Údarás Náisiúnta Iompair
National Transport Authority

An Roinn Iompair
Department of Transport

Cycle Design Manual

September 2023

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The Cycle Design Manual has been prepared by the National Transport Authority (NTA) and overseen by the Department of Transport. This manual replaces the previous National Cycle Manual, published by the NTA in 2011, which is now withdrawn.

Version	Description	Publication Date
1.0	First publication of Cycle Design Manual replacing previous National Cycle Manual (2011)	September 2023

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Introduction

1.1 General

The National Cycle Manual, published by the National Transport Authority in 2011, has guided the design of cycle infrastructure in Ireland over the last decade and helped set the foundations for normalising cycling as a regular mode of transport in Ireland.

Design standards change over time to take account of emerging best practice and changing user needs. The changes required can be influenced by many factors including changes to the volume and diversity of people cycling and by the use of different types of cycles such as e-bikes, cargo bikes, tricycles etc.

Increasing the number of people cycling as a regular mode of transport is embedded in national policy including in our National Planning Framework, National Sustainable Mobility Policy and the Climate Action Plan. Providing safe, connected, high-quality cycle facilities are key to achieving this aim. In particular, research has shown that safety, including road safety and personal safety, is the single largest barrier to cycling for many people.

This new Cycle Design Manual supercedes the National Cycle Manual. The new manual draws on the experience of delivering cycling infrastructure across Ireland over the last decade, as well as learning from international best practice, and has been guided by the need to deliver safe cycle facilities for people of all ages and abilities.

Typical layout drawings are provided in the appendix to assist designers. The layouts are numbered TL 101, TL 102 etc. and have been cross referenced and hyperlinked throughout the manual in the relevant sections.

It is noted that some newer features will require amendments to legislation which is underway. Designers should check with the NTA prior to installing any of the new features as it is expected to take 18 to 24 months from release date to have all legislative changes in place.

1.2 Use of Guidance

This manual provides guidance on the design of both on-road and off-road cycle facilities for both urban and rural locations. The manual should be used for the design of all new or improved cycle facilities in Ireland unless otherwise agreed with the relevant oversight body (e.g. NTA, TII, DoT, Local Authority). Please note that Transport Infrastructure Ireland (TII) may apply alternative requirements for the design of cycle facilities on the National Roads Network or works funded by TII.

This guide outlines the context of designing cycle facilities in Ireland and the increased emphasis on segregation of facilities from motor traffic, provides information on what designers need to be aware of in regard to every aspect of cycle infrastructure design and is followed, in the Appendix, by Typical Layouts (TL) for most types of cycling infrastructure.

1.3 Relationship with Other Design Standards and Guidelines

Cycle facilities are frequently implemented within new or existing road and street corridors that typically need to cater for a variety of transport modes and other uses. As such, the design of cycle facilities on multi-modal corridors will need to comply with a number of other relevant standards and guidance documents.

In this regard, designers should refer to the Department of Transport National (Infrastructure) Guidelines and Standards Group circular “NGS Circular 2 of 2022” for a comprehensive list of the approved standards and guidelines for works on public roads in Ireland.

It is particularly important to note that the design of cycle facilities on urban roads and streets (i.e. those , with speed limits up to 60 km/h) will need to comply with the requirements of the Design Manual for Urban Roads and Streets (DMURS), the overarching design manual for urban road and street design in Ireland.

Designers should also be aware of the requirements to conduct Quality Audits and Road Safety Audits during the various stages of a project lifecycle. The exact requirements for which are set out in the Department of Transport circular "NGS Circular 3 of 2022".

Tactile paving shall be provided as part of all Active Travel corridors to facilitate people who are blind or vision impaired. The layout of the tactile paving should be in accordance with the UK Department of Transport Guidance on the Use of Tactile Paving Surfaces.

1.4 Relaxations and Departures

Designers should always aim to design cycle facilities in accordance with the guidance in this manual. In some situations the manual provides a degree of flexibility for designs by stating desirable minimum and absolute minimum values. Designers should aim to achieve at least desirable minimum values in all cases.

Where desirable minimum values cannot be achieved, incremental reductions towards absolute minimum values should be considered. For example, the manual states that the desirable minimum width for a one-way cycle track with peak flows less than 300 cycles per hour is 2 metres, with an absolute minimum width of 1.5 metres. If the 2m desirable minimum width cannot be achieved on part of a given cycle scheme, then designers should look to provide the widest facility possible between 1.5m and 2m rather than simply reducing the width to 1.5m.

