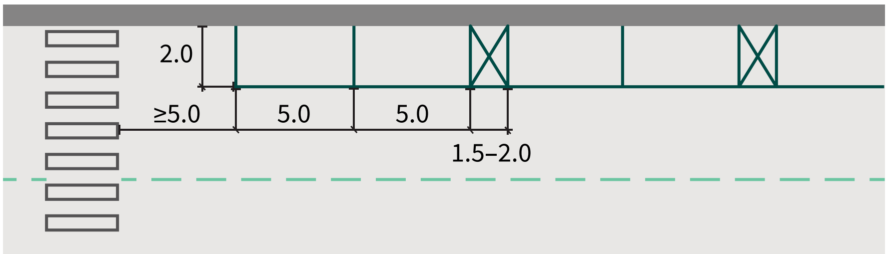


FIGURE 4-48 Longitudinal parking (dimensions in metres).

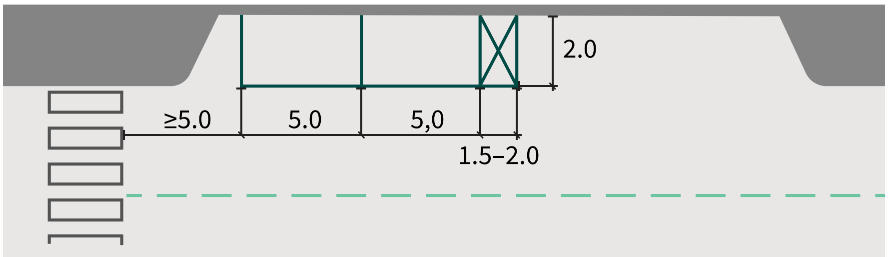


FIGURE 4-49 Parking bay (dimensions in metres).

SHOULD With charging islands, the parking should be designed as shown in Figure 4-50.

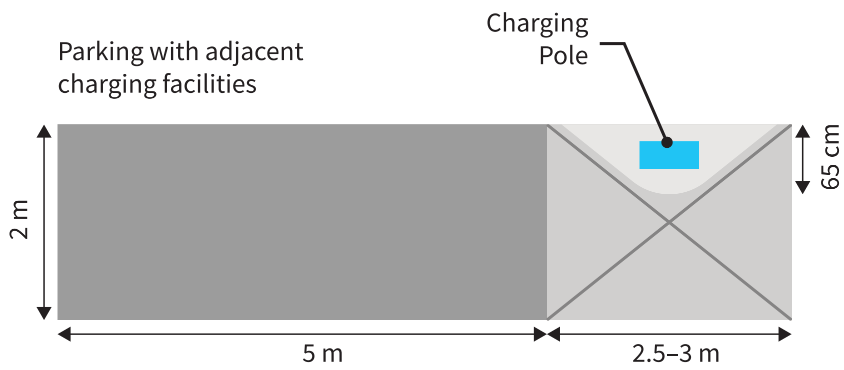


FIGURE 4-50 Parking bay with charging island (dimensions in metres).

4.10.7 Turning place

All public streets must have turnaround options.

MUST Turning places on municipal roads must be designed in accordance with Standard Sheet 1-02. In the interests of road safety, turning places that do not require reversing should be provided where possible.

SHOULD Public streets and roads that are dead ends should be laid out with a turning place at the end. This also applies to public streets that end in a private road.

If the topographical conditions prevent the feasibility of a turnaround, a turning head could be considered as an alternative option (a deviation from the manual). The design of turning heads is shown in Standard Sheet 1-04. Roadside areas and pavements may be added.

For quiet type B and C streets that are not used by vehicle types VT and B, turnaround options of reduced size may be provided, as shown in Standard Sheet 1-03.

Photo: City of Oslo, Agency for Urban Environment

5. Detailed Planning III. Urban Quality: Surroundings, Vegetation, and Environment

5.1 Vegetation

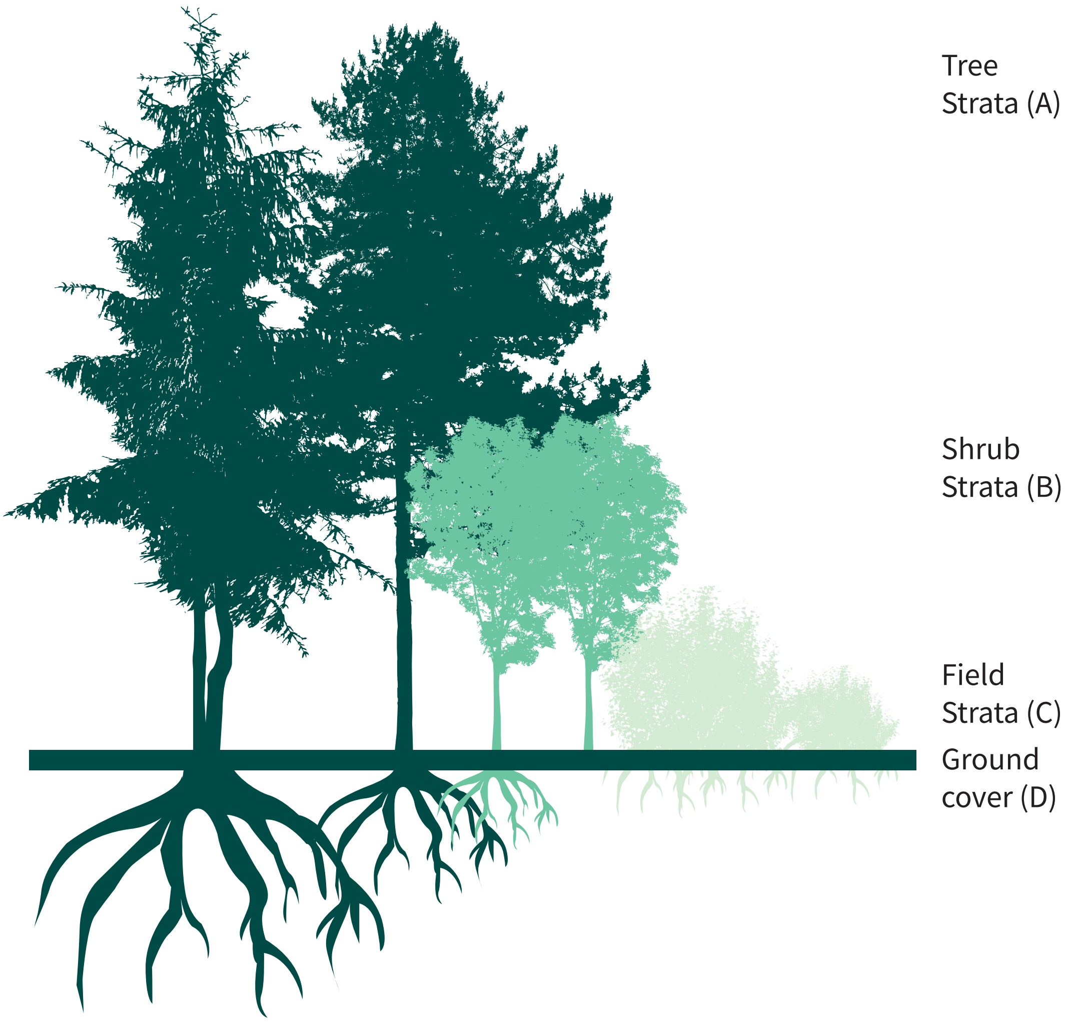
Vegetation along streets and roads has several important functions such as aesthetics, reducing urban run-off, regulating temperature, providing ecosystem services and strengthening, protecting and preserving biodiversity. Oslo's streets should have a green aesthetic.

FIGURE 5-1 Here the vegetation provides a habitat for burnet moths.

BIODIVERSITY IN OSLO

The municipality of Oslo is responsible for preserving biodiversity in the city. Green spaces along roads and streets are an important part of the overall impression.

It is estimated that 2/3 of all recorded species in Norway can be found in the municipality of Oslo, which is among the municipalities with the greatest biological diversity in the country. Over 300 of the recorded plant and animal species in Oslo are red-listed. Oslo has its own unique flora, which is part of the city's identity. The green spaces of the city should reflect the Oslo regions natural flora.



Multi-strata vegetation provides varied habitats and cover for animals and birds, and encourages biodiversity.

FIGURE 5-2 Vegetation in different stratas.

5.1.1 Roundabout, traffic barrier/ central divider

SHOULD Vegetation should be established on roundabouts, traffic barriers/central dividers and narrowing points.

5.1.2 Indigenous species

There are many advantages with indigenous species, as they provide biodiversity and reduce the risk of spreading of unwanted species and plant diseases. Indigenous species can also contribute to the local identity and provide a site specific aesthetic. Indigenous species should be used along the streets in Oslo wherever practically feasible.

SHOULD Indigenous species with their natural genetic origin in eastern or southern Norway or western Sweden should be used in the suburbs. Foreign species should not be used, including all species listed in the latest version of the species database, the "Invasive Species List."

The inner city of Oslo is an exception, as foreign species without any known ecological risk can be used. Plants must be studied for diseases in the soil and in the biological tissue.

Meadow plants for verges outside the towns can also be used in urban areas.

MUST If any foreign or cultivated species, not listed in the species database with a risk assessment, is to be used a written environmental risk assessment must be produced by an expert (cf. Section 23 of the Regulations on non-native organisms). This assessment must confirm that the species can be used without posing an ecological risk in the short or long term.

5.1.3 Invasive species

In areas where invasive species have established themselves, measures to counter their presence and to prevent them from spreading to other areas should be considered.

MUST The guidance from the Agency for Urban Environment on the treatment of *Ground where Invasive Species are Present* should be followed.

5.1.4 Trees

Existing trees have great value to their surroundings, the vegetation and the environment, and should therefore be preserved where possible.

MUST Every tree felled on municipal property must be replaced with a similar volume of biological tissue within the project boundary. For example, if a tree with a trunk circumference of 100 cm is felled, it can be replaced with 10 trees with a trunk circumference of 10 cm. Where it is not possible to plant trees, multi-strata vegetation may be considered.

SHOULD Existing trees should be safeguarded where they are well established and healthy.

The “Instructions for Excavation Around Roadside Trees and in Parks and Recreation Areas” and “Work Close to Trees – Guidance and Requirements for Rigging and Construction Work” from the Agency for Urban Environment must be applied. Large trees that are still growing have great capacity to capture CO_2, absorb water, and in some cases bind airborne particles - arguments for the preservation of them.

NEW TREES

If trees are to grow and stay healthy, the quality and quantity of soil is crucial. Measures must be taken when developing the growth site to prevent compression of the soil around the trees, damage from future digging, and conflict with infrastructure in the ground or with structures around the trees.

MUST Requirements in Table 5-1 must be followed.

TABLE 5-1 Mandatory (“must”) requirements for new trees.

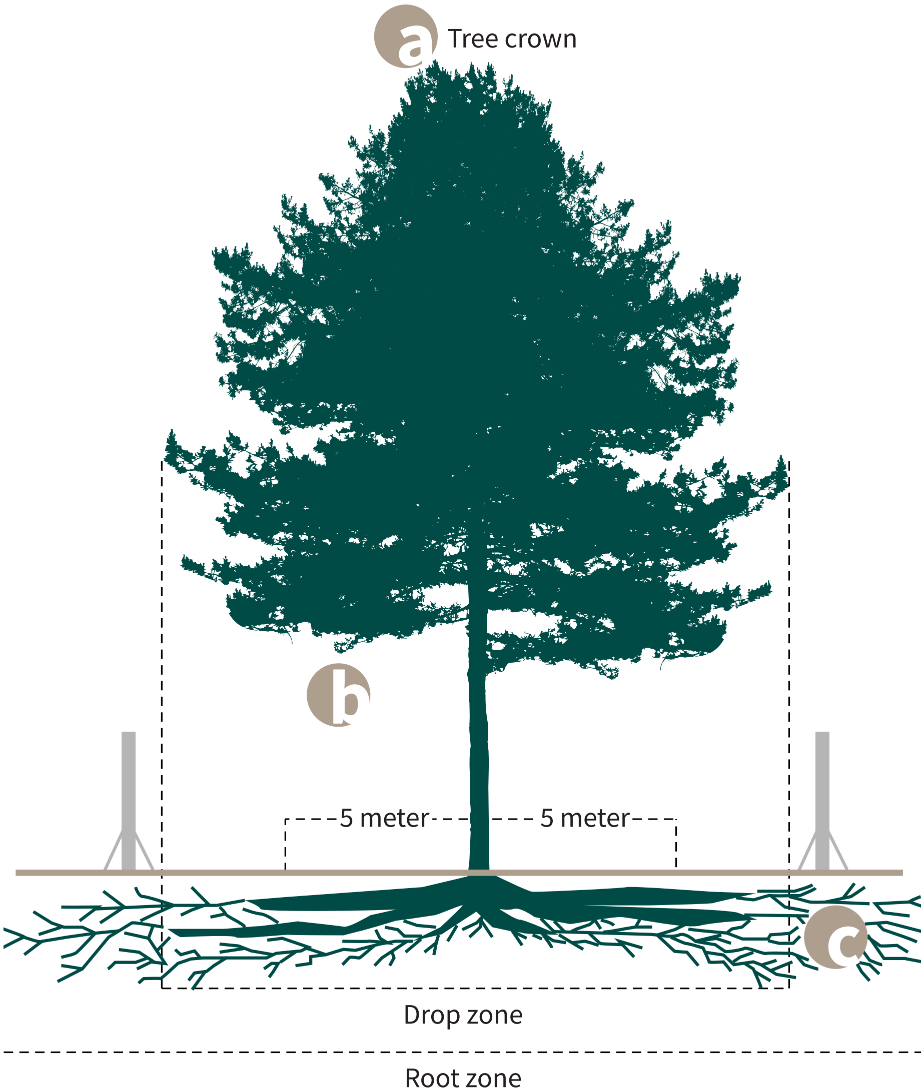
Exposed soil	There should be exposed soil extending at least 50 centimetres out from all sides of the tree trunk.
Root reinforcement layer	Use of a root reinforcement layer, structured soil, root barriers and other measures should be considered in every project to provide the trees with good growing conditions and prevent conflict with infrastructure or buildings. “Establishment of trees”, Norwegian Public Roads Administration handbook no 89 should be followed; for guidance on soil mixtures containing biochar, refer to experts on trees from the Agency for Urban Environment.

Trees in rain garden	If trees are to be planted in a rain garden, specific checks should be performed to provide for a good growth medium for the trees and air to their roots. The position of the tree with regard to the degree of saturation of the soil is important. The chosen species must be able to tolerate the saturation levels and any salinity.
Containers/ planters	Trees in containers/planters above the ground should not be adopted as a permanent solution.
Vertical clearance	When trees are fully grown there should be a vertical clearance of at least 4.7 metres above the roadway and 3.5 metres above pavements, footpaths and cycle paths.
Protection	The tree should be protected with adequate trunk guards to prevent it from breaking or being otherwise damaged.
Other	Norwegian standard NS 4400 for nursery products applies.
Tree planting in combination with local stormwater disposal (LOD soil)	Designers should consider whether it might be possible to produce a combined solution where local stormwater disposal is part of the growth medium for the trees.

SHOULD Requirements in Table 5-2 must be followed,

TABLE 5-2 Desirable (“should”) requirements for new trees.

Trunk circumference	The trunk circumference of trees to be planted should be more than 18 centimetres. This means that trees of indigenous origin need to be ordered well in advance.
Soil volume	The volume of soil should be more than 15 cubic metres per tree.
Shared beds	Rows of trees should be planted in a continuous bed to increase the available volume of soil.
Distance from structures	Light fittings and other structures such as water and waste pipes should be placed at least 5 metres from the tree trunk.
Increasing the available soil volume	To increase the total volume of soil around the trees and the scope for root growth, a root reinforcement layer should be established in the surrounding ground, e.g. under the pavement and other areas with a low traffic load.



Good root development is the most important thing for a tree. The crown (a) is the green part of the tree. The drop zone (b) is the area underneath the crown. The root zone (c) is the underground part of the tree, where the roots spread out.

A typical root zone around trees in parks is 2–3 times the width of the crown. 80–90% of the roots are often in the top half-metre.In urban environments, roots develop with limited branching.

FIGURE 5-3 Root and drop zones.

5.1.5 Pots and planters

MUST Pots and planters for summer flowers and similar plants must contain at least 300 litres of soil with an integrated watering tank.

5.1.6 Soil and plant care

MUST The compost and filter medium must match the needs of the chosen plant species with regard to soil quality. The soil must not contain peat taken from intact bogs or root chips from invasive plants. Soil samples must be presented and approved before planting.

5.2 The Street Furniture Zone

The street furniture zone is a place for recreation and could fulfill needs that are not met in a pedestrian clearway zone. A street furniture zone can be established on both sides of a fpedestrian clearway zone. When the street furniture zone runs along the facade, it is called the frontage zone.

Stormwater management and climate considerations necessitates the need to provide green areas in the cross-section. The street furniture zone can be part of a blue-green zone, such as an open stormwater management solution.

When planning the street furniture zone, designers should aim to re-use existing elements, or suitable furniture and equipment from elsewhere. When new elements and equipment are purchased, they should consider the environment and climate.

The type of elements and needs to be emphasised and prioritised will be determined for the individual project. Needs should be clarified in high-level planning. In streets where speed-reducing measures are wanted, elements in the street furniture zone can actively be used by extending this zone out into the carriageway.

Where the frontage zone or the street furniture zone has a paved surface, the street furniture zone should be differentiated from the pedestrian clearway zone through tactile and visual means, so the transition becomes a natural guide line. Doors which are no wider than the street furniture zone can then be opened without hitting people following the natural guide line.

The street furniture zone can have a more uneven surface structure than the pedestrian clearway zone, but it should be easy to get to elements and equipment. Permeable surfaces should always be considered in the street furniture zone.

The same requirements and recommendations apply to the frontage zone as to surfaces in the street furniture zone. If the frontage zone is on private property, there must be a clear difference in materials between the public and private land.

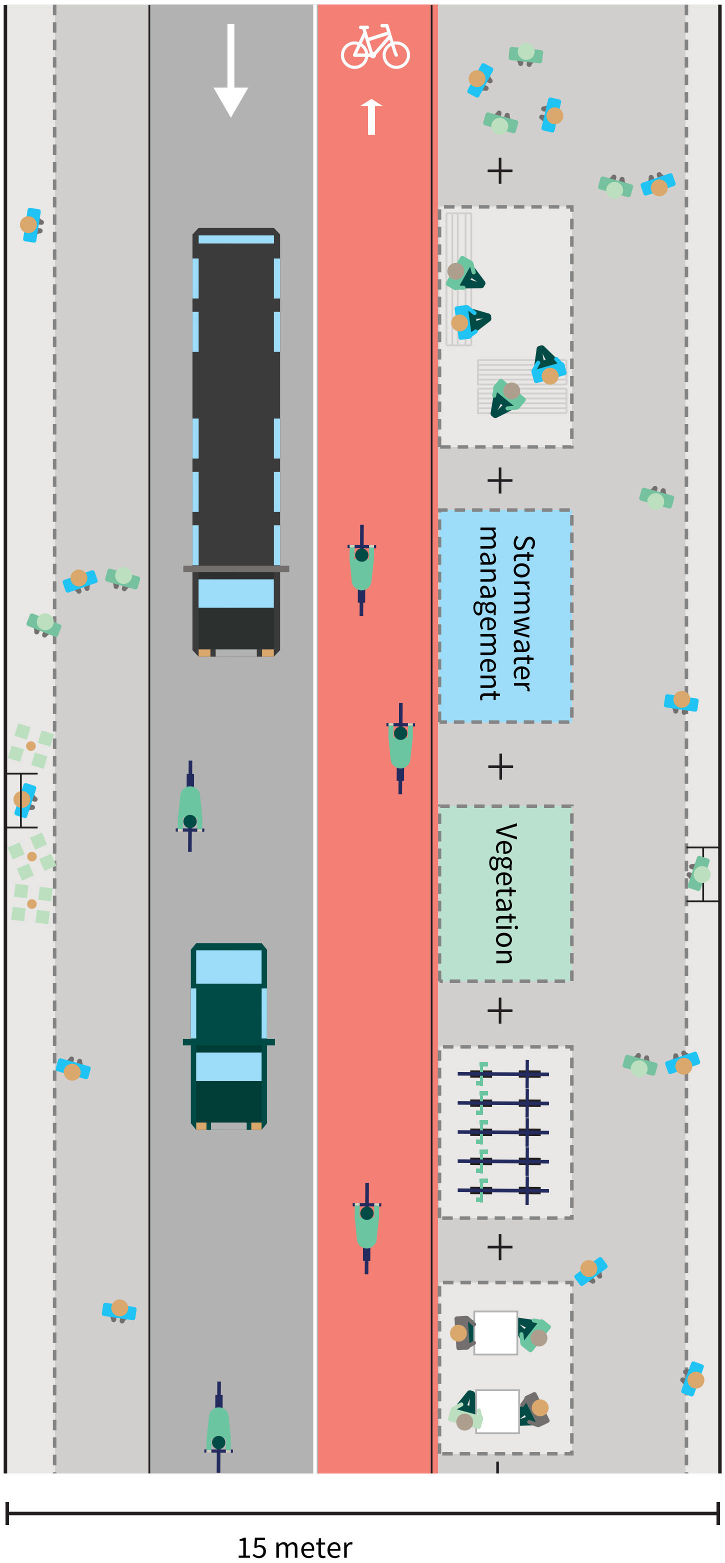


FIGURE 5-4 Street furniture zone with various functions.

REQUIREMENTS FOR PLANNING THE STREET FURNITURE ZONE

The width of the street furniture zone depends on the prioritised function of the street (blue-green, trees, cycle parking, play, benches). It will be difficult to make the street furniture zone work if it is less than one metre wide.

Some elements require an extra buffer zone around them to ensure that the pedestrian clearway zone is kept clear.

The street furniture zone should aim to be part of the blue-green zone and the open stormwater solution.

MUST The street furniture zone must, as a principle, be placed next to the pedestrian clearway zone, and can act as a buffer and barrier between hard and soft road-users.

MUST Street furniture and other fixed installations must be positioned where they do not obstruct the pedestrian clearway zone or other traffic, guidelines, operation and maintenance.

MUST The surfaces in the pedestrian clearway zone and the frontage zone/ street furniture zone must be differentiated from each other by tactile and visual means, and act as a natural guide line.

MUST Street furniture must in general be placed at least 2 metres from drains. If placed closer, the street furniture zone must be designed to accommodate future maintenance with diggers. Street furniture must be placed at least 2 metres from fire hydrants.

SHOULD To cater for wheelchairs, there should be an area 1.6 x 1.6 m with a flat horizontal surface next to relevant furniture and equipment.

The list below shows possible functions and elements that can be placed in the street furniture zone. The list is in alphabetical order, not in order of priority. The list is not exhaustive and new elements and functions can be added when future needs arise. Universal design is an underlying goal for all functions.

1. Lighting.
2. City bikes.
3. Speed-reducing measures and barriers to vehicles.
4. Charging stations for cars, including rapid charging facilities.
5. Play and exercise equipment.
6. Mobility hub.
7. Street furniture.

8. Stormwater management.
9. Advertising and other types of signage.
10. Snow piles.
11. Stopping places (bus, taxi).
12. Cycle parking.
13. Charging for electric bikes.
14. Cycle pump station.
15. Toilets.
16. Trees.
17. Water filling station.
18. Vegetation.

5.2.1 Type of furniture

Items in street furniture zones may be benches, tables, supports for cycles, waste bins, ashtrays, trunk guards, bike racks, planters, lamp posts or advertising displays.

MUST Temporary furniture (such as outdoor tables in the summer period) must be placed where it does not block the pedestrian clearway zone.

MUST Within Ring 1, the relevant aesthetic plan must be followed.

MUST Products must be chosen that allow wear parts to be repaired.

SHOULD Furniture elements, as mentioned above, should be certified by a recognised climate and environmental certification agency, and greenhouse gas emissions should be considered when choosing suppliers.

SHOULD Where street furniture is specially designed, the production should not be awarded to just one supplier.

SHOULD Furniture should be designed to be used by everyone. Seats and tables should be at a convenient height and in a position where wheelchairs can easily come right up to the table. A table height of 0.7 m is recommended.

COLOUR AND REFLECTION

Vertical elements reflect less light than horizontal surfaces. It is recommended that street furniture and equipment should have significantly different luminance (much darker or much lighter) than the background to create great contrast, thus preventing clashes. In other words, when the background is dark, grey street furniture should be avoided.

5.2.2 Advertising

It is not permitted to place advertising or other items on municipal property without authorisation.

MUST Both fixed and movable advertising must be placed in the street furniture zone where they do not obstruct the pedestrian clearway zone.

DECISION-MAKING AUTHORITY: PLACEMENT OF ADVERTISING

The municipality of Oslo's Agency for Urban Environment is the decision-making authority with regard to the placement of advertising pursuant to the Roads Act, Section 33, Advertising Along Municipal Roads. The Agency for Urban Environment will assess any advertising against the interests of road safety. The guideline for dealing with advertising along public roads pursuant to Section 33 of the Roads Act (the "Advertising Provision") is Norwegian Public Roads Administration Handbook V323 "Advertising and Danger to Traffic."

The placement of advertising along municipal roads is governed by the following provisions (among others):

- Roads Act.
- Planning and Building Act.
- Decisions from the local police.
- The Road Traffic Act and Signage Regulations.

5.2.3 MULTI-LAYER VEGETATION

Multi-layer vegetation provides varied habitats and cover for animals and birds, and encourages biodiversity. Multi-layer vegetation has space for several plant species that flower at different times of the year and can support multiple ecosystem services such as pollination, binding airborne particles and cleaning stormwater in the root zone.

SHOULD Multi-layer vegetation should be established in green spaces.

DESIGN OF GREEN SPACES
WITH MULTI-LAYERED INDIGENOUS VEGETASJON

The “Guide to Urban Design” (City of Oslo, 2019) also stresses biodiversity and includes the following guideline: “Multi-layered vegetation must be established in parks, roof gardens, and green verges etc. to provide for increased biological diversity.” This somewhat departs from large parts of current practice. Many new green spaces are planted with just one layer, rarely with a combination of several. Multi-layered vegetation can be very beautiful, and it can also support ecosystem services and biodiversity.

The use of indigenous species is an advantage in terms of reducing the risk of spreading unwanted species, and it can also strengthen the local identity. The use of imported plants can be unfortunate because this plant material can carry plant diseases and animal pests in the soil and in the biological tissues themselves. As of yet, there is limited experiences with the establishment of indigenous species and multi-layered vegetation in green spaces. But the City of Oslo has a responsibility under the Biodiversity Act to safeguard nature and all its biological, topographical and geological diversity and ecological processes. The design and maintenance of green spaces along streets and roads are an important part of the municipality’s efforts to meet this responsibility. Vegetation along streets and roads forms effective dispersal corridors in the landscape. We must therefore be especially careful in our choice of plants in such places, and avoid the use of potentially unwanted and foreign species wherever possible.

A number of species with their genetic origin in eastern or southern Norway or western Sweden may be suitable for use in green spaces in Oslo. Many are widely sold, while others can be ordered or produced by request. The report “Wild Vegetation for Parks and Gardens” (Fagus 2015) contains a list of wild Norwegian species available from Norwegian nurseries in 2015. The list includes trees, bushes, creeping and climbing plants, conifers and herbaceous perennials. There are also seed mixtures on sale for indigenous species. For example, NIBIO has produced a Norwegian meadow seed mixture for southern and eastern Norway, partly with pollinating insects in mind.

Examples of Norwegian species suited to green spaces, which can be grown from indigenous seed or cuttings	
Bushes	Cinnamon Rose, Dog Rose, Downy Rose, Blackthorn, Juniper, Hawthorn, Willow, Guelder Rose, Ivy, Hops, Honeysuckle
Ericaceous plants	Bearberry, Heather, Crowberry, Bilberry, Lingonberry
Mosses	Sickle Moss, Haircap Moss
Grasses, rushes	Wavy Hair-Grass, Bush Grass, Yellow Sedge, Sedge, Tussock Grass, Broad-Leafed Bog Cotton, Sheep’s Fescue, Lyme Grass
Trees	Norway Maple, Bird Cherry, Rowan, Azalea and Pine, Crab Apple, Morello/Sweet Cherry
Herbaceous plants	Dropwort, Lily of the Valley, Cowslip, Fleabane, Lemon Thyme, Bloody Crane’s-Bill
	Bluebell, Devil’s Bit Scabious, Water Avens, Brown Knapweed, Bladder Campion, Catchfly, Greater Knapweed, Spotted St John’s Wort, Spotted Cat’s Ear, Autumn Hawkbit, Meadow Vetchling, Goldenrod, Cock’s Comb, Caraway, Sneezewort, Viper’s Bugloss, Ox-Eye Daisy, Perforate St John’s Wort, Kidney Vetch, Yarrow, Field Scabious, Red Campion, Wild Red Clover/ Zigzag Clover, Buttercup, Bird’s Foot Trefoil. Lady Fern, Meadowsweet, Yellow Iris, Large Yellow Loosestrife, Marsh Marigold, Globeflower, Wood Crane’s-Bill, Devil’s Bit Scabious, Great Wood-Rush, Purple Moor-Grass. Many of the species listed above will also be suitable for a rain garden.

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5.3 Use of Materials

5.3.1 Recycling

The choice of materials affect the carbon footprint. Lifecycle analyses will clearly identify the environmental impact of products and materials.

Direct re-use, where kerbstones are recycled as kerbstones and paving stones as paving stones, is preferable.

The potential for re-use should be considered in all phases of the project. This should begin with an assessment of whether parts of the street can be left as they are, and planning and design should document existing materials and determine whether they can be stored and re-used. Plans should be drawn up for re-use, including storage of materials and how demolition works should be carried out. Careful demolition and dismantling and storage must be included as specific clauses in the contract with the builder.

SHOULD Material and equipment should be re-used to limit the production and transport of new materials.

It is important to consider the following before choosing materials:

- Operation and maintenance should be looked at with particular thought for the setting of the stones.
- Need for permeability and infiltration.
- Wheel-friendliness.
- Every project should consider whether the pavement should be designed for wheeled vehicles.
- Small paving stones are more resistant to breakage than larger ones, and also easier to take up and replace.
- Almost climate-neutral materials should be considered where possible, including log ends, recycled natural stone of new products.

5.3.2 Asphalt

MUST Asphalt surfaces must be dimensioned according to Norwegian Public Roads Administration Handbook N200.

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5.3.3 Natural stone

Natural stone can be re-used after cleaning (e.g. to remove mortar or paint) or reworked.

The choice of stone based on individual technical properties and features, surface treatment and format must be adapted to the project to meet its requirements for durability, functionality, and user-friendliness for all players and users.

CHOICE OF NATURAL STONE

Major factors in the choice of natural stone for outdoor paving and design:

- Expected load and scope of usage.
- Appearance.
- Adhesion/friction.
- Requirements for finished surface
- Contrast and tactile considerations.
- Durability – technical requirements.

Natural stone from different countries and continents may have different properties. For reasons such as format and loading, requirements for mechanical strength, e.g. bending tensile strength, compressive strength and absorbency, specified requirements for stone proprieties cannot be specified and should be project-specific. On the other hand, indicative requirements for materials to be used in Norway and the Nordic region may be specified.

There are three main types of use for natural stone for outdoor paving:

- Slabs/paving stones.
- Cobbles.
- Kerbstones.

5.3.3.1 Technical Requirements

When re-using stone that was previously used for the same function, the need to document technical requirements may be dismissed, e.g. where kerbstones are to be re-used as kerbstones.

MUST The characteristics of the stone, such as colour, structure and appearance, must be described by specifying the location of the quarry and typical brand name.

Water absorption tells us something about the propensity of the stone to soak up water and has a direct bearing on its durability and resistance to frost, salt and chemicals.

MUST Water absorption must be no more than 0.3% by weight on average.

Compressive strength is an expression of the ability of the stone to withstand a static load on a given area without breaking. This is generally relevant to smaller formats such as paving stones. Rock types with low porosity generally have great compressive strength.

MUST The minimum expected compressive strength with a high traffic load must be 155 MPa.

Bending tensile strength is the maximum linear load and curvature under which the stone can bend without breaking, and is important for large slabs and kerbstones. The bending tensile strength of the material can be misleading or give a false sense of security, and should always be viewed in conjunction with the format (length, breadth and thickness), expected load and strain.

For example, the fact that a particular type of natural stone has a high bending tensile strength will not necessarily mean that the thickness can be reduced to save weight and cost.

To compensate, the thickness can be increased and/or smaller slabs used. The laying method (bound paving) may allow larger formats in smaller thicknesses or oddly shaped formats to be considered.

MUST For areas without any load from vehicles on them, unbound paving with min. 10 MPa bending tensile strength must be used (as recommended in NS 3420-K).

MUST For areas that may be driven over, min. 14 MPa applies to both laying methods.

MUST For particularly large traffic loads (both static and dynamic methods), the recommended bending tensile strength is at least 16 MPa.

SURFACE FINISH

Granite/natural stone is available in many different colours, textures and surface finishes. It is important to choose the right surface with regard to grip and non-slip properties. Requirements for surface finish also apply to the remaining faces, such as sides, ends and underside. This is to provide friction with the materials in the joints and the base layer. When re-using stone that was previously used for the same function, the need to document technical requirements may be disregarded, e.g. where paving stones are to be re-used as paving stones.

Insufficient friction can result in lateral movement and hence damage.

SHOULD All contact surfaces to joint and base materials should be at least flamed or worked to produce the same finish.

SHOULD Visible edges of slabs should have a 2-5 mm chamfer to prevent scaling.

SHOULD If slabs or paving stones are supplied with sawn sides and underside, a binding agent should be used on the bottom to provide adhesion for the mortar in bound paving.

SHOULD Sawn sides/underside should not be used in unbound paving.

SLABS AND STONE

The following principles govern the use of slabs and stone:

Slabs

- **Flamed or “steel ball blasted”** is the minimum requirement for adhesion and friction.
- Edges and underside should be at least flamed or blasted whatever the laying method.
- **Rough-hewn surfaces** have grades 1-4 which are the most common and provide very good grip.
- **Rough-hewn surfaces** are used to mark or guide on slabs They are very rough and not well suited to wheelchair users, and the raised areas left after splitting/cutting can pick up rust marks from snow ploughs.

Paving stones

- **Rough-hewn/split** stones have a structure and technical properties that determine their cleavability and roughness after splitting. Paving stones with no specific requirement for a smooth surface, e.g. in cycle lanes or for universal design, may generally be chosen with a rough-hewn surface on all sides.
- **Smooth-cut tops** are used in areas with more strict requirements for the surface or marking. Others should be split or at least flamed/blasted. Cut sides are not permitted outdoors without precautions.
- **Flamed or “steel ball blasted” tops** are used where there are more stringent requirements for a smooth surface, such as cycle lanes, to support universal design or for aesthetic reasons. The other sides should have the same roughness, with the roughest possible structures (friction and adhesion).
- **Cut sides** are not recommended. If the underside is cut and not finished, a binding agent may be applied to improve adhesion in addition to bound paving.

Kerbstones

Rough-hewn stone is most common kerbstones for traffic islands, central dividers, around green spaces or along roads; not to be used in central areas / city centers with local aesthetic requirements. These surface requirements apply to all sides, including the undersides, to provide the best possible adhesion to concrete and possibly mortar.

Smooth tops and edges use grades 1-4, which is most usual in town centres, roundabouts, drivable areas or areas that requiring a more fine-grained surface such as areas with a smooth surface up to the kerb.

Other sides where there is a graded top and edges should be rough-hewn to provide adhesion for the concrete base and mortar. If this cannot be provided in the project, they must be at least flamed or blasted. Cut and flamed end surfaces should have a small chamfer of 2-5 mm to prevent scaling.

5.3.4 Concrete

SHOULD At bus stops with a frequent service, concrete surfacing should be used to provide extra friction.

SHOULD Emissions of CO_2 should be considered in the choice of concrete. Concrete with low CO_2 emissions is preferable.

5.3.5 Permeable surfaces

Permeable surfaces should be prioritised where the soil allows for infiltration on the street furniture zones and parking areas.

MUST The use of permeable surfaces must be planned and applied in collaboration with the Agency for Urban Environment.


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6. Detailed Planning IV. Climate and Infrastructure: Stormwater, Snow, Cables, and Lighting

6.1 Stormwater

The management of stormwater in streets must take account of the drainage network, water courses, green structure, flooding, climate change and universal design in line with municipal and statutory requirements. Refer to the City of Oslo's "Strategy for Stormwater Management in Oslo 2013-2030" and the "Action Plan for Stormwater Management in Oslo" (2019). When new streets are built and older streets upgraded, the new municipal requirements will call for innovative approaches for stormwater management in the streets and for the stormwater management of the urban run-off from neighbouring properties.

PURPOSE OF STORMWATER MANAGEMENT

Stormwater management is intended to address climate challenges, minimise damage and nuisance to people, buildings and infrastructure, safeguard the environment, and maintain good ecological and chemical conditions in the water. The stormwater should also be used as a resource in the green urban landscape and fed back into the cycle. Meltwater from snow is also considered to be stormwater.

The following are the main priorities:

- The stormwater should be handled locally in open solutions on private land.
- Multi-functional blue-green solutions should be prioritised.
- Disconnect stormwater from the drainage network
- Measures against run-off into the street from neighbouring properties.
- Measures to prevent emissions of polluted stormwater into watercourses.
- Establish secure flood channels
- Side-gutters in housing developments should be considered in every project.

Stormwater should be handled through open and local solutions that provide retention, infiltration, irrigation and flood channels. These measures will keep discharges of stormwater at acceptable levels and satisfactory quality (low level of pollutants).

The emphasis should be on open multi-functional solutions and use of the stormwater as a resource to facilitate for the water cycle, provide efficient use of space and exploit the ability of nature to remediate itself. Discharges of stormwater into the public drainage network should be reduced.

The most important principle behind stormwater management is the three-step strategy. Design precipitation volumes for each step are based on the City's "Guide to Stormwater Management."

THE THREE-STEP STRATEGY:

0

Planning

Plan land use to provide for a good solution to the 3-step strategy.

1

Infiltrate

Infiltrate the stormwater into the soil when in case of moderate rain to maintain a constant groundwater level and water cycle. This could be done by diverting the stormwater to green areas, rain gardens, trees or green roofs combined with an infiltration solution, or by replacing watertight surfaces with more porous coverings (such as gravel or permeable paving stones).

2

Delay and retain

Delay and retain the stormwater in the event of heavy rain. This could be done by establishing dams and rain gardens and designing parks, squares and other large outdoor spaces with sunken areas where stormwater can be stored on the surface. These functions collect stormwater and release it in a controlled manner.

3

Ensure secure flood corridors

Provide secure channels and corridors for urban run-off from streets into watercourses and the fjord, in the event of extreme climatic events. It is important to design streets and canals to deal with the volumes of floodwater. Rivers and streams are natural flood corridors. Secure flood corridors can be provided by re-opening streams, maintaining adequate distances between buildings and rivers, and where necessary retaining stormwater in adapted parks and other municipal flood control areas.

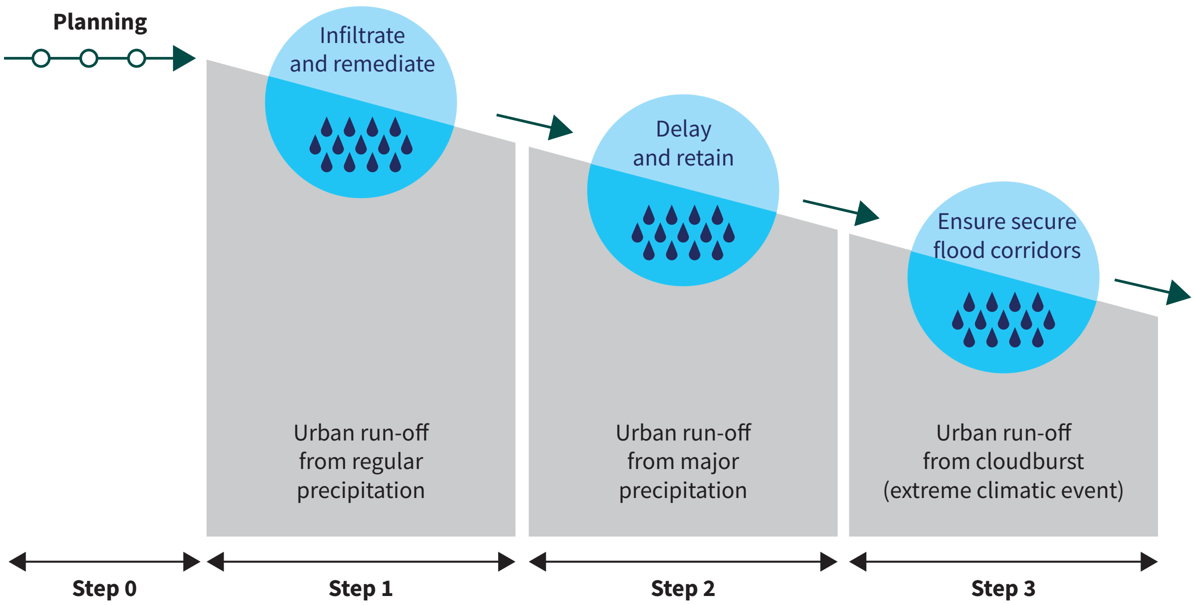

FIGURE 6-1 The three-step strategy.

6.1.1 Climate mark-up

Climate change poses many challenges, including increased annual precipitation, periods of drought, more short bursts of intense rain, more precipitation falling as rain in the winter, more frequent temperature swings above and below zero, and hence more periods of freezing and thawing that can produce slippery surfaces and cause injury on the street. Climate change has to be considered in the design of our streets.

MUST A climate factor must be applied when sizing stormwater solutions as the climate is changing.

The climate mark-up is based on the latest national climate projections (see Norwegian Climate Service Centre, climate profile for Oslo).

CLIMATE MARK-UP

Expected relative change in precipitation intensity because of climate change. A climate mark-up of 40% equates to a climate factor of 1.4. The climate mark-up specifies how much today's precipitation should be increased by to take account of future climate change. The recommended climate mark-up (%) must be used in designing stormwater solutions.

6.1.2 Requirements for handling stormwater in streets

Discharges into watercourses or active stormwater diversion must be managed in terms of both quantity and quality. The latest "Guide to Stormwater Management" must be followed.

MUST Stormwater must be used as a resource, retained, and routed via an infiltration solution before being discharged into watercourses.

MUST Polluted stormwater must be treated in order to satisfy the environmental targets in the Water Regulations.

MUST The stormwater must be managed locally on the site with open measures, prioritising multi-functional blue-green solutions.

MUST Solutions for stormwater (including roof water) must be coordinated with new and existing infrastructure above and below the ground, and with green structure and solutions on neighbouring properties.

MUST Streets must be designed for safe handling of floodwater.

SHOULD Stormwater with differing degrees of pollution should be separated where appropriate in order to meet the environmental targets in the Water Regulations.

6.1.3 Local blue-green solutions

MUST Stormwater must be managed in open, local facilities for irrigation, infiltration and retention to reduce discharges into drains and watercourses.

MUST New projects must apply the City's blue-green factor (BGF Oslo).

SHOULD Blue-green solutions which combine green structure and stormwater management should be prioritised. This approach provides local storage, infiltration and remediation of run-off. Gullies are another blue-green solution.

BLUE-GREEN SOLUTIONS

Blue-green solutions are used to delay run-off through infiltration and retention in green structures. As well as preventing flood damage, these solutions can contribute to increased vegetation, natural diversity and well-being for the population.

Blue-green infiltration solutions in streets should have an uninterrupted trajectory to the underlying masses/roadbed, in order to prevent spatial conflicts with pipe infrastructure. This is especially important where large trees are to be established within the blue-green solution. The minimum width of longitudinal sunken blue-green structure with trees is 1.5 m (assuming vertical walls). The solution requires a root reinforcement layer on both sides of the green structure. This should be established under pavements and cycle lanes, but not under the carriageway. Narrower green structure may be established provided that suitable vegetation is used with the appropriate quality and volume of soil.

Blue-green solutions must use soil grades that provide the adequate infiltration capacity and ecological requirements of the vegetation. To compensate for any gradient, sluices should be established in the green structure to provide for local storage and infiltration of the stormwater. Where blue-green solutions are used, it is important to drain the street properly to prevent infiltration where the soil conditions are unsuitable for this purpose. Drainage is also important to prevent the groundwater level rising and damaging the street and surrounding buildings. Blue-green solutions can absorb water into the ground and counteract subsidence in buildings resulting from a sinking water table.

Blue-green solutions capture particles from run-off and act as an open sand trap. A possible approach to the sand trap function is to connect a collection solution (tank) at the inlet to the rain garden to collect particles and rubbish. This solution will also capture any waste matter in the run-off. It is imperative that sludge can be extracted from particle solution in a simple manner.

Blue-green solutions relieve the drainage network (by disconnecting stormwater from the network) and remediate the stormwater. Refer to the City's information/fact sheet on stormwater solutions and the latest "Guide to Stormwater Management."

The following areas may be used to collect and retain stormwater: street furniture and frontage zones, traffic islands, central dividers, roundabouts and the like.

RAINGARDEN

A planted depression in the ground where water is stored on the surface and infiltrated into the soil or drains.

BLUE-GREEN FACTOR (BGF OSLO)

A standard and tool for documenting stormwater management and blue-green qualities in residential projects. The BGF is a figure between 0 and 1, which should be below the specified thresholds. The main ideas behind the BGF Oslo are stormwater management, biodiversity, cleaner water and air, reduced traffic noise and more sustainable urban spaces.

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Floodwater is diverted along the kerb. All surface water is separated from the drainage network and handled in open blue-green solutions. The inlet to the green structure should have an open collection solution for particles and rubbish. Floodwater follows the kerb through the rain gardens. The green structure could be a replacement for parking spaces or a road narrowing to reduce speeds.