Where a proposed scheme or part thereof does not meet the requirements of this manual, a departure or derogation from standard should be sought and approved in accordance with the requirements stated in the Department of Transport circular "NGS Circular 2 of 2022" mentioned above, prior to the relevant design element being incorporated into the works.

1.5 Updates and Revisions

The Cycle Design Manual and any associated guidance documents will be available for download from the NTA website. It is intended that manual will be a live document which will be updated and expanded as required to reflect emerging best practice and feedback from user experience of the manual.

For this reason, the latest version of the guidance should always be accessed through the NTA website.

Feedback from practitioners is welcome, and should be sent to cyclemanual@nationaltransport.ie.

1.6 Policy Context

The delivery of safe cycling infrastructure to encourage more people to cycle as a regular mode of transport is strongly supported by a number of national policies and plans. Promoters and designers of cycle facilities should be aware of the contents of all relevant documents. The following is a non-exhaustive list of some of the key national policies and plans to be considered.

- National Investment Framework for Transport in Ireland (NIFTI);
- National Sustainable Mobility Policy;
- Climate Action Plan 2023;
- National Planning Framework – Project Ireland 2040;
- National Development Plan 2021-2030 Road Safety Strategy 2021-2030;
- National Physical Activity Plan;
- CycleConnects: Ireland's Cycle Network (under development by NTA); and
- National Cycle Network (under development by TII).

At a regional and local level, the delivery of safe cycle infrastructure and increasing the mode share of cycling for transport purposes is likewise supported by many regional and local policies and plans which designers and promoters should be aware of. These documents are location specific so it is not possible to list exact titles, however the following is a non-exhaustive list of the types of documents that should be consider.

- Regional Spatial and Economic Strategies (RSESs);
- Metropolitan Area Transport Strategies e.g. Greater Dublin Area (GDA) Transport Strategy 2022-2042, Limerick Shannon Metropolitan Area Transport Strategy (LSMATS) etc.;
- County Development Plans;
- County Cycle Network Plans;
- Local Area Plans and Strategic Development Zones; and
- Local Transport Plans (developed using the Area Based Transport Assessment approach).

2

Main Requirements & Design Principles

2.1 Five Main Requirements for Cycle-friendly Infrastructure

For cycle infrastructure to cater for the needs of people who currently cycle and to also attract new cycle users to the network, there are five main requirements which designs should fulfil under the headings of:

i. Safety
ii. Coherence
iii. Directness
iv. Comfort
v. Attractiveness

i. Safety

There are two aspects to this requirement; actual safety and perceived safety.

Actual Safety

Cycle facilities should be designed so that they are safe for people of all ages and abilities to use. To ensure facilities are safe, there are a number of factors that need to be considered.

An appropriate type of facility should be chosen in accordance with Table 2.1. For on-line cycle facilities (i.e. facilities within road boundaries), the type of provision will primarily depend upon vehicular traffic speeds and volumes. On roads and streets with very low traffic speeds and volumes, it will generally be safe to cycle on the carriageway therefore no specific cycle infrastructure may be required, although traffic calming may be necessary to ensure low vehicular speeds. Such streets might include residential or access streets. As traffic speeds and volumes increase, cycle facilities will generally need to be segregated from vehicular traffic to provide safe facilities for all users.

Getting the design and construction details right is also important to ensure facilities are safe to use. Some key considerations in this regard include the removal of potential hazards, providing high-quality smooth surfacing, ensuring smooth horizontal and vertical transitions and providing appropriate gradients.

From a safe approach perspective (See Section 2.2), designs should also be forgiving so that if/when mistakes or accidents occur, outcomes are as benign as possible. For example, the use of bevelled kerbs adjacent to cycle tracks can assist with evasive manoeuvres and the use of horizontal buffers can provide additional recovery space between cycle facilities and carriageways should accidents occur.

Perceived Safety

As well as being actually safe to use, facilities should be perceived to be safe i.e. people must feel safe using them. Perceptions of personal safety can vary from one individual to another, so facilities should generally be designed so that less confident users would feel safe using them. To assess the perception of safety, it could be useful for designers to consider the following:

» Is there sufficient passive surveillance?
» Is there sufficient lighting?
» Can cyclists travel freely without unnecessary interruptions/ stoppages?
» Are there enough access/egress points?
» Are there any known issues of anti-social behavior/crime in the area that should be considered?

ii. Coherence

At a network level, cycle routes should be connected and easy to navigate. Cycle routes should not have gaps or be interrupted at difficult locations. Any weak links in the network will reduce the overall level of service, could deter new or less confident users to cycle and render a whole journey inaccessible for some people.