Flood corridor

Run-off

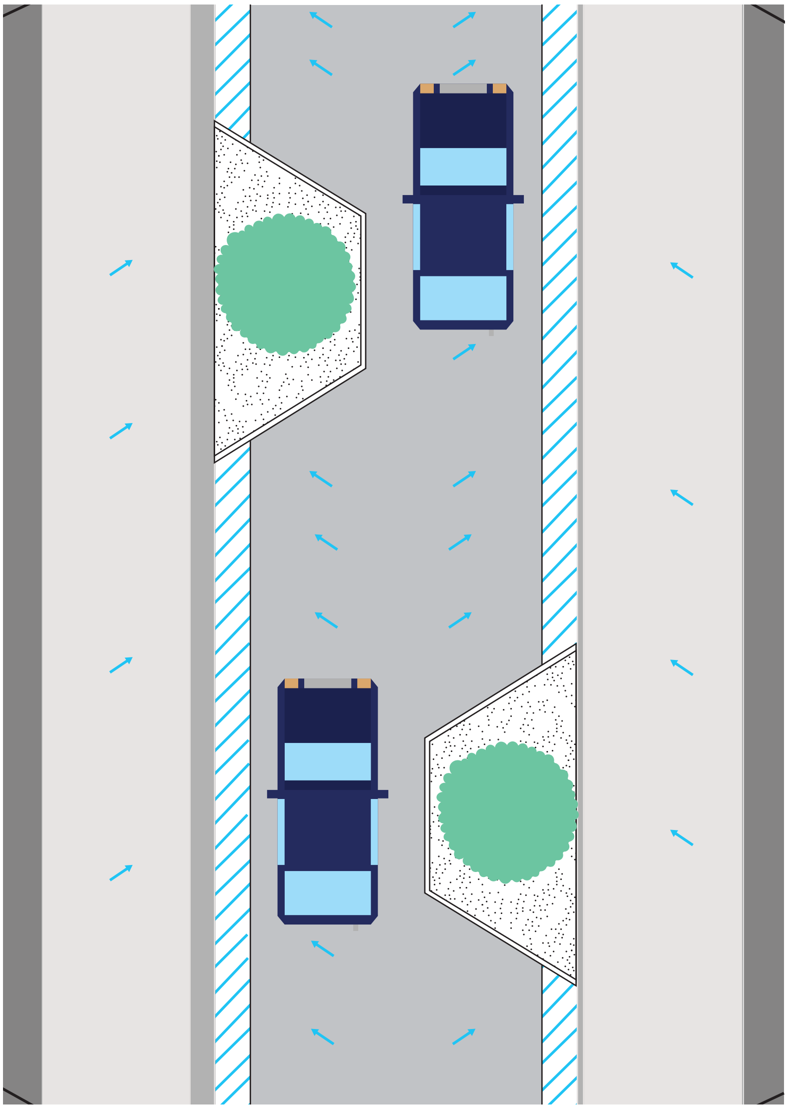


FIGURE 6-2 Sunken green structure/rain garden for storage, infiltration and cleaning of stormwater.

FIGURE 6-3 Example of open dam to retain and clean stormwater from the road.

FIGURE 6-4 Example of green space in a park.

The green space is designed for storage and infiltration of stormwater from the road.

Water from roofs and from the street is diverted to the rain gardens. The rain gardens have metal boxes at the inlets to collect particles and rubbish.

FIGURE 6-5 Example of rain garden in an established street space, Deichmans gate.

6.1.4 Stormwater from neighbouring properties

MUST The stormwater must be managed locally in accordance with the City's "Guide to Stormwater Management." Stormwater including roof water from neighbouring properties must not be discharged into drains without a permit.

Water from neighbouring properties may be managed locally in the street space in exceptional cases (on application), based on an agreement between the road owner (Agency for Urban Environment, Municipality of Oslo) and the property owner (applicable particularly to streets with historic buildings). The solution must not add to the load on the drains, and water from neighbouring properties must not be mixed with polluted water from the street. Clean water from neighbouring properties should be infiltrated by some other open and local method and then discharged into water courses after a delay via gutters, gullies or other routes such as shallow stormwater pipes. Infiltration can be achieved with a combined drain and distribution pipe in the street.

FIGURE 6-6 Solution for stormwater with collection tank from Deichmans gate.

6.1.5 Cleaning polluted stormwater

WATERCOURSES IN OSLO

All of the watercourses in Oslo are classed as very vulnerable to pollution because none of them met the environmental targets in the Water Regulations as of 2019. Because of the high density of streets in the city, requirements for remediation are set for less trafficked streets too. Polluted stormwater is cleaned locally before being discharged into the stormwater system and watercourses/lakes. Solutions along smaller roads with low AADT include diverting the stormwater via open green ditches or otherwise through the ground, before discharge into watercourses.

MUST Stormwater from the street must be cleaned before being discharged into watercourses, lakes and soil.

Possible open blue-green solutions include infiltration ditches with sluices, rain gardens combined with green structure, and open treatment ponds (infiltration/permanent bodies of water).

At sites where it is not possible to establish open treatment solutions, closed systems may be designed. These could include central, closed treatment ponds or small local ponds (pipe stores) connected to a sand trap. Separation of stormwater with differing degrees of pollution (to separate clean from polluted water) must be prioritised to facilitate cleaning solution with less capacity but greater cleaning effect.

Cleaning solutions for polluted stormwater from trafficated areas are described in Norwegian Public Roads Administration Handbook N200 “Road Construction.”

To reduce work on the drainage network, the stormwater must be re-mediated. Sand traps retain particulate material and are needed where water from the street is taken to a closed drainage system. Infiltration sand traps may be used in preference to normal sand traps where the local materials have sufficient infiltration capacity and the stormwater is not heavily polluted (low AADT). Infiltration of polluted stormwater must primarily be in open solutions (accumulating pollutants in soil close to the surface). Open stormwater solutions such as dams, rain gardens, infiltration ditches and permeable paving stones will retain particles in the same way as sand traps.

MUST

Discharges from open stormwater solutions (without sand traps) must be considered ahead of conventional sand traps. If this is not possible, discharges of stormwater into the public drains must pass through a sand trap. The design, positioning and sizing of sand traps must follow the requirements in Standard Sheets 4-01 to 4-04.

6.1.6 Flood corridor

Providing safe flood corridor is the last stage in the 3-step strategy and good street planning must take account of this. Flood corridor in streets must be designed in a manner where water is safely diverted to a recipient and does not cause any more significant damage to the surroundings than is the case today. Every street project must calculate the catchment area for the flood corridor. A plan must be produced to show where the floodwater from the street project is to be taken, to ensure that it is routed safely to a recipient and does not cause any damage to the surrounding area. Areas that are suitable for controlled flooding should be included in an overall flood control solution (e.g. parks, squares and sports facilities).

In a city like Oslo there are many streets that are not wide enough to serve as adequate flood channels. Streets intersecting with and parallel to the street project itself can play a major role in fulfilling the demand for flood channels.

The City's drainage channels are indicative, and not synonymous with safe flood channels.

SHOULD When a street is developed or renovated, the instructions in the "Guide to Stormwater Management" must be followed; the water level in the flood corridor should not exceed 10 cm, and the flow rate should be kept below 1.5 m/s to avert the risk of injury.

Exceptions may be made where measures are taken to reduce the risk of injury to the public and damage to property, and where they do not impede the passage of emergency vehicles. Any future flood control plan for the city should may designate selected streets as main flood channels where different depths and flow rates can be accepted.

DESIGN OF FLOOD CORRIDOR

A secure flood corridor in a street can be designed to use the camber of the roadway, the kerbs, gutters, green structure, speed humps and other surface objects.

Every street project must calculate the catchment area for the flood corridor. The design of the street must provide sufficient capacity for stormwater while meeting the requirements for the water level and flow rate. This must be coordinated with the overall plan for the road network, to ensure that the water is routed safely to a recipient and does not cause any injury or damage to the surrounding area.

Streets with a V profile have much greater flood capacity than streets with a ridge or one-sided fall. Use of a V profile must be considered in the individual project where operation, speed and depth of water, road safety and risk of erosion are examined. Use of a V profile in busy streets without a central divider could conflict with road safety. The AADT, proportion of heavy vehicles and road safety must be carefully weighed up is this solution is to be used.

The figure below shows how the stormwater is routed to the green structure and isolated from the drainage network. The street has no drains in the carriageway, pavement and cycle path. The green structure acts as a sand trap and flood corridor.

LEGISLATION AND FLOOD CHANNELS

There are no statutory rules or requirements for the maximum water level and flow rate in flood channels. As this is still a developing area in Norway, the street design manual will be based for the time being on the guidelines from the City of Copenhagen. The topic is under review and new requirements will emerge that are adapted to the conditions in Oslo.

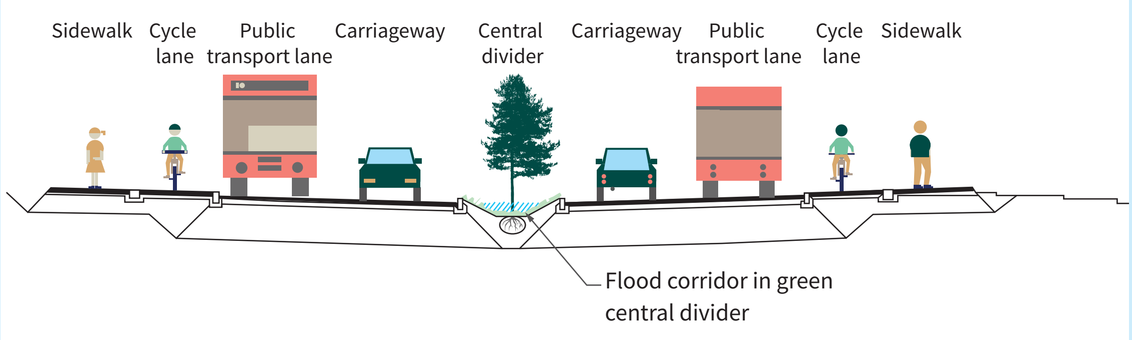


FIGURE 6-7 Example of a street with a low break in the middle (V profile).

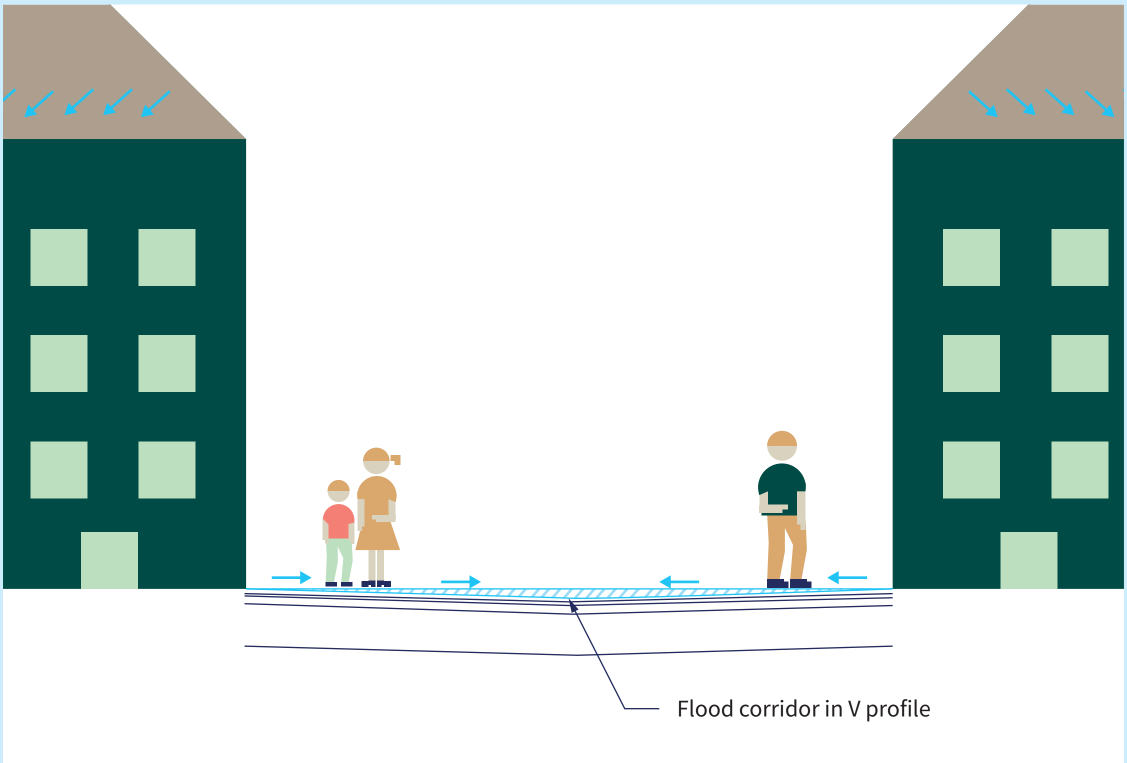


FIGURE 6-8 Example of a pedestrian street with V profile and no green structure.

6.1.7 Vegetation

The vegetation must consist of indigenous species; see section 5.1 Vegetation. The species chosen must tolerate periods of drought and periods with saturated soil. Where the streets are gritted, the species must also tolerate salty soil.

Soil in rain gardens is also called an infiltration medium.

MUST When choosing soil, designers must consider the right infiltration capacity and suitability for the chosen plants, and the soil must be free from root matter, as indigenous plants may have low resistance to weeds.

6.1.8 Universal design and safety in solutions for stormwater

Universal design and safety must be considered in design solutions for stormwater managment, based on the relevant technical regulations.

There should be a buffer zone on the road surface between e.g. the rain garden and the pedestrian zone, so the natural guide line is the transition in the surface between the buffer zone and the pedestrian zone.

MUST Gutters that go across the pedestrian clearway zone or the pavement must be designed in such a way that they can be crossed in a wheelchair, and must not be trip hazards.

MUST Where the gutter is narrow, it must be designed so a wheelchair user does not notice the change in level and can easily roll over.

SHOULD If the gutter is wide, there should be a level cover across it to keep the wheelchair at the same level.

Standard Sheet 6-06 shows a solution for gutters to cater for wheelchair users.

6.2 Area for Snow

Ploughing and removal of snow from streets and roads are important operations in the management of the street network to keep it operational during the winter season. The need to remove snow to suitable recipients is increasing with the focus on pedestrians, more elderly people, year-round cycling and concentrated development areas.

The City of Oslo has limited capacity to store snow. The Agency for Urban Environment only removes a small proportion of the fresh snow that falls on municipal streets each season. The snow that is not removed melts and runs naturally into the groundwater or the stormwater/drainage network. Snow removal should prioritise safety, emergency vehicles, refuse disposal and major public transport routes.

Snow that is not removed must be ploughed or swept out to surrounding areas. With limited capacity it is important to allow sufficient space for snow piles along public thoroughfares. The consequences of poor provision for snow piles may be closed streets, reduced road safety and ease of movement, and more snow removal resulting in greater emissions of greenhouse gases.

Snow storage must not be confused with a snow dump.

SNOW PILE

Area alongside or close to a ploughed area. Only snow from the same street may be ploughed or swept directly into the snow pile. The area cannot be used as a snow dump.

SNOW DUMP

Large area for a large volume of snow removed from the street. Requires an emissions permit from the county governor, and the snow must be cleaned of emissions.

MUST The width of the snow storage area must be 25% of the ploughed width.

SHOULD The width of the snow storage area should be half of the ploughed width.

Areas for snow storage can also be used for stormwater management, signage, technical infrastructure etc. No planting should be established if it could be harmed by salt on gritted streets. In existing streets with limited space, the street furniture zone may be used for snow storage.

Snow piles are a source of concentrated polluted run-off, and must be viewed in conjunction with the establishment of sand traps and other remediation solutions for run-off.

MUST Snow storage must not be planned where there will be run-off into watercourses, unless the meltwater is passed through a treatment solution.

6.3 Underground Infrastructure

6.3.1 Introduction

Streets must serve as conduits for critical infrastructure under the ground. In Oslo there is a shortage of space under the ground. The aim is to make use of the space that is available in the most sensible and efficient way possible.

PIPE AND CABLE OPERATORS

Pipe and cable operators are infrastructure owners and/or contractors responsible for the construction and operation of various networks such as water and sewerage, electricity, telecommunications, signals, district heating, oil, gas, waste suction etc. Pipe and cable operators may be public or private.

Good coordination of the pipe and cable network under the ground means that no pipe should block the progress of others if at all possible. Every pipe or cable owner is therefore responsible for taking up the least amount of space underground, and for laying the pipes or cables in such a way that other operators coming later can also find space. The municipality of Oslo aims to plant more trees in its streets, which makes it important to take account of their root systems in the streets being planned or conserved. When a new pipe or cable is laid, any new infrastructure must be matched to the existing infrastructure in the ground.

LAWS

Roads Act, Section 32

The Act of 21 June 1963, Section 32, requires operators to seek permission from the road owner to lay cables and pipes over, under or along public roads within 3 metres of the edge of the asphalt.

A "*Regulation on administration and responsibility for laying and moving pipes and cables over, under and along public roads, as amended on 01.01.18*" *has been produced, with associated guide, which provides guidance both to operators and to the highways authority with regard to pipes and cables laid in the road alignment.*

The "*Instructions for Excavation Works on the Municipal Road Network*" will also help where the national guidelines are not sufficiently well specified.

Pursuant to Section 1a of the Roads Act, the municipality of Oslo has resoluted that all new pipes and cables should be laid underground. Where there are overhead cables today, space/clearance must therefore be allowed for future relaying of overhead cables when other cables are to be laid under the ground.

MUST All operators who wish to use municipal streets as a route for pipes or cables or to place other elements under the street must apply to the Agency for Urban Environment for a permit to start pipe or cable-laying works.

SHOULD Space should be set aside to relay overhead cables in the ground when planning new cabling and pipe works.

OUTLINE PLAN FOR CABLES AND PIPES (VPKL)

A VPKL (outline plan for cables and pipes) is a high-level planning document which sets out and documents the planning assumptions and development strategies for cables and pipes (water supplies, waste water, stormwater, drains, district heating, street heating, high/low voltage cables, ICT/telecoms and waste suction) to be considered in construction or renovation works in urban development areas. It is important for pipe and cable operators to be familiar with the latest VPKL plans if pipes and cables are to be laid in these areas.

NS 3070 “Coordination of Pipes and Cables in the Ground, Part 1” describes the mandatory requirements for the pipes and cables of individual operators, and provides guidance on how pipes and cables should be laid in relation to each other.

MUST All manholes placed in the roadway must have circular covers.

SHOULD Manholes should not be placed on pedestrian crossings, in the kerb, on cycle paths or on/over/between tactile guidelines.

[1. INTRODUCTION] [2. PRINCIPLES OF STREET DESIGN] [3. DETAILED PLANNING I.] [4. DETAILED PLANNING II.] [5. DETAILED PLANNING III.] 6. DETAILED PLANNING IV. [7. TOOLBOX] [8. ANNEX] [9. STANDARD SHEETS]

In special cases, particularly within Ring 3, the highways authority may require greater cover for technical reasons, such as impact issues; cf. Pipework and Cabling Regulations, Section 5, last paragraph. Where pipe and cable operators do not comply with this requirement, they will be held liable for a 10-year period for monitoring, measuring and where necessary remedying any impacts over the limits laid down in the Pollution Regulations.

6.3.2 Planning/implementation

All planning and design of infrastructure to be placed within the road alignment must be planned in accordance with IN-MAL Parts 1 and 2. Construction must follow the standards from the Agency for Urban Environment.

MUST Double sets of posts along the street are not permitted (wooden and steel posts).

SHOULD If street lights are to be erected close to traffic lights, shared posts should be used for lighting and signals. In this case, the mast must have two covers and a pull-through manhole close by.

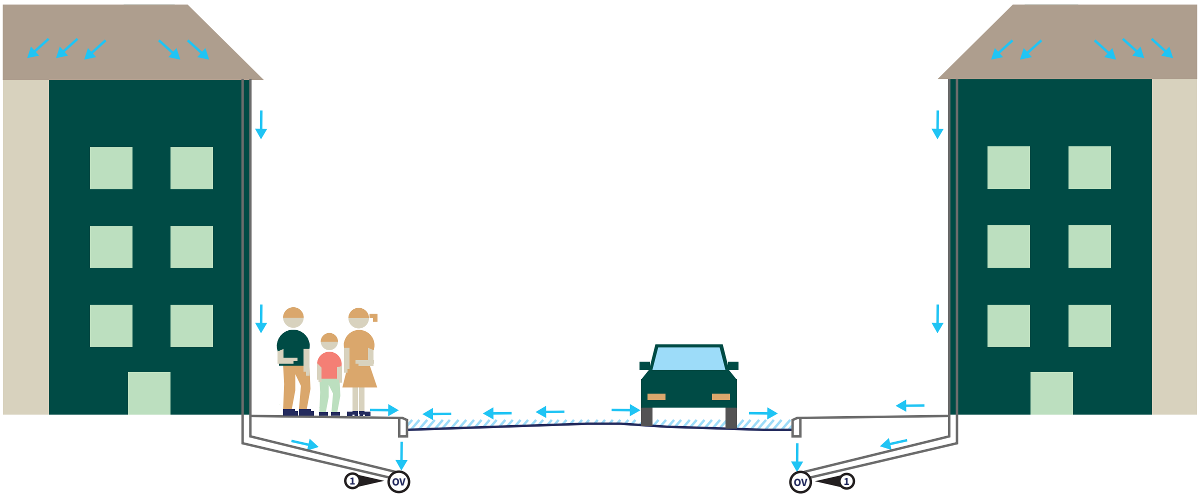
6.3.3 Disconnect stormwater from the drainage network

The aim is to reduce the strain on the drainage network to avert flood damage, prevent any overflow and reduce run-off to treatment plants. In practical terms, this means that the least possible stormwater from the street should be diverted into the drainage network. Possible solutions are:

- To divert the stormwater into blue-green solutions for infiltration or to a recipient (watercourse/lake).
- To lay a shallow stormwater pipe which will normally take the stormwater to green areas or to a recipient, possibly combined with infiltration. For clean stormwater, the stormwater pipe could be slit on the bottom to increase infiltration.
- Flood channels carrying floodwater safely overground to watercourses without straining the drainage network.

These solutions are shown in the figures below.

SHOULD When streets are renovated or rebuilt, the stormwater must be removed from the drainage network.