Clear signing and wayfinding can be particularly important where cycle routes use minor roads and off-line facilities that are not signed for other traffic. See example in Figure 2.1. Wayfinding can be very useful for new users and visitors to navigate their way around the cycle network. Refer to Section 5 for further guidance on signing and wayfinding.

Figure 2.1 Example of wayfinding on the Dun Laoghaire Rathdown County Council Active School Travel Scheme.

Coherence is also important at an individual scheme level, particularly where a number of different link types are connected. For example where the cycle provision changes from quiet street to a cycle track (Figure 2.2) the transition must be logical and intuitive.

Figure 2.2: Example of a seemless transition from a quiet street to a cycle track, Eden Park, Dublin.

Similarly, at large or complex junctions the route for cyclists through the junction should be clearly defined and easily understood by all users. The use of red surfacing and road markings (see Figure 2.3) will be key design tools in this regard.

Figure 2.3 Example of red surfacing and road markings used to delineate the cycle route through a large junction.

iii. Directness

Directness is measured in both distance and time. Ideally cycle routes should connect origins and destinations using the shortest route with as little delay as possible. This includes providing facilities at junctions that minimise delay and the need to stop. Minimising the effort required to cycle, by enabling cyclists to maintain momentum, is an important aspect of directness. An indirect designated route involving extra distance or more stopping and starting will result in some cyclists choosing the most direct, faster option, even if it is less safe. However, it is sometimes advantageous to avoid steep gradients or major junctions by using an alternative route that is slightly longer but more convenient and easier to use.

To make cycling an attractive alternative to driving short distances, cycle routes should be at least as direct – and preferably more direct – than those available for private motor vehicles. Permitting cyclists to make movements prohibited to motor traffic, allowing contraflow cycling on one-way streets, and creating links between cul-de-sacs to enable cyclists to take the shortest route, should be the default approach in traffic management schemes and new road networks. Area-wide schemes and new developments can enable filtered permeability, allowing cyclists and pedestrians to take more direct routes than motorised traffic. See example in Figure 2.4.

Figure 2.4: Example of filtered permeability scheme in Bishopstown, Cork where access for motor traffic is restricted but pedestrians and cyclists have a direct route.

iv. Comfort

Cycle facilities should be designed and maintained so that they are comfortable to use. Anything that causes unnecessary discomfort or delay is likely to reduce the comfortableness and therefore the attractiveness of the facility. There are a number of factors that influence the comfortableness of a facility including:

- **Width** – ensure the width is sufficient for the number and type of users;
- **Gradients** – ensure gradients are not excessive;
- **Stoppages and Delays** – minimise the number of obstructions or detours that impact on the cycling momentum;
- **Surfacing** – ensure surface is smooth and well drained;
- **Shelter** – minimise exposure to inclement weather; and
- **Maintenance** – ensure facility is regularly cleaned and maintained in good condition.

v. Attractiveness

Cycling is a sensory experience as people are directly exposed to the environment they are moving through therefore the cycling environment along a route should ideally be as pleasant and interesting as possible.

Cycle routes through high-quality urban environments, parks and waterfront locations are typically some of the most attractive cycling environments.

The use of horizontal buffers between cycle facilities and carriageways (Figure 2.5) can also significantly improve the attractiveness of a route. Setting back cycle facilities behind a buffer can reduce the negative impacts of noise and air pollution from vehicles on people cycling. Additionally, buffers can also provide opportunities for planting and/or sustainable drainage systems (SuDS) which can further enhance a route's attractiveness.

Figure 2.5: Example of green buffer between a cycle track and carriageway.

Cycle infrastructure should help to deliver public spaces that are well designed and finished in attractive materials and be places that people want to spend time using. The surfaces, landscaping and street furniture should be well maintained and in keeping with the surrounding area. Planting in parks and rural areas should consider the aesthetic and sensory qualities that create attractive vistas and fragrances as well as practical considerations about maintenance.

Regular maintenance is very important to maintain the attractiveness of cycle facilities. Cycle links should be cleaned regularly to maintain a ride surface that is free of litter, debris, broken glass, fallen leaves etc. The maintenance of other facilities such as cycle parking or light segregation devices is also important to ensure they remain fit for purpose, clean, visible etc.

2.2 Key Design Principles

The principles below should be adhered to when designing cycle facilities.