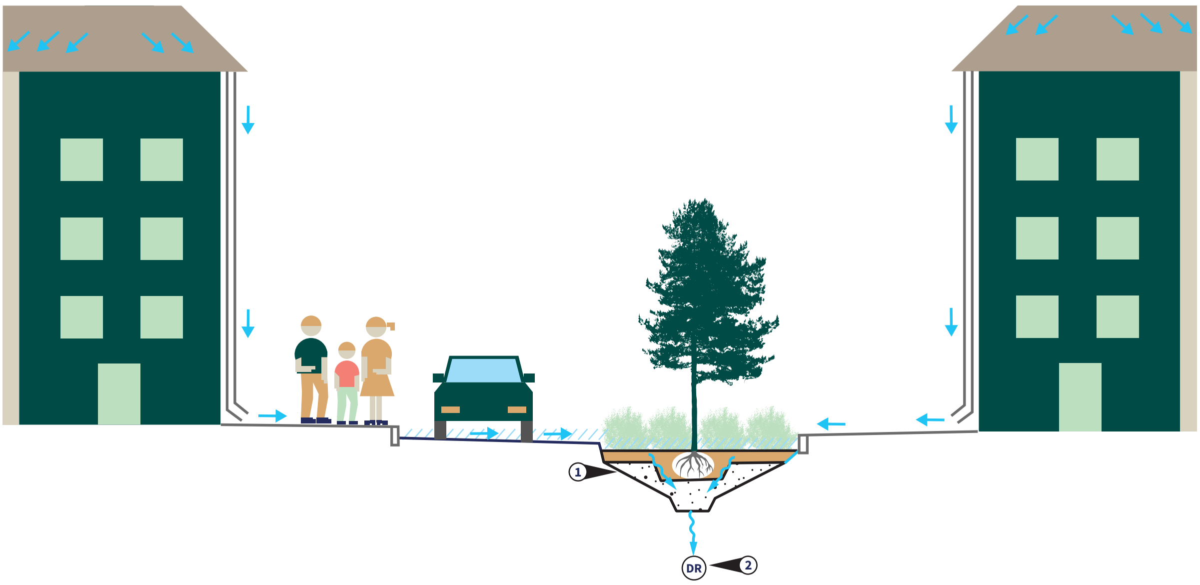
NOTES

1 Shallow stormwater pipe taking water from the street and roofs.

Flood corridor

Principle for isolating stormwater from mains pipes by establishing a shallow stormwater pipe for water from the street. Roof water from neighbouring properties must be managed on the premises, but an alternative solution with infiltration on public land or discharge into a new shallow stormwater pipe together with other water from the street may be approved in exceptional cases and on application. The street is designed with a flood corridor along the kerb. It is desirable to establish an open LOD facility downstream to slow the flow of water.

FIGURE 6-9 Establishment of shallow stormwater pipe for water from the street.



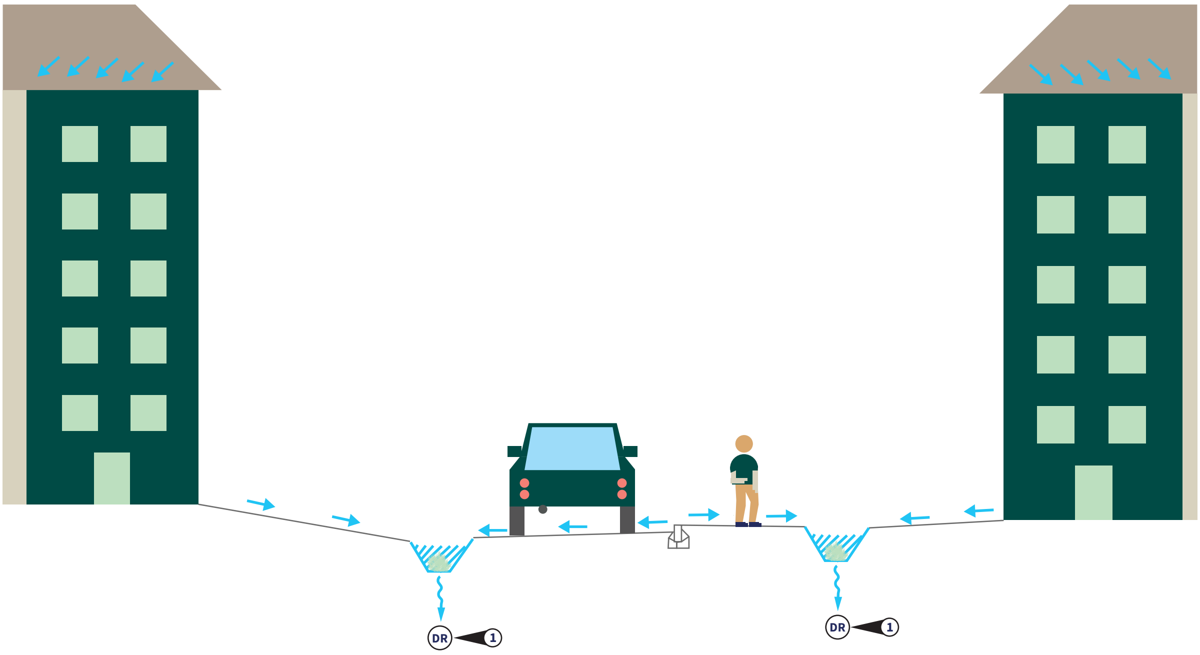
The water from the street is taken to a sunken green verge for retention, infiltration and cleaning. The green verge also acts as a flood corridor. All surface water is separated from the drainage network and handled in open blue-green solutions. Roof water from neighbouring properties must be managed on the premises, but an alternative solution where the roof water is diverted into a blue-green solution on public land together with other water from the street may be approved in exceptional cases and on application. The main drain drains the road surface (and determines the maximum groundwater level) and enables an infiltration solution to be used even where the ground has naturally poor infiltration.

NOTES

1 Rain garden
2 Drain pipe
Flood corridor

FIGURE 6-10 Blue-green solution for stormwater from the street and roofs.

[1. INTRODUCTION] [2. PRINCIPLES OF STREET DESIGN] [3. DETAILED PLANNING I.] [4. DETAILED PLANNING II.] [5. DETAILED PLANNING III.] 6. DETAILED PLANNING IV. [7. TOOLBOX] [8. ANNEX] [9. STANDARD SHEETS]



NOTES

1 Drain pipe

Flood corridor

All of the stormwater is diverted into the gutters and isolated from the drainage network. The general rule is that neighbouring properties have to manage their stormwater within their own properties. The gutters can provide a shared stormwater solution for the street and neighbouring properties by agreement. The example shows a combined solution where roof water is handled on the premises while the private stormwater from the lot is managed together with the water from the street, by agreement. The gutters can be designed as infiltration ditches with sluices to retain and clean the stormwater. The gutters also act as flood channels. The main drain drains the road surface.

FIGURE 6-11 Street with side-gutters.

6.4 Lighting

6.4.1 General requirements

Lighting of high quality strengthen all users ability for wayfinding and public safety.

Places where good lighting is important are:

- Places that require extra road safety such as pedestrian crossings and other crossing points.
- Changes of direction.
- Squares and pedestrian streets.

- Bus and tram stops.
- Cycle routes.
- Information boards.
- Major entrances, such as stations.
- Stairs and ramps.

Lack of glare is essential to many people if they are to see properly. To achieve freedom from glare, it may be necessary to shield light sources and evaluate the optical properties of the luminaire.

PRINCIPLES FOR LIGHTING

- Good even lighting emphasises contrasts. Designers should choose luminaires that do not dazzle.
- Shadows that could hide a possible obstruction should be avoided.
- Lighting around entrances should have a high light intensity, and the light should fall down on the entrance area.
- Signs and information panels should have integrated lighting or be illuminated.
- Lights on footpaths should stay on the same side.
- Intersections and changes of direction should always be marked with a street lamp.
- Posts and luminaires must be positioned outside the footway in their own street furniture area, so they do not constitute a hazard.
- Uplighters at ground level in pedestrian areas should be avoided because they can dazzle.
- Where practicable, shared masts/posts should be erected for lighting and traffic signals, to avoid placing two posts right next to each other. The masts should then have two covers and a pull-through manhole close by.
- Where colours are important for people to understand their surroundings, luminaires with good colour rendering should be used.

MUST All streets in Oslo must be lit, and the lighting must be planned and designed in accordance with the *"Street and Road Lighting Manual for the City of Oslo."* The *Lighting plan for central Oslo* gives guidance on the design of lighting in the city centre.

MUST The lighting design must take special account of glare around disabled parking spaces.

MUST To achieve freedom from glare, the light source must be shielded.

STREET AND ROAD LIGHTING MANUAL FOR THE CITY OF OSLO

The *Street and Road Lighting Manual for the City of Oslo* is a lighting standard for new projects, standard improvements and general maintenance works. This manual forms the basis for work on lighting installations that the municipality owns or takes over for further operation and maintenance.

The *Lighting Plan for Central Oslo* is a management tool which sets out general guidelines for how the city's lighting should be designed and planned in central Oslo.

The lighting plan may be helpful in planning, design and construction street lights in the rest of the municipality of Oslo as well.

MUST Where the street profile changes, designers must consider the possible need to upgrade the lighting system.

MUST Light pollution and scattered light must be considered.

6.4.2 Lighting of pedestrian crossings

Lighting at pedestrian crossings should ensure that people crossing the street are visible to other groups of road-users. Good visual contrast between pedestrians and the carriageway should ensure this.

6.4.3 Lighting on the cycle network

The aim should be that the cycle network of Oslo can be used all year round and at any given time of the day. Among other things, this requires specific requirements for lighting.

MUST There must be lights along the whole of the cycle network.

6.4.4 Intersections and entrances

Intersections and entrances are potential accident spots. To provide a clear view, these points should be well-lit.

6.4.5 Energy-efficiency

There are more than 60,000 street lights in Oslo and more are to be erected in new and existing areas. In the interests of cost savings and energy-efficiency, the light intensity should be adjusted to the season and the time of day. All luminaires connected to the street lighting network should be dimmable with powerline control.

CONSIDERATE LIGHTING

In some cases, lighting can give false information to road-users. Care should be taken in the following cases:

- **Gateposts and the like:** private lighting should not compromise the lighting in the street.
- **Exits on a bend:** lighting entrances can give false information on the alignment to the street.
- **Trees:** where there are trees, there should be at least 5 metres from the tree to the base of a lamp post.

7. Toolbox

The toolbox contains examples of the use of the street cross-section, crossing solutions with special arrangements for bikes, and detailed solutions for the design of rain gardens. These are solutions that have not yet been sufficiently implemented, to be incorporated as requirements in this manual, and which may require the user to apply for a waiver.

Particularly with improvements to existing streets, there will be a need to find solutions which are not shown in the requirements part of the manual. All requirements in the Street Design Manual must be followed in urban development and transformation areas.

Sections 7.1 and 7.2 give examples of the design of streets where adaptations are needed because of limited space and for reasons of speed and road safety.

7.1 Type A and B Streets

7.1.1 12-METRE STREETS

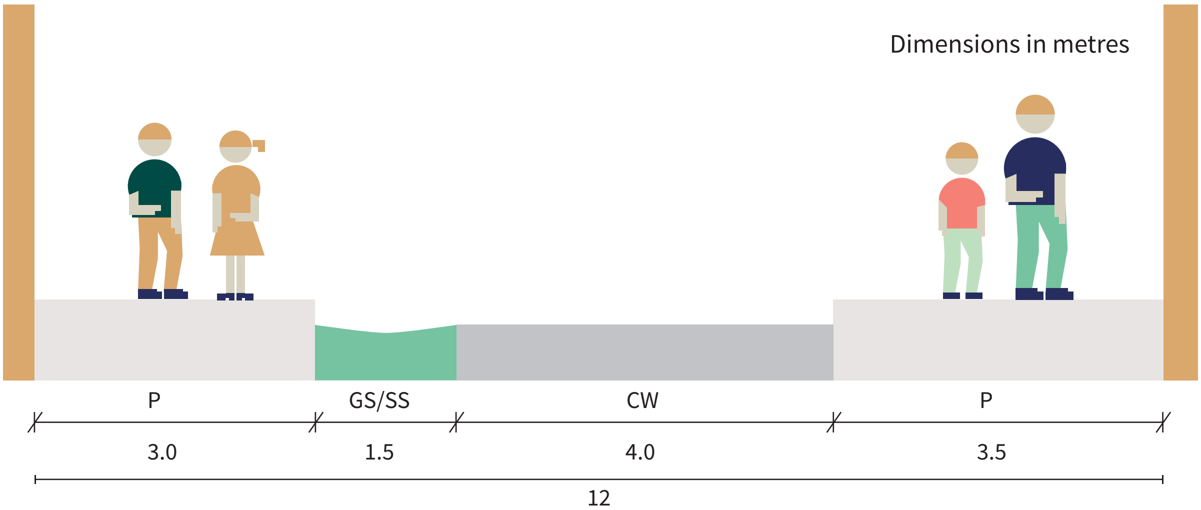
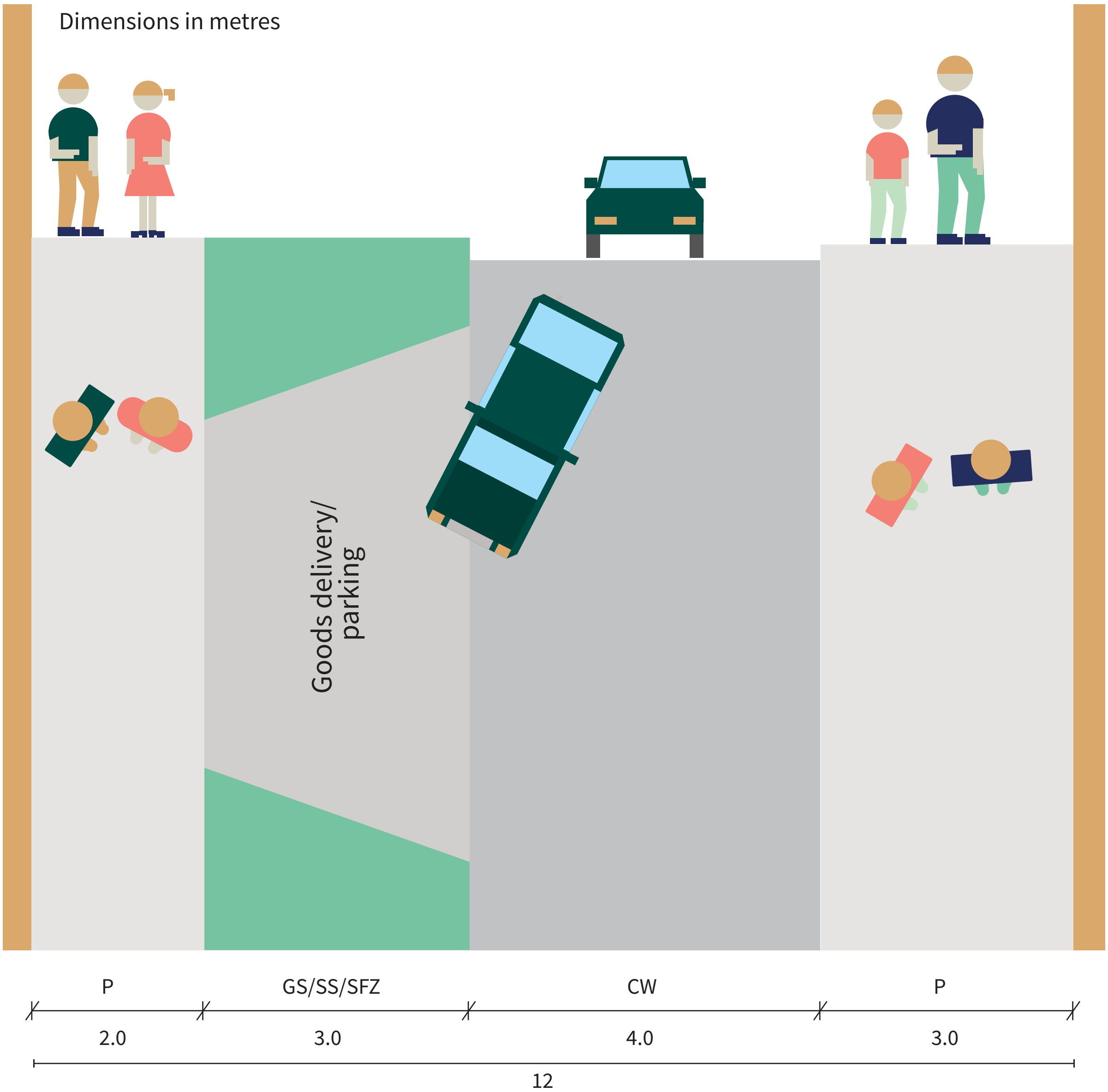


FIGURE 7-1 Cross-section 1: One-way street with vegetation, and pavement on both sides (type A street).

P: Pavement
GS: Green space/vegetation
SS: Stormwater solution
CW: Carriageway



P: Pavement
GS: Green space/vegetation
SS: Stormwater solution
SFZ: Street furniture zone
CW: Carriageway

FIGURE 7-2 Cross-section 2: One-way street with pavement on both sides, variable zone for street furniture, vegetation, deliveries and/or parking (type A street).

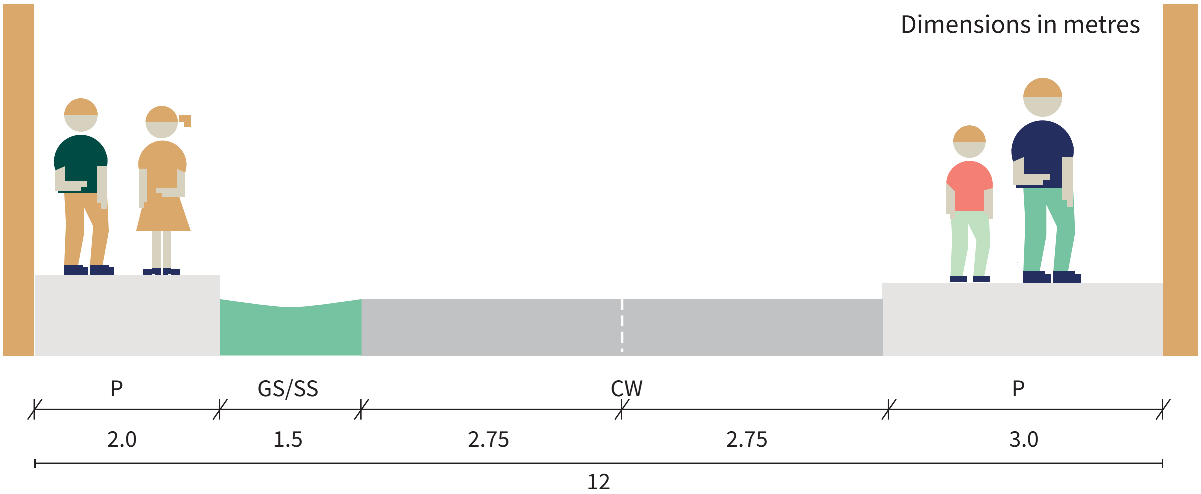


FIGURE 7-3 Cross-section 3: Two-way street, with vegetation/stormwater solution and pavements on both sides. This street is not suitable for a main bus route (type B street).

P: Pavement
GS: Green space/vegetation
SS: Stormwater solution
CW: Carriageway

7.1.2 15-METRE STREETS

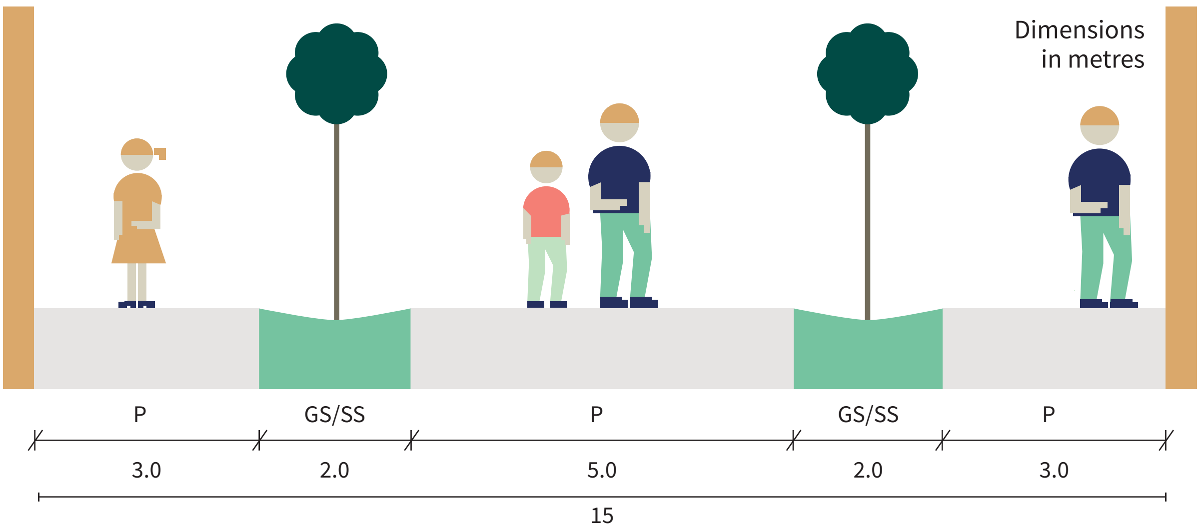
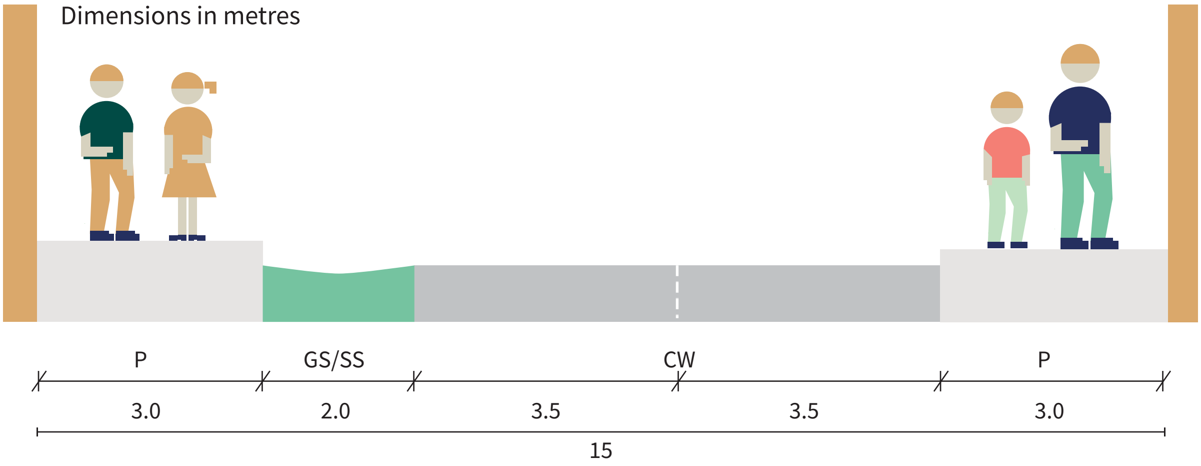


FIGURE 7-4 Cross-section 4: Pedestrian street, with green area/stormwater solution on both sides, overall width 15 metres + variable width (type A street).

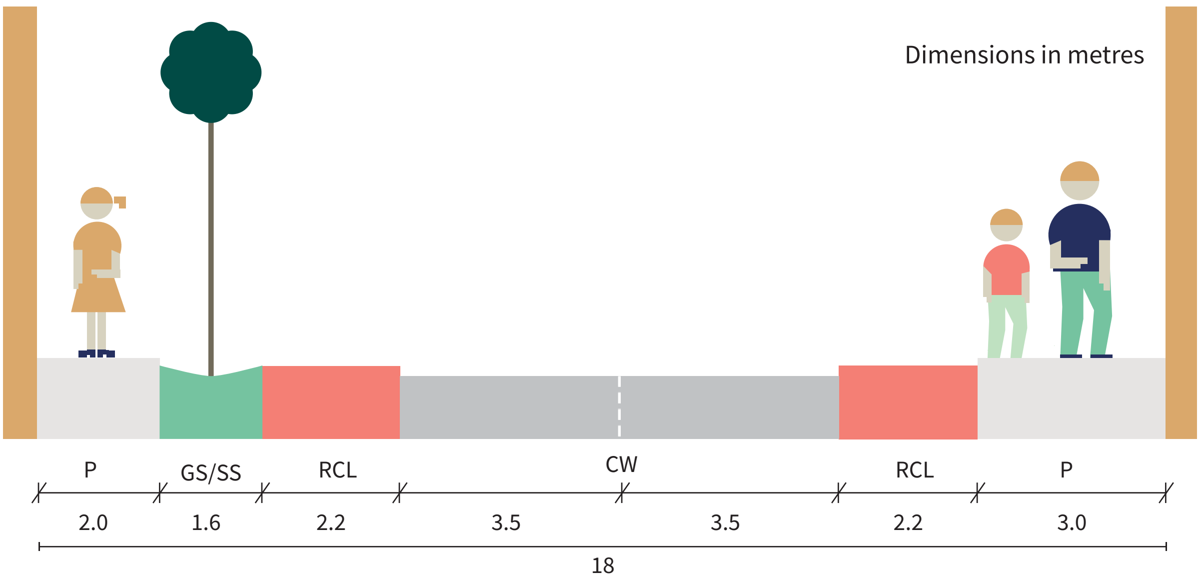
P: Pavement/pedestrian clearway zone
GS: Green space/vegetation
SS: Stormwater solution



P:	Pavement
GS:	Green space/vegetation
SS:	Stormwater solution
CW:	Carriageway

FIGURE 7-5 Cross-section 5: Street with pavement on both sides, green space, and carriageway with total width of 7.0 metres. The carriageway is suitable for bus traffic (type B street).

7.1.3 18-METRE STREETS



P:	Pavement
GS:	Green space/vegetation
SS:	Stormwater solution
RCL:	Raised cycle lane
CW:	Carriageway

FIGURE 7-6 Cross-section 6: Street with pavement on both sides, a green space with space for stormwater solution and trees, raised cycles lanes on both sides and two-way carriageway. The green space can also be established between the cycle path and the carriageway (type B street).

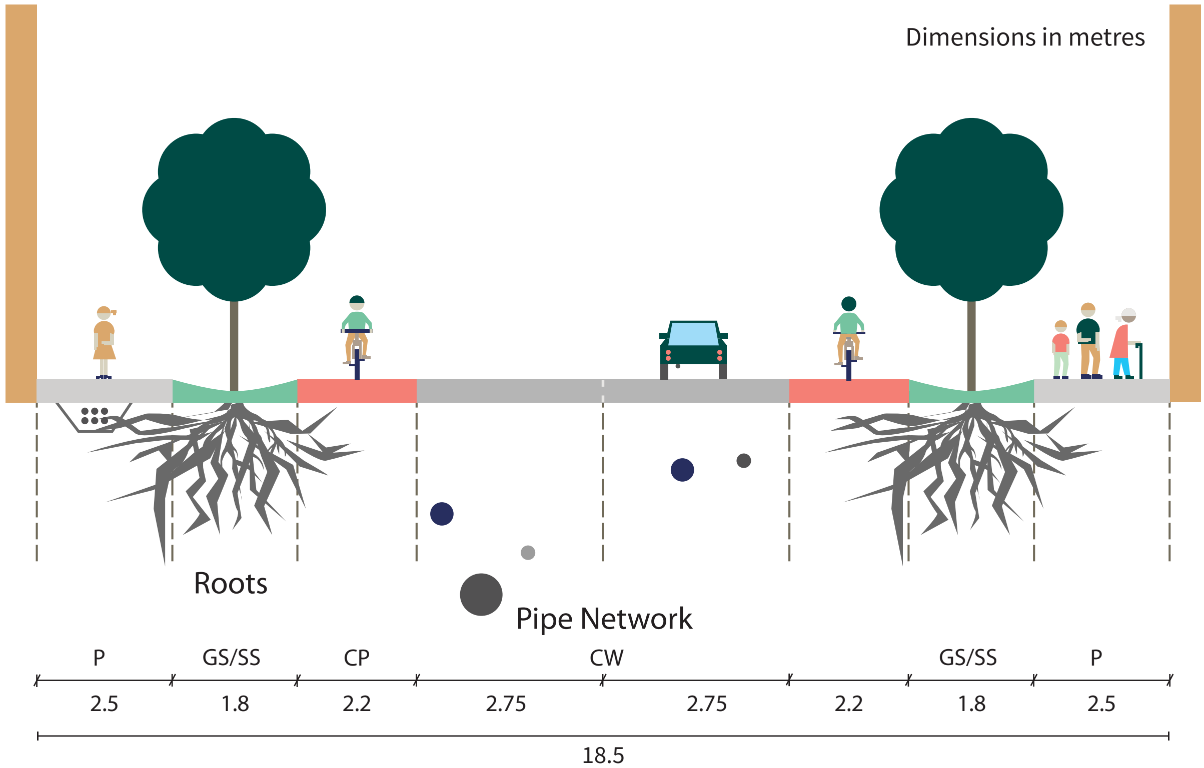


FIGURE 7-7 Cross-section 7: Example of infrastructure under the ground. Street with pavement on both sides, a green area with trees, and raised cycles lanes on both sides. In cross-sections where the green space is placed between the pavement and the cycle path, roots can get sufficient soil volume to thrive as the roots can grow beneath the pavement and the cycle path.

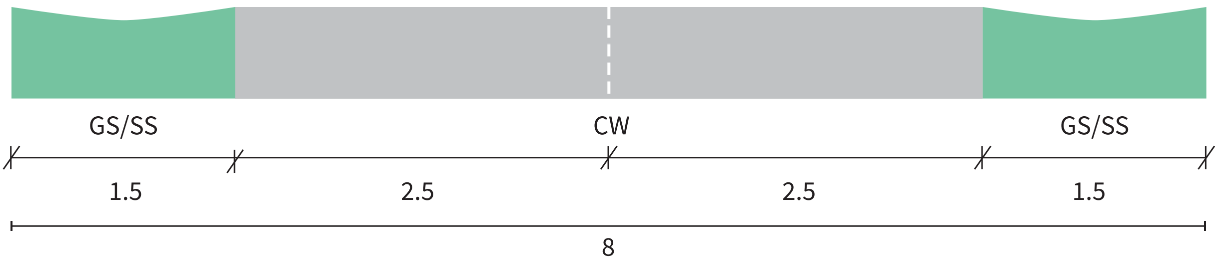
P:	Pavement
GS:	Green space/vegetation
SS:	Stormwater solution
CP:	Cycle path
CW:	Carriageway

7.2 Type C Streets

The following cross-sections are examples of existing and typical regulated street widths in residential areas in suburbs of the city. These streets generally carry little traffic, and can separate groups of road-users when they are altered or built new. These sections are not standard. Where the regulated width limits any widening of the road, these cross-sections can be used by agreement with the Agency for Urban Environment.

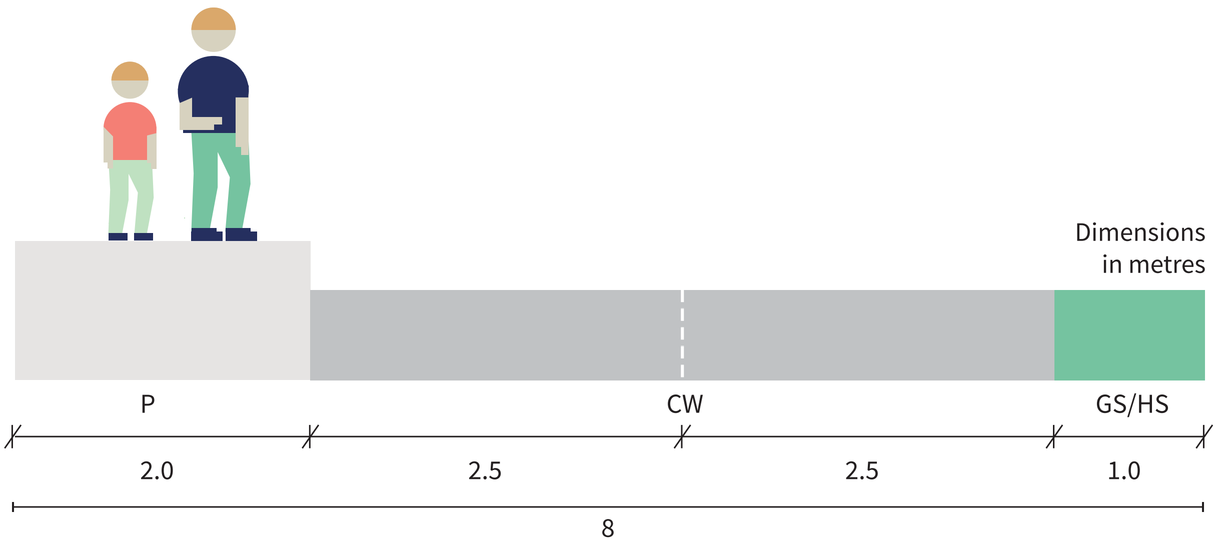
7.2.1 8-METRE STREETS

Dimensions in metres



GS: Green space/vegetation
SS: Stormwater solution
CW: Carriageway

FIGURE 7-8 Cross-section 8: Two-way street with gutter on both sides.



P: Pavement
CW: Carriageway
GS: Green space
HS: Hard shoulder

FIGURE 7-9 Two-way street with carriageway and hard shoulder.

7.2.2 9-METRE STREETS

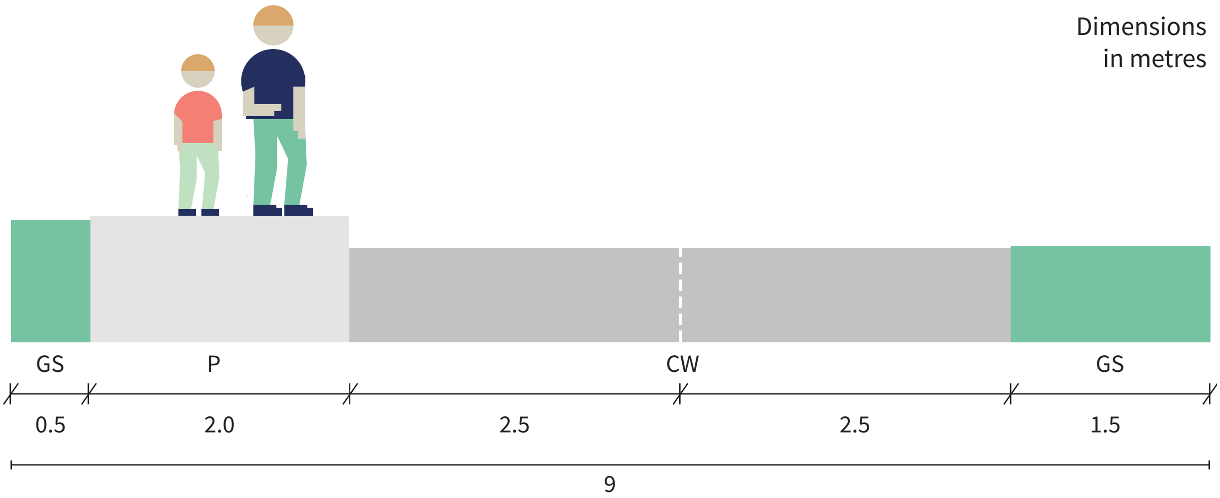
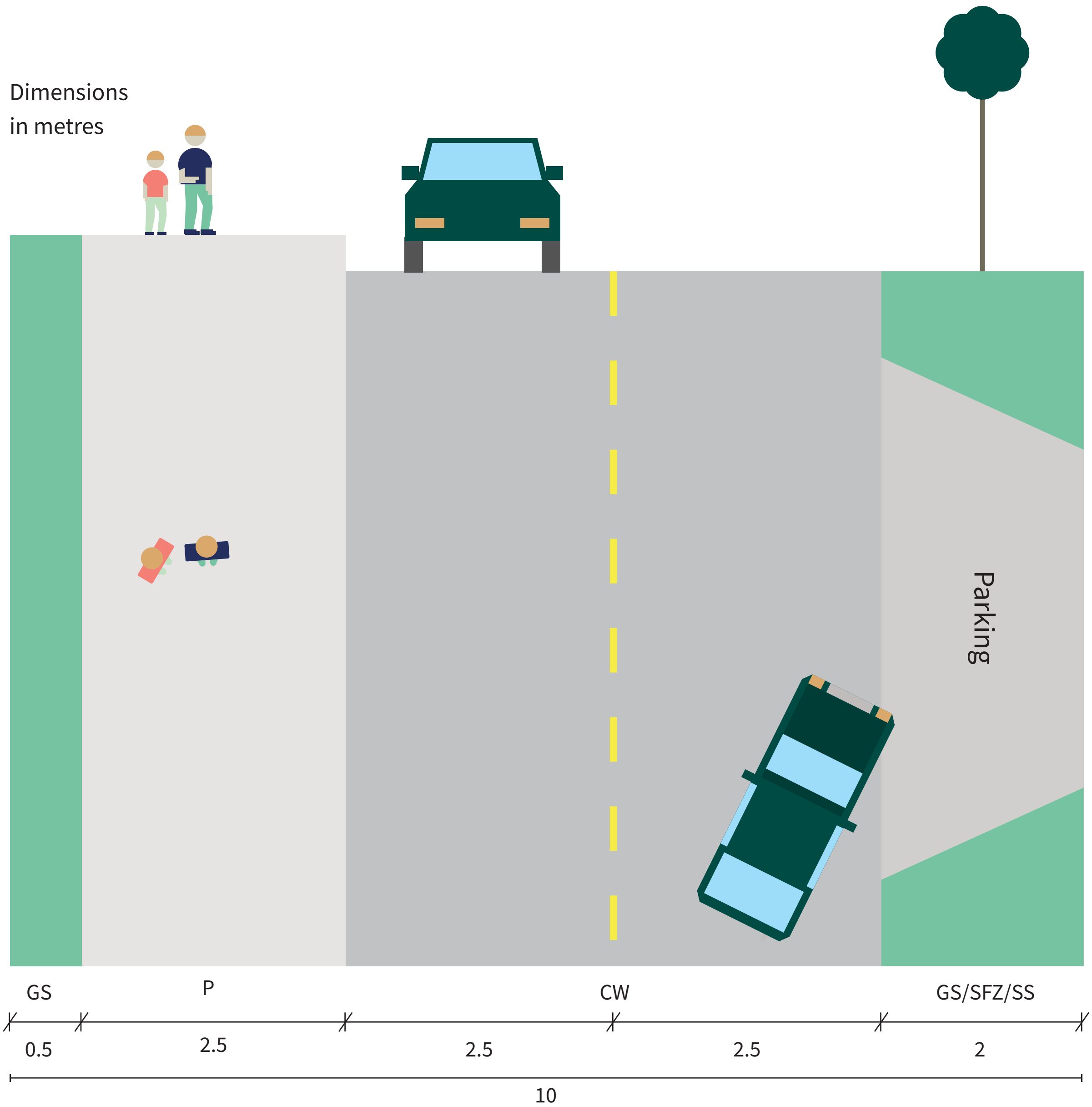


FIGURE 7-10 Cross-section 10: Two-way street with carriageway and hard shoulder.

P: Pavement
CW: Carriageway
GS: Green space
HS: Hard shoulder

7.2.3 10-METRE STREETS



P: Pavement
GS: Green space/vegetation
SFZ: Street furniture zone
SS: Stormwater solution
CW: Carriageway

FIGURE 7-11 Cross-section 11: Street with two-way carriageway, pavement, gutter, and combined area (parking and vegetation).

7.3 Other Intersection Solutions

7.3.1 Roundabout with mixed traffic and speed-reducing measures

This solution is designed for type B2 streets. It has a raised intersection, rigid design, and a guide zone in the circulation area. The guide zone is an area with a bike-friendly surface, but cyclists do not have any special rights within this zone.

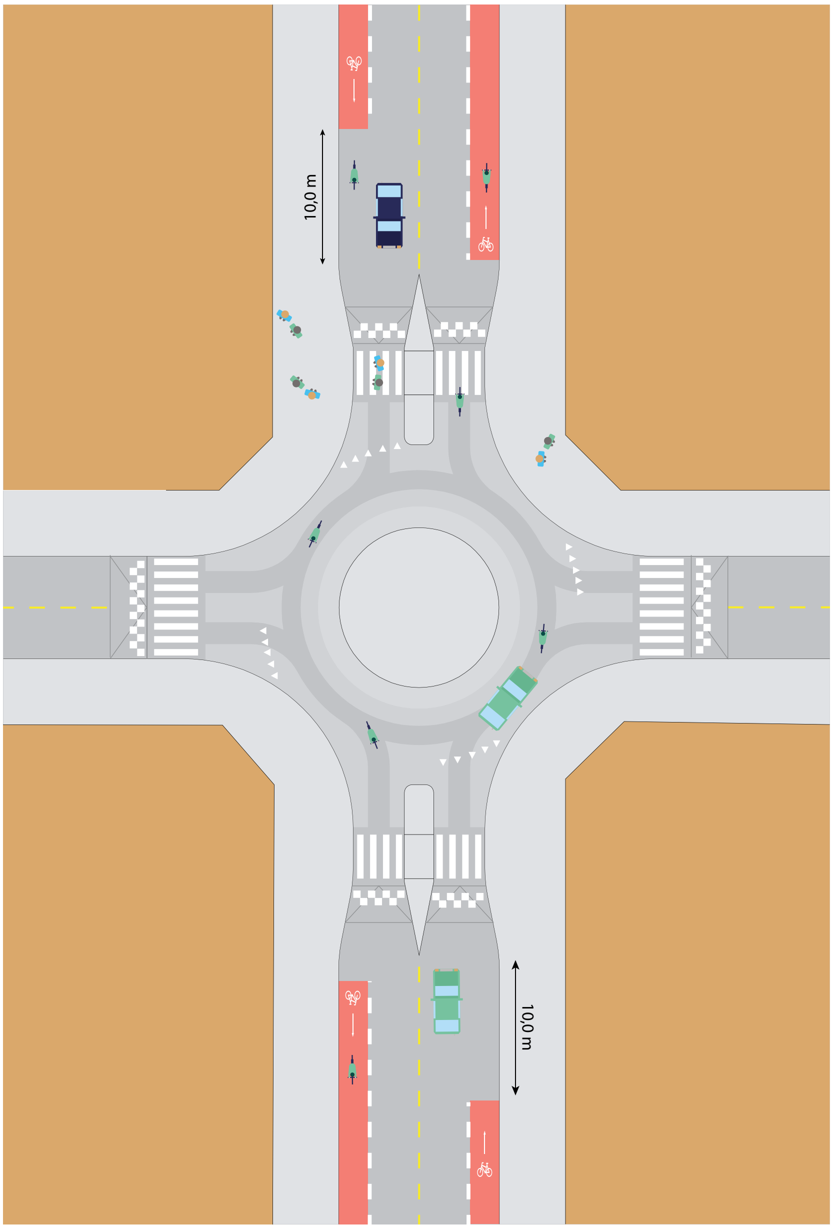


FIGURE 7-12 Roundabout with mixed traffic and speed-reducing measures.

7.3.2 Roundabout with cycle path in separate arm

This solution is designed for type B2 streets. The cycle path should be taken right into the circulation area, without any change in level and without crossing the kerb.

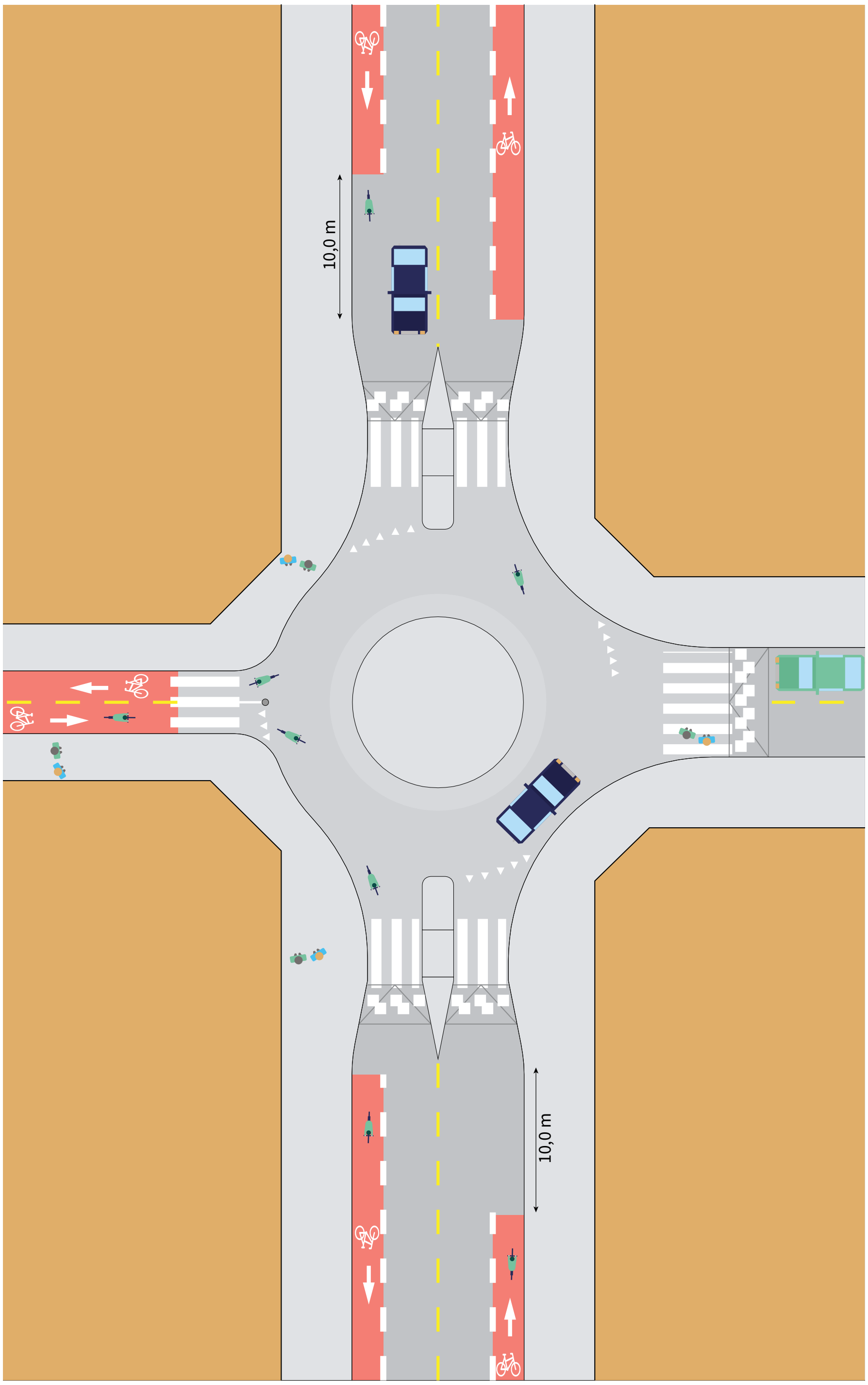


FIGURE 7-13 Roundabout with cycle path in separate arm.