1. Safe system approach

The safe system approach, which is a key component of Ireland's Road Safety Strategy 2021-2030, should be adopted in the design of cycle infrastructure. The Safe System approach recognises that human bodies are fragile and that human error cannot be eliminated. The approach aims to reduce the likelihood of a collision occurring and, if one does occur, to ensure that those involved will not be killed or seriously injured. A key consideration of the safe system approach for cycle infrastructure will be to ensure designs are as forgiving as possible.

2. Promoters of cycle facilities should cycle

Designing cycling infrastructure is quite different to designing infrastructure for motorists or pedestrians. Cyclists have a particular set of requirements as outlined above, which are similar to those for pedestrians in some respects, but differ in a number of key ways:

» ***Cyclists travel at greater speeds than pedestrians.***

» ***Cycling requires more physical effort than walking*** – particularly on steep gradients and taking off from a stationary position.

» ***Cyclists often have to share the road with motor traffic*** – the only way to appreciate what it feels like to cycle on road with motor traffic is to experience it first-hand. It is worth remembering that mixed traffic environments can provide a suitable provision for cycling but only when vehicular traffic speeds and volumes are at an appropriate level (see Table 2.1)

To have a greater understanding and appreciation of the main needs of cyclists, it is strongly recommended that everyone involved in the promotion and delivery of cycle infrastructure should have recent experience of utility cycling, i.e. cycling for transport purposes, on various types of infrastructure in Ireland. This includes engineers, technicians, planners, senior management in Local Authorities and elected representatives.

Designers of cycle facilities should also cycle each route they are designing to experience the cycling environment first-hand and gain an appreciation for how the route fits in to the overall cycle network.

It is also recommended that designers gain first-hand experience of the new types of cycle infrastructure promoted in this manual e.g. protected junctions, as the infrastructure is rolled out across the country. As many of the new design elements in the manual stem from international best practice, particularly from The Netherlands, Denmark and the UK, designers are also encouraged where possible to gain user experience of such facilities abroad.

3. Network approach

Focus on the delivery of coherent and connected cycle networks i.e. a series of interconnected routes joining all main origins and destinations without gaps or interruptions in provision.

4. Segregation

Pedestrian and cycle facilities on roads and streets, other than quiet streets (i.e. those with low vehicular speeds and volumes), should be segregated from traffic and from each other. There is a growing body of evidence which shows that the provision of segregated, safe cycle infrastructure is crucial to attract people to switch to cycling as a regular mode of transport.

5. Everyday mobility

Focus on delivering cycle infrastructure that caters for everyday cycle trips to schools, shops, services etc. as well as commuting trips. Some rural cycle facilities e.g. greenways, may be more focused on recreational cycling, however such facilities can also provide important transport corridors so it is important that this is factored into such scheme designs.

6. Universal Design and Inclusive Mobility

Cycle facilities should be designed to be useable by people of all ages and abilities using a variety of different types of cycles and wheeling equipment. It is worth noting that there has been a noticeable increase in recent years in the use of non-standard cycle equipment such as cargo bikes, tricycles, electric bicycles etc. and it is anticipated that their popularity will continue to increase as our cycle networks become more developed.

The use of motorised wheelchairs and mobility scooters is also permitted on cycle tracks and it would be similarly anticipated that as our cycle networks are developed further, more people using wheelchairs and mobility devices will be encouraged and enabled to use the networks as is commonly seen in other countries with more mature cycle networks (see Figure 2.6).

It is also worth noting that legislation to allow the use of Powered Personal Transporters e.g. E-Scooters, on Irish Roads including cycle facilities, was enacted in June 2023. It is anticipated that further guidance in relation to the accommodation of these devices on cycle infrastructure will be issued in due course.

Figure 2.6: Person using a mobility scooter on cycle track in the Netherlands.

2.3 Types of Cycle Vehicles

Nowadays there are a wide variety of vehicles used for cycling. Figure 2.8 shows the typical types and dimensions of cycles vehicles in use which include a range of non-standard cycles including cycles with trailers for children or deliveries, cargo bikes (Figure 2.7), tricycles, tandems, and a range of inclusive cycles designed for people with mobility impairements including hand cycles.

2.3.1 Universal Design Vehicle

To ensure cycle facilities are accessible to all users, it follows that cycle facilities must be designed to cater for all the different types of cycle vehicles in use.

As these vehicles come in different shapes and sizes, the concept of a “Universal Design Cycle” should be used for design purposes. The universal design vehicle represents a composite of all the cycles that may reasonably use the cycle network.

The dimensions of the Universal Design Cycle are 2.8m long and 1.2m wide. Designing the cycle network based on these vehicle dimensions will ensure that facilities are accessible to all.