7.3.3 Roundabout with separate path for cyclists

In this solution, the cycle lanes are physically separated from other traffic by the use of islands The solution requires a 5-metre gap for vehicles approaching the ‘give way’ lines.

This solution requires an approved deviation from the signage manual, and must be discussed with the Agency for Urban Environment and the Norwegian Public Roads Administration.

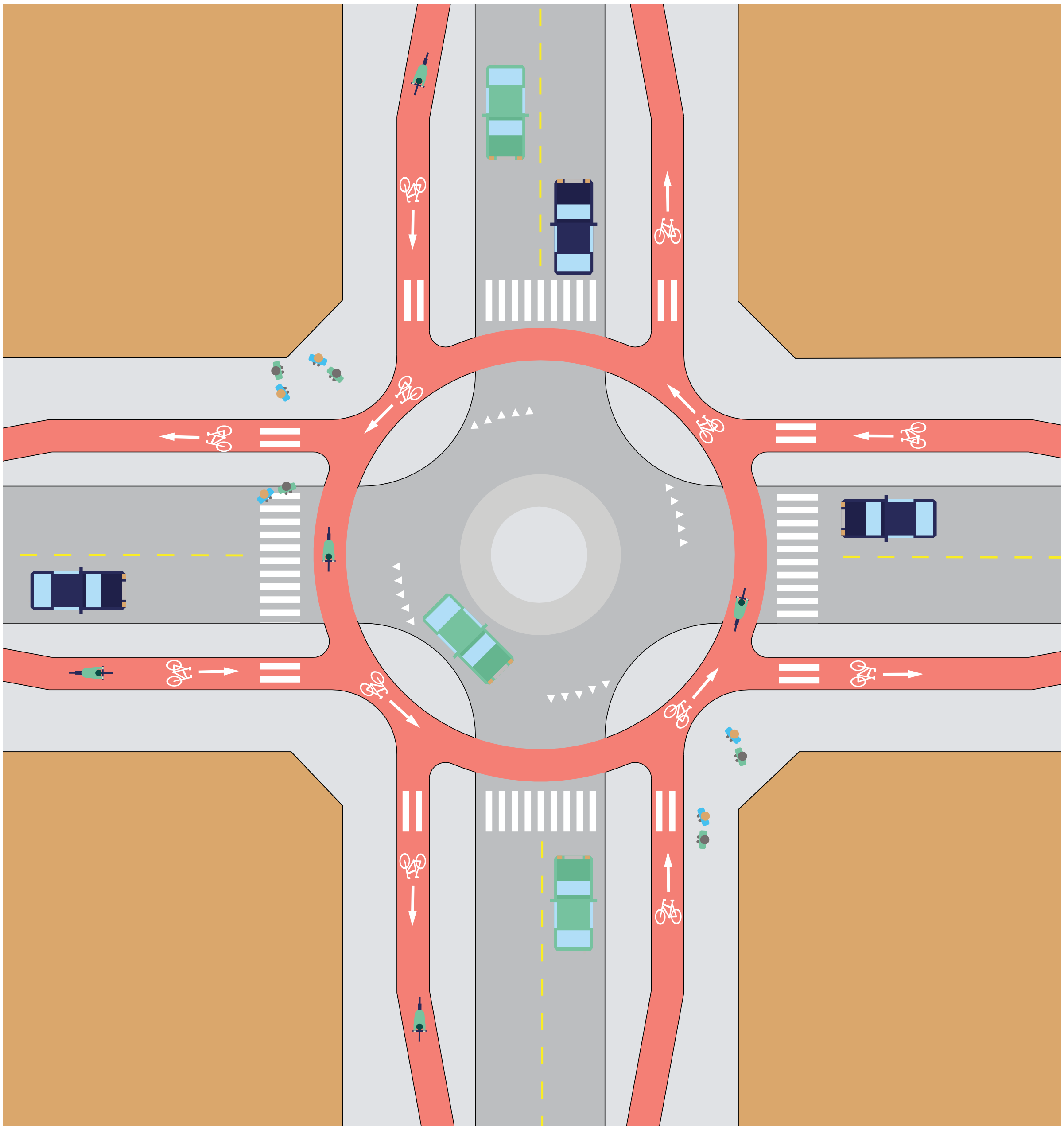


FIGURE 7-14 Roundabout with separate lane for cyclists.

7.3.4 SIGNAL-CONTROLLED JUNCTION WITH SEPARATE PATH FOR CYCLISTS

This solution can be used in streets with three or more lanes in arms with facilities for cyclists. The actual intersection point should be moved 5-6 metres out from the theoretical edge line of the nearest continuous lane.

A waiting area should be provided for cyclists ahead of the stop line. A signal plan should be drawn up to reduce waiting time for cyclists turning left. A cycle crossing can only be marked in the priority direction.

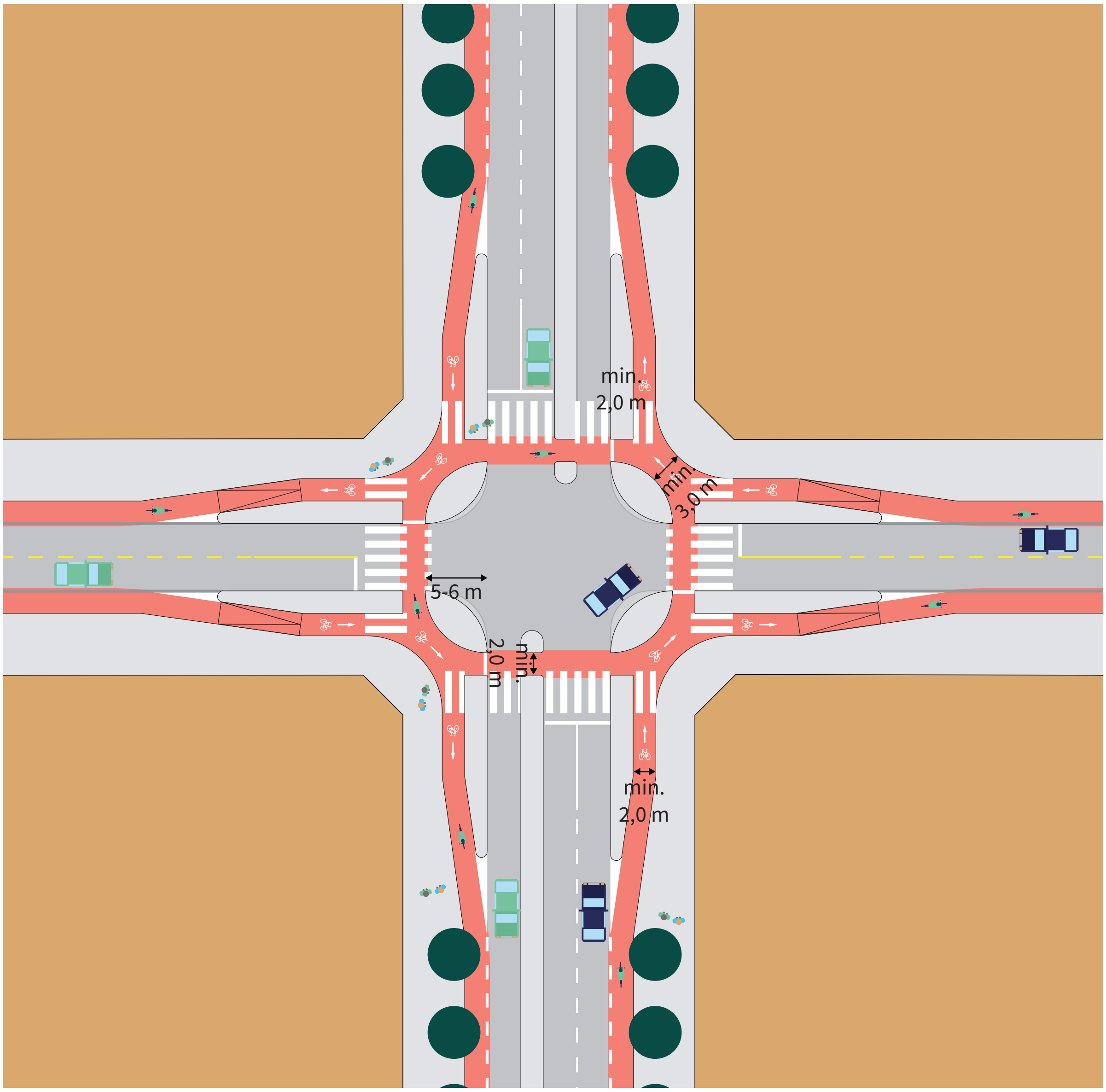


FIGURE 7-15 Signal-controlled intersection with separate lane for cyclists.

7.3.5 Outline diagram of control of buses in a street

FIGURE 7-16 Example of bus management in the street structure.

7.4 Details for Design of Blue-Green Facilities along Streets

Blue-green solutions are a relatively new type of solution for local stormwater management in the design of streets in Oslo. Various solutions are being tested and will later be standardised and incorporated into the manual as mandatory solutions.

7.4.1 Soil for different purposes

When choosing soil, designers should consider what the soil is to be used for and what characteristics it has. The soil may be categorised according to use as lawn soil, bedding soil, rain garden soil, soil for use together with water management systems (LOD systems), and capillary soil.

Lawn soil is used where grass is to be laid. This soil must withstand the stress and use grass is subjected to in the city. The soil may consist of earth from other works etc.

Bedding soil is used for borders, summer flowers, bushes and trees in areas with no traffic or pedestrians. There are several good soil mixtures on the market. These should ideally contain well-decomposed compost, preferably from garden waste.

Soil that will be used for management of stormwater must be suitable for the retention and absorption of water. Soil with biochar for stormwater management should be considered. The soil of raingardens must be able to absorb water through its surface and retain it before it either evaporates or is discharged. Capillary soil is a soil profile that is designed to absorb water from underlying reservoirs and masses to support vegetation, and should be considered for green verges and green space.

7.4.2 Surface water management and planting

PLANT BED

Raingardens of high quality, as it relates to planning and design, will manage run-off and provide trees with the best possible conditions for growth in urban environments. Similarly, to how tree crowns grow outwards the roots need space to grow underground. In their natural environment roots grow together with stones and rock and the root systems of other plants. Trees in urban environments often have limited space. It is therefore crucial to provide roots additional space to grow outwards, so they can gain access to nutrients and water. Soil profiles of high quality are solutions for certain issues with ecological conditions and climate change in urban environments and should therefore be considered.

BIOCHAR

Biochar is charcoal made from organic waste and can be used to improve the soil. Biochar is produced for this purpose and can stimulate tree growth. Roots can absorb the necessary amounts of water and nutrients from the biochar, just as they do from soil. Biochar has been shown to work well in both new planting and for reinvigoration of existing plantings where the soil volume is limited.

EXAMPLE OF SOIL STRUCTURE UNDER PAVED SURFACES FOR TREES IN THE URBAN ENVIRONMENT

In urban settings, the surface has to withstand great pressure from vehicles. This normally makes the sub-soil ill-suited for tree roots, because the soil gets compacted, which in turn creates problems for the top surface of asphalt or stone which settles unevenly. There are several ways of dealing with this so the subsoil under paved surfaces can also be used by tree roots. A recommended schematic solution is shown in the street design manual.

One example is a top layer with 10 cm of bedding soil. Half of the bedding soil should be well-digested garden compost. Around the root ball in the planting hole, a soil mixture made up of 4-8 mm crushed stones, biochar and well-digested garden compost can be used. If a bearing layer is needed beneath the hole, a mixture with 32-64 mm of chippings and biochar specially produced for the purpose can be used.

FIGURE 7-17 Example of a root reinforcement layer and biochar laid on Bygdøy Allé.

SOIL WITH GOOD CAPILLARY PROPERTIES

Capillarity causes water to be transported up through the soil profile. The water is then available to the roots of plants and can be absorbed in the bed. This provides the plants with better growing conditions and reduces the amount of water that is discharged to the stormwater network.

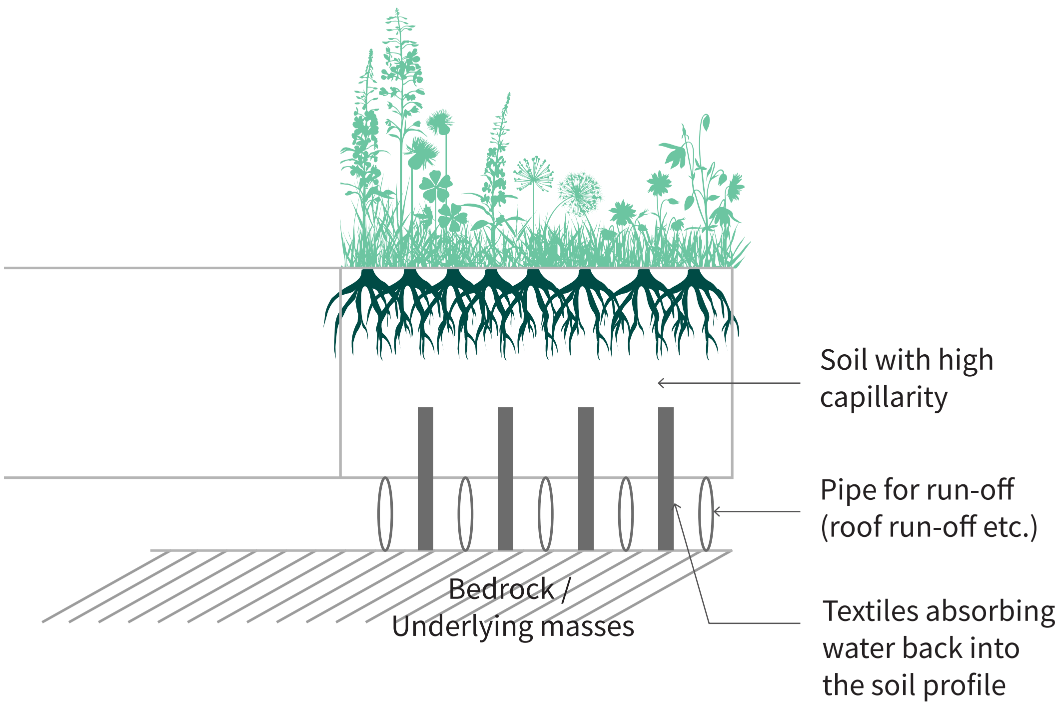


FIGURE 7-18 Diagram showing stormwater management where the stormwater is taken down into pipes underground and transported up into the plant bed with the aid of cloth "wicks" and soil with good capillary properties.

7.4.3 Care and mulching plans

Management and drift plans should be produced for all new projects to ensure that trees in urban environments get sufficient nutrients, even immediately after planting. These plans will usually include a pruning plan to prevent conflict between the future crown and passing traffic. A qualified or certified arborist should handle the pruning work.

7.4.4 Kerb with rain garden

Raised kerbs along raingardens leads to issues with diverting stormwater efficiently into the rain gardens. Various solutions for stormwater outfalls may be used (slits, side-gutters through the kerbstones). It is not always appropriate to use kerbstones without any slope, particularly for operational reasons.

The rain garden in Bjørnstjerne Bjørnsons gate in Drammen was created with a raised kerb and side-gutters from the carriageway, and dropped kerbstones along the pavement. This produces a slight fall from the pavement towards the pedestrian crossing. As a result, the stormwater is efficiently diverted. Given a good gradient in the street, there will be no puddles by the pedestrian crossing of the street.

FIGURE 7-19 Kerb with rain garden on Bjørnstjerne Bjørnsons gate in Drammen.

A slight fall to the pedestrian crossing reduces the risk of puddling and works well in combination with the kerb solution.

Every project should look at the kerb height in a broad perspective, taking account of operation, universal design, salt spray, aesthetics, environment and run-off.

7.4.5 Steel edging

Where space is limited, steel edging may be used around rain gardens and green strips. In the example below, the surface of the green strip is sunk 25-30 cm below the pavement. The trees are planted below the pavement surface where there is space for low vegetation. The steel plates extend around 1 metre down into the ground. Below the ground they are perforated to allow the roots to extend into a root reinforcement layer beneath the solid surface of the pavement.

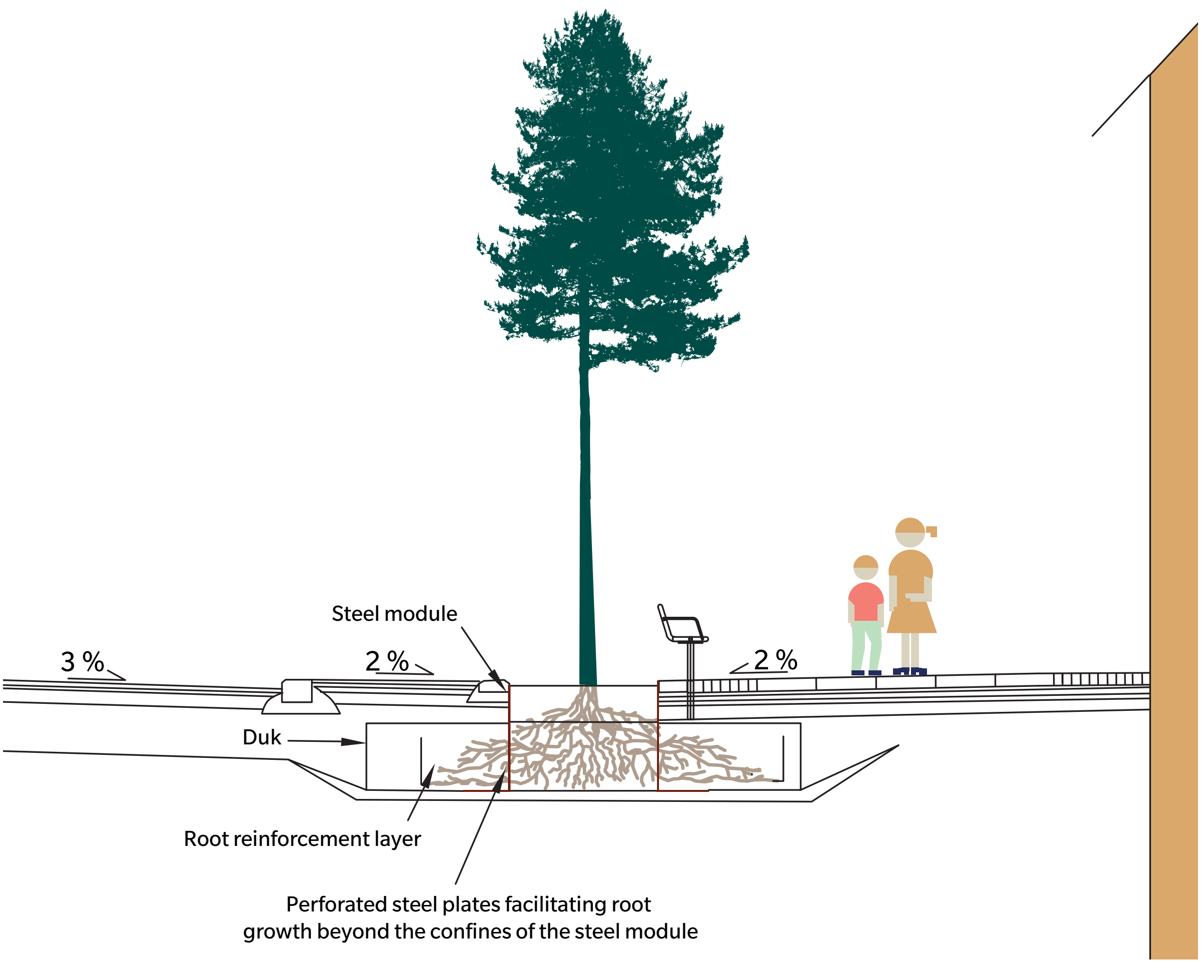
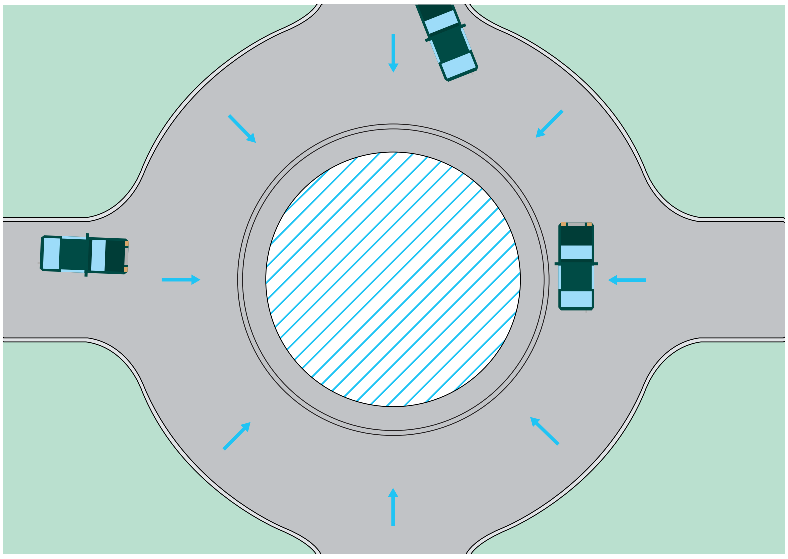


FIGURE 7-20 Section through grass verge with steel edges which saves space and increases the volume of soil.

7.4.6 Roundabout with crossfall to rain garden



Retention volume

Run-off path

The carriageway has a crossfall towards the middle of the roundabout.

FIGURE 7-21 Roundabout with blue-green retention volume in the middle.

Notes:

In the example the pond is drained by infiltration. The solution should have a remediation measure to collect particles at the inlet to the pond. The solution also has an overflow and underlying drainage.

To prevent cars from driving onto the central island, the solution is designed with kerbstones that have slits or side-gutters in them. The water runs into the rain garden through slits or side-gutters, so no rain or ice collects on the carriageway.

Retention volume

Run-off path

Infiltration into the soil

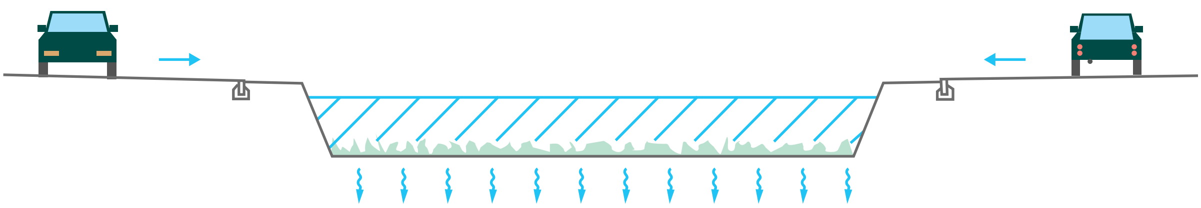


FIGURE 7-22 Cross-section of roundabout with retention volume in the middle.

7.4.7 Quality requirements for the design of blue-green gullies and rain gardens

Standards and rules for blue-green solutions in streets have not yet been fully developed.

When new stormwater solutions are built, it is important to include tolerance requirements in the specification of the facility to ensure that the water follows the path that we want. There are unfortunately examples where incorrect implementation results in insufficient drainage volumes in rain gardens, and too small height differences between the overflow sluice and the bottom of the gully. Figure 7-23 shows an example of this on Bjørnstjerne Bjørnsons gate in Drammen.

Example of minimal height between the bottom of the gutter/rain garden and the overflow/dome grating, partly a result of the tolerance of +/- 10 cm in the “Process Code.”

FIGURE 7-23 Blue-green gully and rain garden, Bjørnstjerne Bjørnsons gate in Drammen.

SOIL FOR RAIN GARDEN

The soil in a rain gardens is also called the filter medium. The soil must have sufficient drainage capacity and be suitable growth medium for the species chosen for the location. The right quality of soil is critical to success, but on the other hand obtaining soil of this quality is often difficult.

For the rain garden in Bjørnstjerne Bjørnsons gate in Drammen, a thorough preliminary study was carried out by e.g. NIBIO, which resulted in a descriptive text reproduced below.

The following description of soil was used in construction of the rain garden in Bjørnstjerne Bjørnsons gate in Drammen, and refers to Process Code 1 (from the Norwegian Public Roads Administration). Until other guideline material is available, this should also be used for street projects in Oslo.

The description is not specific to indigenous species, so designers must assess whether the soil needs to be more nutrient-rich for their choice of species.

However, this is an area where we need more knowledge, so other soil mixtures may be tested in projects to be followed up, perhaps in connection with pilot or research projects.

HUMUS-RICH CONSTRUCTION SOIL FOR RAIN GARDEN

A. Suitable as topsoil in a rain garden.

B. The basis of the soil mixture should be a pure mineral soil, with a composition similar to that of the subsoil described in Process 74.4421. Particle sizes should be close to the coarsest recommended distribution for mineral soil. Refer to the general description in Process 74.44. Organic material should also be added to arrive at a humus content of 2-3% by weight. If any fertiliser is added, this must be organic.

C. Soil depth 30 cm.

D. The nutrient analysis and grain-size distribution must be presented to the client for approval before the soil is laid down.

LOW-HUMUS CONSTRUCTION SOIL FOR RAIN GARDENS

A. Suitable as subsoil in a rain garden.

B. The soil should be a pure mineral soil. Refer to the general description in Process 74.44. The mineral soil should have a coarser particle distribution than normal construction soil. Particle sizes should be close to the coarsest recommended distribution for mineral soil.

C. Soil depth 50 cm.

D. The nutrient analysis and grain-size distribution must be presented to the client for approval before the soil is laid down.

8. Annex

8.1 Design Dimensions

This section provides design dimensions that can be used when planning and developing street and roads.

8.1.1 Pedestrians and cyclists

Facilities for pedestrians and cyclists must be sized according to dimensions given in the tables below. The minimum clearance between pedestrians is 0.1 metre, and between pedestrians and cyclists 0.2 metre.

TABLE 8-1 Design dimensions for soft road-users.

Category	Dimensions (m)
Cyclists	
Width	0.75
Length	1.80
Height	1.90
Cargo bike or cycle with trailer	
Width	1.00
Length	4.00
Pedestrian/person standing	
Width	0.70
Length	0.40
Height	1.90
Pedestrian with buggy	
Width	0.70
Length	1.70
Pedestrian with companion or guide dog	
Width	1.20
Wheelchair	
Width	0.90
Length	1.50

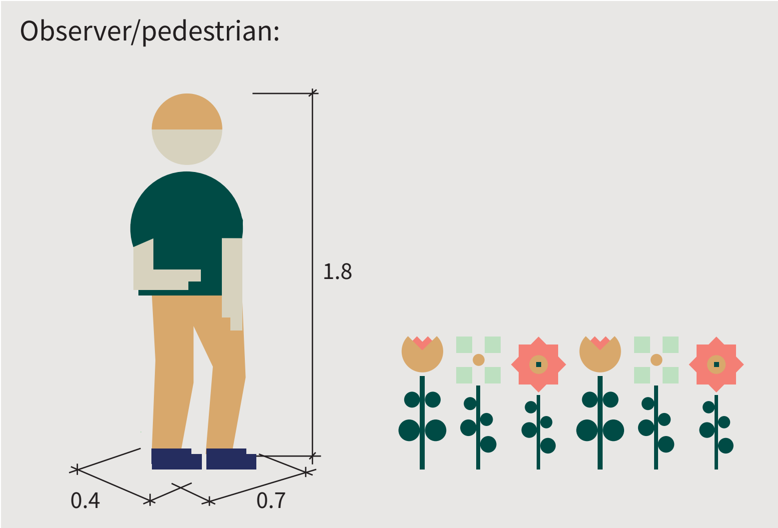


FIGURE 8-1 Design dimensions for pedestrian (dimensions in metres).

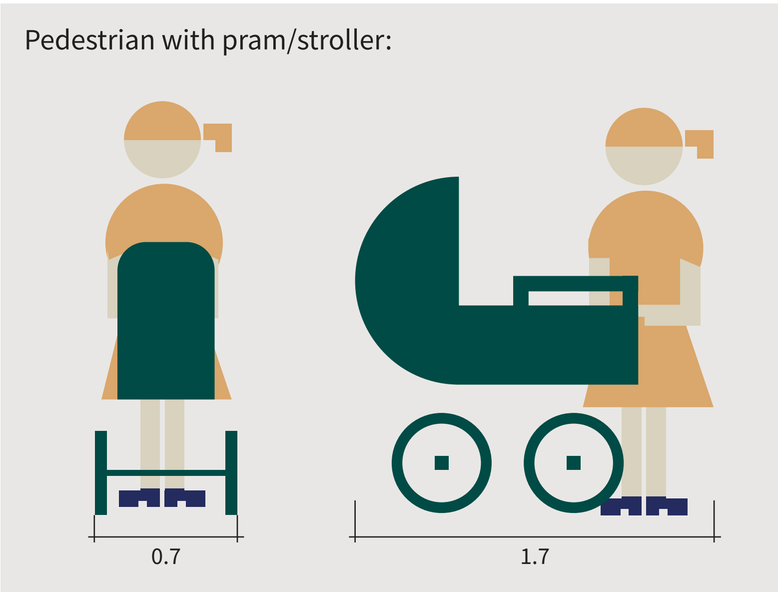


FIGURE 8-2 Design dimensions for pedestrian with pram/stroller (dimensions in metres).

A double buggy is 0.9 metre wide.

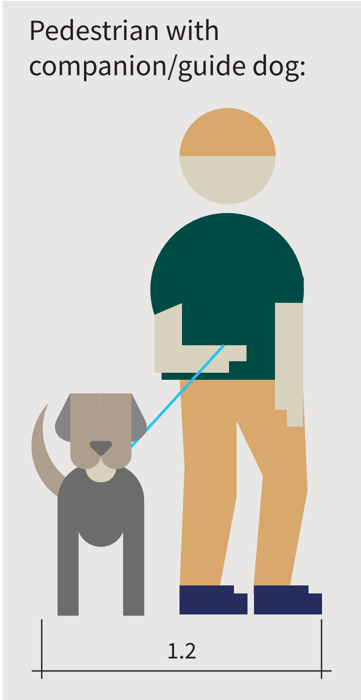


FIGURE 8-3 Design dimensions for pedestrian with companion or guide dog (dimensions in metres).

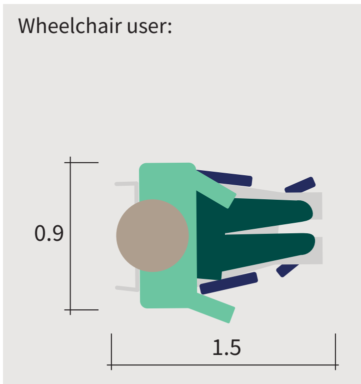
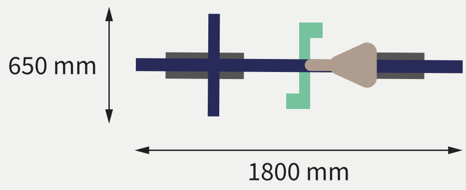


FIGURE 8-4 Design dimensions for wheelchair user (dimensions in metres).

TABLE 8-2 Cycle dimensions.

Standard cycle

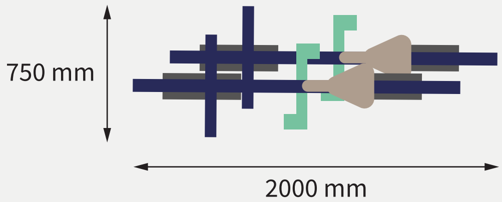
The space needed for simple manoeuvring and locking of normal cycles may be heavily affected by extra equipment on the cycle (basket, child seat etc.).



Two parked cycles

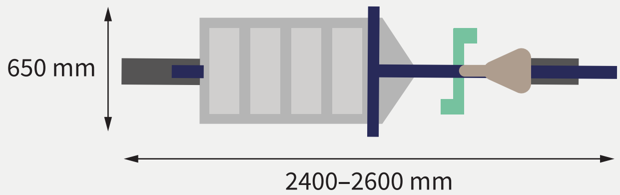
When two cycles are parked and locked to the same rack, they will often be offset relative to each other. This is because the cyclists want to avoid the handlebars and pedals clashing. This gives a total length of approx. 2000 mm for two parked cycles.

The total width of two cycles parked against the same rack can be assumed to be approx. 750 mm.



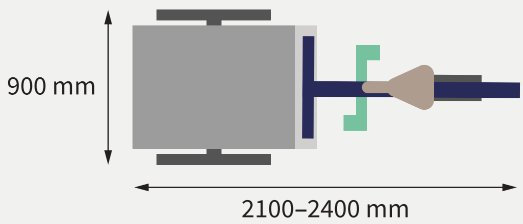
Two-wheeled cargo bike

Many two-wheeled cargo bikes have a stand designed so the cycle has to be pulled back 30 cm for the stand to fold out. When the stand is folded out it is physically difficult to move it forwards again. The optimum depth of the parking area is therefore 3000 mm for the longest cargo bikes.



Three-wheeled cargo bike

Most three-wheeled cargo bikes are almost 900 mm wide. For persons with these cycles to be able to use the cycle parking, a centre-to-centre distance of at least 1000 mm between the racks is needed.



8.1.2 Dimensions for cycle parking

The planning of cycle parking must provide adequate space for the cyclist to manoeuvre safely and not come into conflict with other road-users passing at high speed or persons with physical or mental disabilities.

Figure 8-5 shows the manoeuvring area for standard size cycles and cargo bikes.

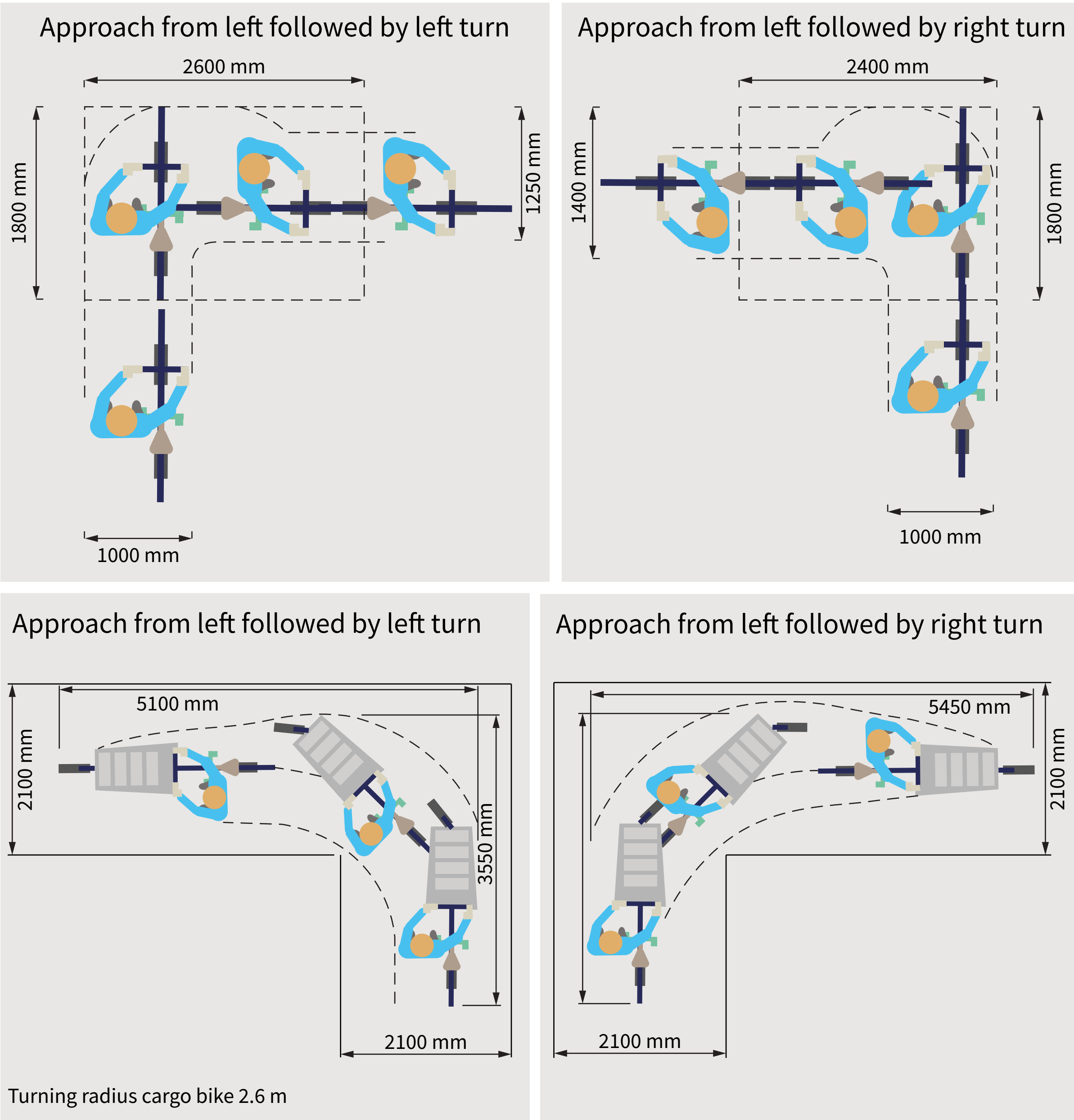


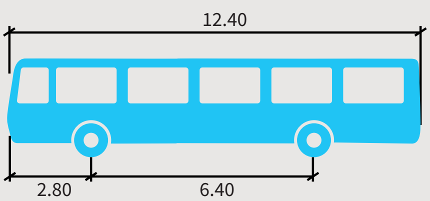
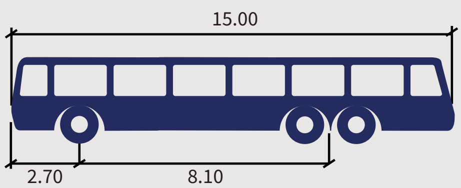
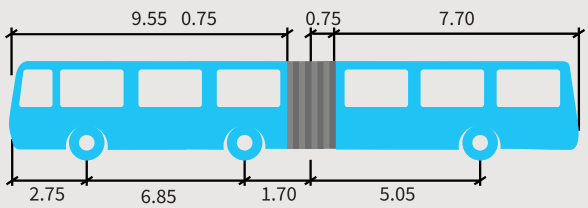
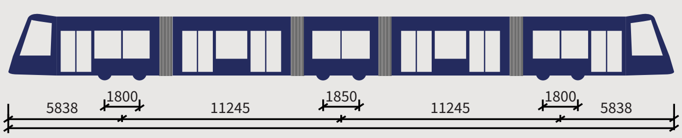
FIGURE 8-5 Manoeuvring area for standard size cycles and cargo bikes.

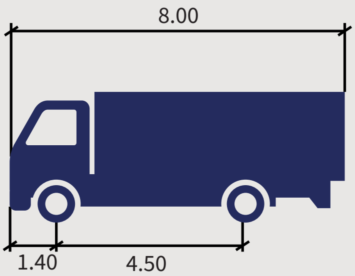
8.1.3 Motor vehicles: Design dimensions

The type of vehicles must be chosen on the basis of the function of the street, the traffic volume and space for turning. In sizing streets, one of the vehicle types shown in Table 8-3 should be chosen as the design vehicle.

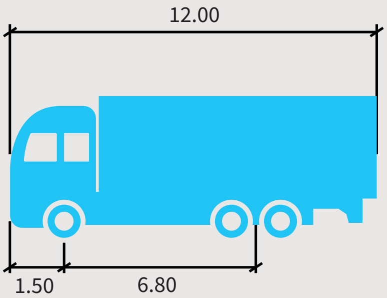
The turning radius refers to the front corners of the bodywork.

TABLE 8-3 Design vehicles.

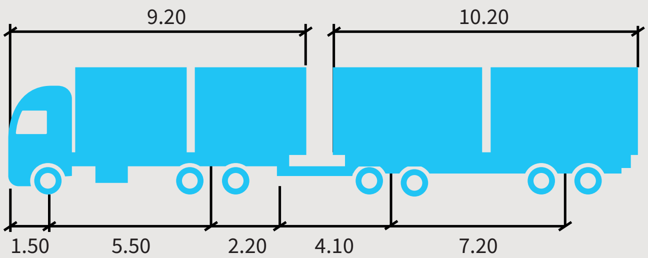
External dimensions	Vehicle	Comments
	**Bus (B)** Length: 12.40 m Width: 2.50 m Turning radius: 13.60 m	
	**3-axle bus (BB)** Length: 15.00 m Width: 2.55 m Turning radius: 12.50 m	The use of 15-metre tracking curves for 3-axle buses makes for good passability for buses in Oslo.
	**Articulated bus (LB)** Length: 18.75 m Width: 2.55 m Turning radius: 11.74 m	
	**Oslo's new trams (T)** Length: 34.166 m Width: 2.65 m	



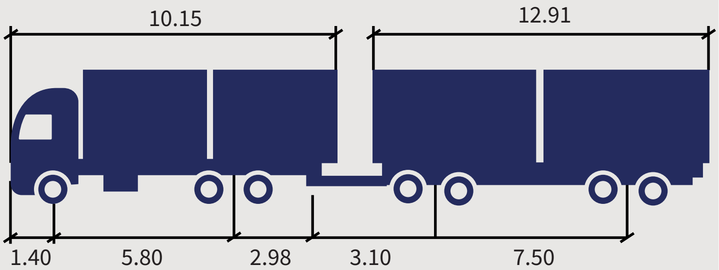
Small truck (LL)
Length: 8.00 m
Width: 2.50 m
Turning radius: 8.26 m
Track width: 4.50 m



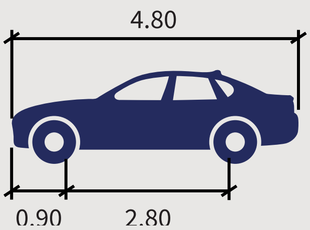
Truck (incl. fire tenders with ladders) (L)
Length: 12.00 m
Width: 2.55 m
Turning radius: 12.00 m



Road train (VT)
Length: 22.00 m
Width: 2.55 m
Turning radius: 12.50 m



Modular road train (MVT)
Length: 25.25 m
Width: 2.55 m
Turning radius: 11.00 m



Cars, vans and pick-ups (P)
Length: 4.80 m
Width: 1.80 m
Turning radius: 6.0 m

Other design dimensions can be found in Norwegian Public Roads Administration handbook V123.

8.2 Design of Driving Modes

Passability for individual large vehicles needs to be assessed when a road layout is sized for a smaller vehicle type. There is then a need to assess driving modes:

Driving mode A

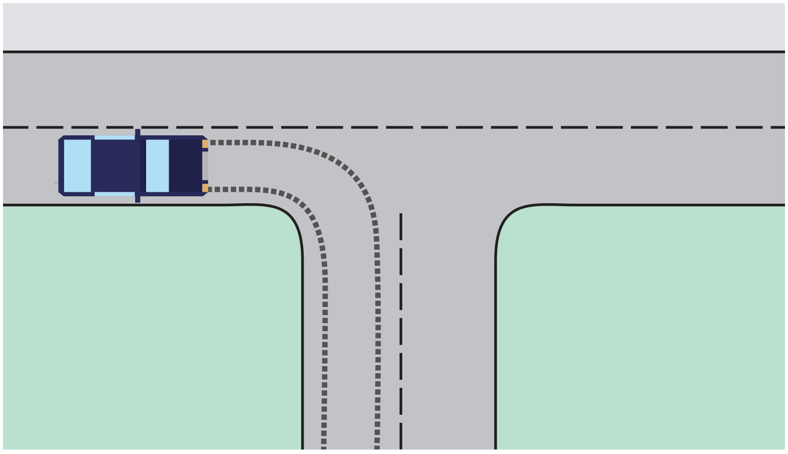


FIGURE 8-6 Driving mode A.

Driving mode A assumes the following with regard to design vehicles:

- The vehicle must be able to pass through the road layout using only its own lane. This means that the whole vehicle, including overhang, must be able to manoeuvre within its own lane.
- On streets away from intersections, vehicles should be able to travel at the speed limit.
- At intersections, the vehicle must be able to drive through at 15 km/h.
- On bends, the vehicle must be able to drive at 15 km/h.
- The vehicle should not need to reverse at turning places.

Driving mode B

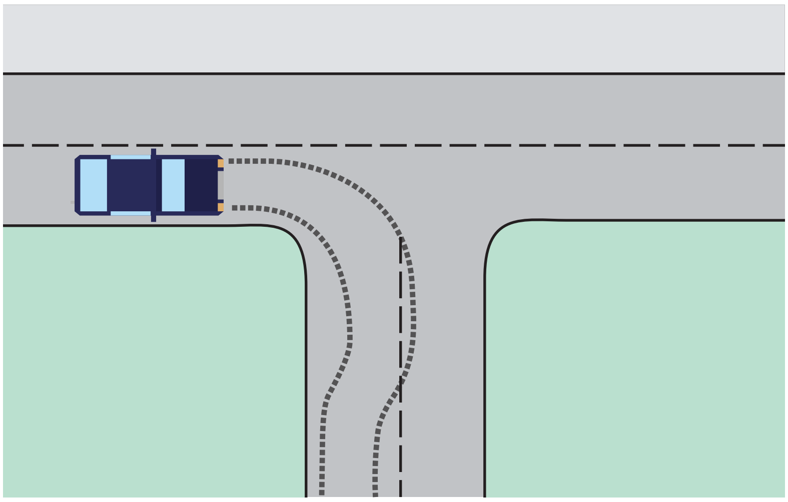


FIGURE 8-7 Driving mode B.

Driving mode B assumes the following with regard to design vehicles:

- At an intersection, the vehicle is required to be able to use parts of the opposite lane in the street/road it is turning into.
- On streets and roads away from intersections, the selected vehicle is assumed to have to take certain sections at a speed below the speed limit.
- At intersections, the selected vehicle may be expected to pass through at less than 15 km/h.
- On bends, the vehicle must be able to drive at 15 km/h.
- In some cases, the vehicle may have to reverse at turning places.

Driving mode C

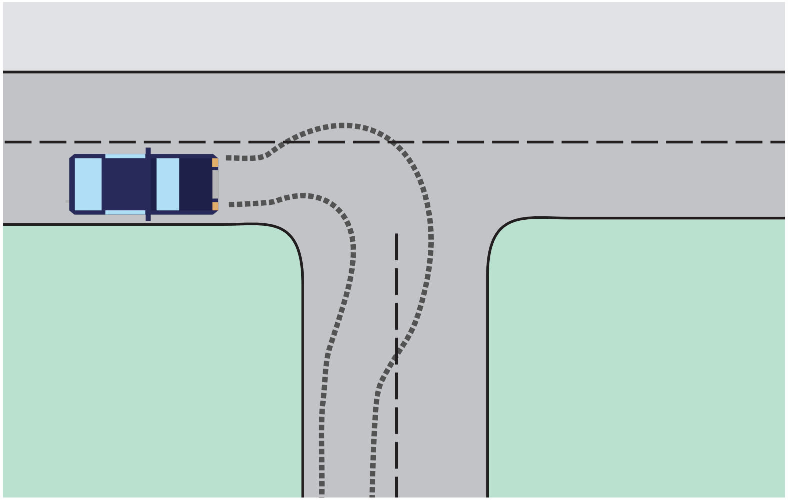


FIGURE 8-8 Driving mode C.

Driving mode C will be mainly associated with intersections.

Driving mode C assumes the following with regard to design vehicles:

- The vehicle must be able to use the whole width of the carriageway both in the street it is turning off and in the street it is turning into.
- The selected vehicle may be expected to pass through the intersection at less than 15 km/h.
- In some cases, the vehicle may have to reverse at turning places.

8.3 Governing Documents

This section lists governing documents on which this street design manual is based.

Note: Laws, guidelines, and manuals may change over time. Rules and guidelines in place at the relevant time should therefore be applied.

[1. INTRODUCTION]
[2. PRINCIPLES OF STREET DESIGN]
[3. DETAILED PLANNING I.]
[4. DETAILED PLANNING II.]
[5. DETAILED PLANNING III.]
[6. DETAILED PLANNING IV.]
[7. TOOLBOX]
8. ANNEX
[9. STANDARD SHEETS]

LAWS AND REGULATIONS

- Building Code TEK 17.
- Regulations on Electrical Supply Installations.
- Railways Act.
- Regulations on Requirements for Trams, Underground and Suburban Railways etc. (Requirements Regulations).
- Pipework and Cabling Regulations and Pipe and Cable Registration Regulations.
- Equality and Discrimination Act.
- Planning and Building Act.
- Roads Act.
- Road Traffic Act.
- Norwegian Highway Code.

GOVERNMENTAL

- National Transport Plan (NTP).

STANDARDS NORWAY

- NS 3070 Coordination of Pipes and Cables in the Ground.
- NS 11005:2011 Universal Design of Developed Outdoor Areas – Requirements and Recommendations.
- NS 4400 Nursery Stock.
- NS 3420 Parts K and Z.
- NEK EN 50126-1:2017 Railway Applications – Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) – Part 1: Generic RAMS process.

CITY OF OSLO

- Current Municipal Plan for the City of Oslo.
- Action Plan for Stormwater Management, City of Oslo.
- Architecture Policy for the City of Oslo.
- Strategy for Stormwater Management in Oslo 2013–2030.
- Plan for Cycle Network in Oslo, City of Oslo.
- Oslo Standard for Bicycle Planning, Agency for Urban Environment.
- Design of Streets, Agency for Planning and Building Services.
- Strategy for City Trees, Agency for Urban Environment.
- Street and Road Lighting Manual, Agency for Urban Environment.
- Strategic Roadmap for Charging Infrastructure in Oslo, City of Oslo.
- Current “Guide to Stormwater Management.”
- How the City of Oslo Manages Its Watercourses. Presentation. City of Oslo, Agency for Urban Environment.
- Guidelines for Separation of Drainage Networks, in Prep. City of Oslo, Agency for Water and Wastewater Services.
- Current Measures for Handling Stormwater in Oslo. Fact-finding visit to Copenhagen and Malmö. Report 1/2017. City of Oslo, Agency for Water and Wastewater Services (2017).
- Climate Strategy for Oslo to 2030.
- Fact Sheet on Stormwater. City of Oslo.
- City trees, Agency for Planning and Building Services (2016).
- Instructions for Excavation Works on the Municipal Road Network in Oslo.
- Guidelines for Warnings to Cyclists and Pedestrians.

CITY OF OSLO

- Refuse Disposal Regulations for the City of Oslo.
- Guideline on the Position and Choice of Refuse Disposal Solutions.
- Current Aesthetic Plan.
- Guideline on Work Close to Trees and Requirements for Rigging and Construction Work.
- Guideline on the Organisation of Rescue and Fire-Fighting Teams in the City of Oslo.

NORWEGIAN PUBLIC ROADS ADMINISTRATION

- N100 Road and Street Design.
- N200 Road Construction.
- N101 Guard Rails and Verges.
- V120 Requirements for Geometric Design of Roads.
- V121 Geometric Design of Intersections.
- V123 Public Transport Manual
- V124 Technical Planning of Road and Tunnel Lighting.
- V127 Crossing Points for Pedestrians
- V128 Speed-Reducing Measures.
- V129 Universal Design of Roads and Streets.
- V262 Stone Surfaces – Paving Stones, Flagstones, Cobbles and Slabs.
- V263 Concrete Slabs.
- V271 Vegetation in the Road and Street Environment.
- N300 Road Signs.
- N302 Road Markings.
- N303 Traffic Signals.
- V323 Advertising and Hazards to Traffic.
- N400 Bridge Design.
- N500 Road Tunnels.
- N601 Electrical Installations.
- Tree Planting, Norwegian Public Roads Administration Report No 89.

8.4 Glossary

The glossary contains a list of terms and specialist terminology used in the street design manual.

TERM	DEFINITION
1-lane street	Street with one lane for traffic in both directions, with passing places.
2-lane street	Street with two lanes throughout.
4-lane street	Street with four lanes throughout.
Accessibility	A product or service that facilitates use, preferably without assistance. This means that there are alternatives to the general solution aimed particularly at persons with disabilities.
Adaptation	Practical organisation of physical, social and pedagogical functions for individuals or specific groups. This differs from universal design in that the facilities do not cover all users.

TERM	DEFINITION
Age-friendly city	A city which is inclusive and has an accessible urban environment promoting active and healthy ageing.
Alignment	Curvature of the street line in the horizontal and vertical plane.
Approach	Part of a street that takes traffic into an intersection.
Artificial guide line	Tactile indicators combining directional and attention indicators.
Attention field	Several attention indicators form an attention area. Attention fields are intended to tell people about important functions and are placed where they need to be aware of changes: pedestrian crossings, bottom of stairs, changes of direction, stopping places, and information points.
Attention indicators	Attention indicators are intended to mark decision points and are marked with ridges across the direction of travel.
Barrier line	Solid line dividing the carriageway, which indicates that the line must not be crossed or driven over.
Bending tensile strength	A property of brittle unreinforced materials with a lower breaking point for tension than compression, to withstand bending forces.
Blue-green factor	The blue-green factor is a tool to define the extent of blue-green areas and provide predictability for developers with regard to requirements for outside space for water handling, vegetation and biodiversity in construction projects.
Blue-green stormwater facilities	Blue-green stormwater facilities refer to multi-functional use of green infrastructure to contain and remediate the run-off by local retention, infiltration, and evaporation of the stormwater. Solutions help to restore/maintain the hydrological cycle in the city.
Buffer zone	A longitudinal area to provide clear passage.
Building boundary	Defined limit of permitted construction under the development plan or the Roads Act.
Building line	Line along the front of a building.
Camber	Slope across the carriageway as it goes round a curve.
Carriageway	Area between edge lines
Carriageway edge	Boundary of the carriageway, i.e. the transition between the carriageway and the shoulder.
Central divider	Physically demarcated area separating lanes/carriageways carrying traffic in opposite directions.
Centre line	Line in the transverse profile that length measurements and heights are related to. On normal 2-lane streets, the centre line will be in the middle of the carriageway.
Centre line	Line on the carriageway separating traffic in opposite directions. When the centre line is a solid line, it is called a barrier line and must not be crossed.

TERM	DEFINITION
Channelling	Measures to guide traffic into particular lanes or in a particular way (physical or marked traffic islands).
Circulation area	Area around a roundabout intended for traffic. The circulation area is outside the central island and delimited by the outer diameter of the roundabout. Areas that can be driven over are not included in the circulation area.
Clear sight	Continuous visible length of road for drivers one metre from the centre-line of the road at eye-level (a1) above the carriageway (sight lines).
Climate factor	The climate factor is a mark-up for the expected relative change in precipitation intensity because of climate change.
Conflict point	Point where crossing or converging streams of traffic meet.
Crossfall	Gradient of the carriageway at right angles to the longitudinal axis.
Cycle lane	Lane in the carriageway shown by public traffic signs and markings to be reserved for cyclists.
Cycle path	Route shown by public traffic signs to be intended for cyclists and physically separated from the carriageway and pavement, e.g. by a grass verge, gutter, fence or kerb.
Dazzle	Reduced contrast-sensitivity in the eye.
Design driving mode	Describes the freedom a vehicle has when using the road network. See driving modes A, B and C.
Design vehicle	Representative vehicle with dimensions typical of the group it represents.
Development plan	Detailed land-use plan for a large or small area, drawn up under the Planning and Building Act.
Direction indicators	Direction indicators are artificial guidelines which give direction information and are laid with ridges in the direction of travel.
Driving mode A	Design vehicles must be able to pass along the street using only their own lane; they should be able to keep to the speed limit on a clear section of street; they must be able to drive through an intersection at 15 km/h; and they must not need to reverse at turning places.
Driving mode B	Design vehicles must be able to use parts of the opposing lane in the street they are turning into; they should expect to drive below the speed limit on parts of the street; they should expect to drive through an intersection at less than 15 km/h; and they may need to reverse at turning places.
Driving mode C	Design vehicles must be able to use the whole width of the carriageway in the street they are turning into; they should expect to drive below the speed limit on a clear section of street; and they may need to reverse at turning places.
Edge line	Solid or dotted line marking the outer edge of the carriageway.

TERM	DEFINITION
Eye level	Eye level above the roadway for a driver in a car. It is set at 1.1 metres.
Flood corridor	A deliberately laid out route for excess precipitation to run down.
Green mobility	Walking, cycling or public transport.
Green strip	A strip of green infrastructure or a green space between carriageways or other areas.
Heavy vehicle	Vehicle more than 5.6 metres long or with total weight over 3.5 tonnes.
High quality public transport stops	A stop which is universally designed to provide step-free access to the bus or tram across the entire public transport stop, and is provided with guidelines and route information. The stops should also be equipped with shelters, real-time information, lighting, and seating where possible.
High season	Busiest period of the year.
High season for pedestrians	The period of the year which normally has the greatest pedestrian traffic through the street, such as a weekend in the summer time. Major events or festivals such as 17 May are not considered here.
Horizontal clearance	Width available to a vehicle, e.g. between lateral obstructions.
Horizontal curvature	Geometric elements of the street alignment on the horizontal axis.
Horizontal curve	Curve on the horizontal projection of the street.
Horizontal curve radius	Radius of an arc in the horizontal projection of the street.
Infrastructure manager	Someone authorised to operate infrastructure; see Sections 1-3 of the requirements specification. In Oslo, this is handled by the Infrastructure division of Sporveien AS on behalf of the operators (trams and underground). The formal authorisation is held by the operators.
Intersection layout	Geometrical design of an intersection.
Kassel stone	Kassel stones are used for kerbs in bus bays. The shape of the Kassel stone allows the bus to come as close as possible to the kerb. This makes it easier for passengers to get on and off the buses, especially wheelchair users.
Kerb height	Height difference between two surfaces, e.g. carriageway and pavement.
Kerbside stop	Stop at a stopping place at the roadside for buses.
Kerbstone, barrier	Kerbstone not meant to be driven over. Barrier kerbstones are shaped with a vertical or near-vertical edge (3:1 to 5:1), and are high enough for drivers not to be tempted to drive over them intentionally. This will normally prevent a vehicle from crossing the kerb by accident.
Kerbstone, standard	Kerbstone shaped to reduce the risk of damage to the vehicle or other traffic on the street if it is driven over. Used to delimit areas that may need to be driven over occasionally, such as central islands at tight roundabouts and exits.

TERM	DEFINITION
Kerbstones	Stones laid to delimit traffic islands, pavements, central dividers etc. Usual materials are granite and concrete.
Lane	One of the longitudinal lanes that a carriageway is divided into with markings, or which is wide enough for a line of cars to pass.
Lane width	Width of a lane.
Local stormwater management (LOH/LOD)	Methods of handling and treating stormwater locally at the source are called local stormwater management (LOH) and local stormwater disposal (LOD).
Low break	Concave transition in the route alignment in the vertical plane (bottom of a hill). Distinguished by the fact that the vertical angle is below the road line.
Luminance	Brightness of a surface expressed as the ratio between the light intensity perpendicular to the surface (measured in candela) and the apparent size of the surface in m^2.
Mobility hub	Area where various forms of environmentally-friendly passenger transport are provided, e.g. bus, car-sharing, city bikes and electric scooters.
Mobility	Mobility describes the way in which people, goods, and services move around in an efficient and accessible system.
Motor vehicle	Vehicle with an engine designed to travel on the ground without rails. Mopeds and motorcycles also fall within this definition.
Municipal road	Public road or street administered by the municipality.
Natural guide line	Elements that form a natural part of the street and changes in the surface that can be felt by people with impaired vision and provide orientation.
Noise level	Amount of noise an area is exposed to. The noise level is measured in dBA.
Overhang	Distance between the outer front wheel tracks and the corner of the bodywork when driving round a curve.
Parking	Anywhere a vehicle stops, even if the driver does not leave it, except for short stops to get in or out or for loading and unloading.
Pavement	The part of the street reserved for pedestrians. Higher than the carriageway and separated from it with kerbstones.
Pedestrian clearway zone	The pedestrian clearway zone is the area with priority given to pedestrians, and is clearly delimited on both sides so it is easy for people with impaired vision to follow.
Pedestrian street	Street reserved for pedestrians covered by the rules in the highway code for pedestrian streets.
Permeable surface	Porous surface/covering for surface water to drain away.
Public transport lane	Lane marked on road signs as reserved for public transport (e.g. buses and taxis), and other vehicles listed in the Norwegian highway code.

TERM	DEFINITION
Public transport	Transport of passengers in large numbers, e.g. by train, bus or tram.
Railway undertaking	Operation of infrastructure, traffic management and/or transportation, or the party responsible for this. In Oslo, this is Sporveien Trikken AS. (Or Sporveien T-banen AS).
Rain garden	A planted depression in the ground where water is stored on the surface and infiltrated into the soil or drains.
Raised crossing	Pedestrian crossing which is raised up to be physically higher than the rest of the carriageway.
Recipient	Collective term for streams, rivers, lakes, seas, marshes or other bodies of water that receive emissions of pollutants.
Refuge	Traffic divider. The term is mainly used in connection with intersections in urban areas.
Resultant fall	Result of longitudinal fall and crossfall. Can be calculated as the hypotenuse of a right-angled triangle where the longitudinal fall and crossfall in the street form the other two sides.
Ridge fall	Crossfall on a straight section of street where the centre line is the apex and each lane slopes down to the shoulder. The gradient is usually 3%.
Risk analysis	Systematic use of all available information to identify hazards and estimate risk; see requirements specification, sections 1-3.
Risk assessment	The overall process including a risk analysis and a risk evaluation; see requirements specification, sections 1-3.
Risk evaluation	Process of comparing the described or calculated risk with given acceptance criteria; see requirements specification, sections 1-3.
Road-user	Anyone travelling along a street or in a vehicle on that street.
Road safety	Road safety is a term for the position that is achieved when road-users feel safe and the risk of injury and loss of life in the traffic is low.
Road widening on curves	Widening of the carriageway on curves to cater for the tracking characteristics of vehicles.
Roundabout	Type of level intersection where traffic on the crossing roads drives one way round a traffic island.
Safe distance	Horizontal distance from the carriageway edge to a place where hazardous obstructions may be allowed. The distance is determined by the AADT and the speed limit on the road.
Safety management	Systematic facilities taken by an organisation to achieve, maintain and enhance the safety level in accordance with the defined goals: see requirements specification, sections 1-3.

TERM	DEFINITION
Safety zone	An area outside the carriageway where there should be no hazardous lateral obstructions, dangerous slopes etc. Inside the safety zone, hazards must be either removed, replaced with a flexible type or protected with railings or buffers.
Shared-use area	A street where all groups of road users are integrated and catered for in the same space.
Sight triangle	Area at an intersection or exit providing for sufficient visibility, according to defined rules.
Signal-controlled intersection	Intersecting where the different streams of traffic are controlled by traffic lights.
Signal priority control	Signal system whereby the various approaches, traffic streams and groups of road-users can be given different priorities by the use of traffic lights.
Signal system	A control unit usually with multiple traffic signals regulating or warning traffic by means of manual or automated control.
Snow dump	Large area for a large volume of snow removed from the street. Requires an emissions permit from the county governor, and the snow must be cleaned of emissions (e.g. Åsland snow dump).
Snow pile	Area alongside or close to a ploughed area. Only snow from the same street may be ploughed or swept directly into the snow pile. The area cannot be used as a snow dump.
Speed level	Representative value for speed along a stretch of road, or on average for the road. The relevant level may be the 85% fractile (the speed that 85% of drivers do not exceed).
Speed limit	Maximum permitted speed on a given stretch of road.
Stop/stopping place	A collective term for all stopping places for passengers to get on and off public transport. This may be anything from a stop at the roadside to major transport hubs (terminals, shuttle stations, street terminals and major transfer points).
Stopping distance	Necessary distance to an object for a driver to be able to see the object, react, decide whether to brake, and bring the vehicle to a standstill.
Stormwater	Surface water run-off from precipitation or thawing.
Street edge	Intersection between outer edge of shoulder, pavement, cycle lane or cycle track and slope (ditch or fill slop), wall, building etc.
Street network	Collection of streets in a given area, with their various functions.
Street space	The area that defines the street. The street space is delimited by the fronts of buildings or other physical elements. The size of the street space and its relationship to building fronts and elements such as vegetation, water and trees has a major bearing on the feel of the street space.

TERM	DEFINITION
Street	Streets are often associated with cities and built-up areas. A street is often bordered by building frontages or rows of trees. Streets will typically have a more straight and rigid geometry than roads, with more intersections and pavements with kerbstones.
Street type	Breakdown of the street network into different types according to the function the various streets perform.
Street width	Distance between street edges
Sustainable mobility	Movement consistent with the principles of sustainable development (environmental, social, economic).
T-junction	Three-way intersection where the three streets form something like a T.
Tactile indicator	Standardised surfaces that can be recognised by visually impaired persons with their feet or stick. It should be possible to distinguish between different types of tactile indicator.
Three-step strategy	Method for handling stormwater: Step 1 – infiltration of small precipitation events. Step 2 – retention of larger events Step 3 – secure flood channels in the event of a cloudburst.
Through traffic	Part of the traffic flow that does not start or end in the defined plan area where the traffic flow is found.
Traffic divider	Physically demarcated area separating lanes/carriageways carrying traffic in opposite directions.
Traffic island	Area limited by lanes on all sides which must not normally be driven over. A traffic island may be marked on the road or it may a raised area demarcated with kerbstones.
Traffic load	Number of road-users or vehicles passing a defined point over a defined period.
Traffic stream	Traffic with similar movement pattern, e.g. same turning movement.
Traffic volume	Amount of traffic expressed as the number of vehicles (possibly car units).
Transition curve	The part of the horizontal curve between the straight line and the arc. This makes the transition gentler for the driver. A clothoid curve is normally used.
Transverse profile	Cross-section of a street at right angles to the centre line.
Turning place	Place reserved for vehicles to turn.
Uncontrolled intersection	Intersection where none of the approaches is signal-controlled or signed ‘give way’. The general principle of ‘give way to traffic from the right’ will apply.
Universal design	Design or organisation of the main solution in terms of physical aspects, including information and communications technology (ICT), so the normal function can be used by as many people as possible, regardless of disability.

TERM	DEFINITION
Urban quality	Factors contributing to city life, quality of life and recreation.
User group	Used to identify different types of road-user
Vehicle type	Defined vehicle used in designing road systems.
Vertical clearance	Minimum height between the carriageway and obstructions above. Signage must allow for a certain reserve to cover a safety margin and building tolerance.
Warning field	Several warning indicators placed together form a warning field. Warning fields are placed by pedestrian crossings (not on the downslope), at the top of stairs and at stopping places.
Warning indicators	Warning indicators are placed where people need to be aware of danger, and are formed of parallel and diagonal rows of humps.

9. Standard Sheets

ID	NAME
1-01	Pavement widths
1-02	Turning places
1-03	Turning place, reduced size
1-04	Turning head
2-01	Central island in roundabout
2-02	Laying/re-laying kerbstones
2-03	Dropped kerb at pedestrian crossing
2-04	Dropped kerb at entrance
2-05	Design of standard speed humps
2-06	Design of standard raised pedestrian crossing
2-07	Work description/materials for standard speed hump/raised pedestrian crossing
2-08	Kerb at a high-standard bus stop
2-09	Mini-humps for use on bus routes
2-10	Road narrowing
2-11	Parking with charging island alongside pavement
3-01	Natural stone kerbstones
3-02	Natural stone kerbstones
3-03	Natural stone kerbstones
3-04	Natural stone kerbstones
3-05	Natural stone slabs
3-06	Natural stone – paving
3-07	Natural stone – kerbstones
3-08	Natural stone
4-01	Infiltration sand trap where water drains directly into the soil (IFS)
4-02	Relocation of road and street gutters and sand traps
4-03	Auxiliary gutters
4-04	Sand traps
4-05	Grating
4-06	Manhole top
4-07	Retention tank, concrete pipe
4-08	Retention tank outside road bed

ID	NAME
4-09	Positioning of manhole cover
5-01	Pipe in trench
5-02	Canal
5-03	Rectangular manhole, TK1
5-04	Rectangular manhole, TK2
5-05	Round manhole Ø650/800/1000
5-06	Manhole with safety cross
5-07	Safety cross, centric, + cover
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5-09	Outline design of deep pull-through manhole
5-10	Detector pit 1
5-11	Detector pit 2
5-12	Tubes for lattice mast, portal, lamp post
5-13	Tubes for telescopic mast and mast for SIS sign
5-14	Foundations for switching cabinet
5-15	Detector laid in figure-of-eight in new tramway track bed
6-01	Bench
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6-06	Gutters
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