Figure 2.7: Front Loading Cargo Bike.

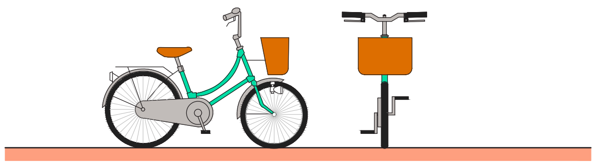
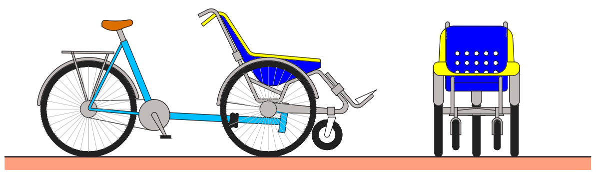
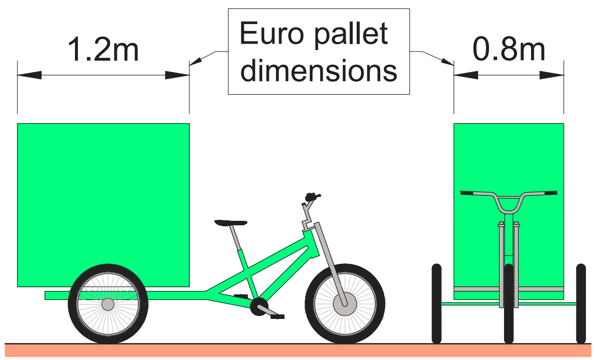
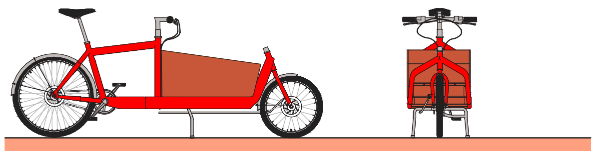
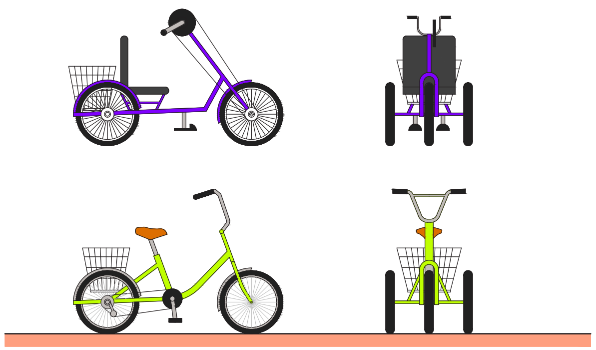
Standard Bicyle	Wheelchair Bicycle	Child Trailer Bicycle
		
• 1.8m length • 0.65m width • 1.65m turning circle	• 2.65m length • 0.66m width • Additional turning circle requirements up to 3.2m	• Additional turning circle requirements up to 3.2m • Trailer attached (up to 1.3m long)
Cargo Bicycle	**Front Loading Cargo Bicycle**	**Tricycle / Handcycle**
		
• Trailer can be attached (extra 1.6m long)	• 2.0m - 2.5m • Up to 0.85m wide • Additional turning circle requirements up to 2.65m	• Additional turning circle requirements up to 2.65m • Lower eye height for visibility • Lower clearance to kerbs and other objects

Figure 2.8: Typical types and dimensions of cycle vehicles.

2.4 Types of Cycle Links

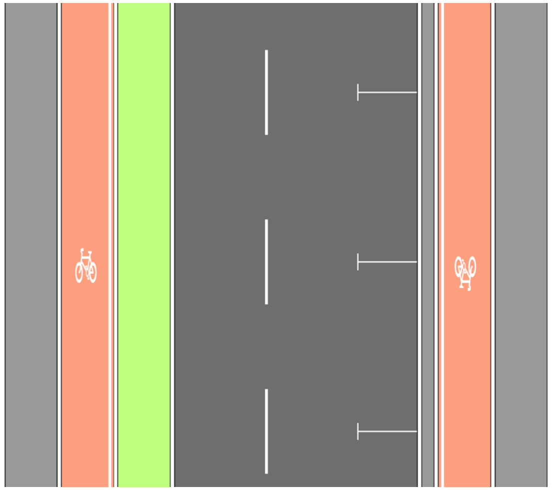
This section provides a high-level overview of various types of cycle links that may be used. Further details on each type of facility are provided in Section 4.2.

Standard Cycle Track

Segregated cycle facilities that are separated from vehicular traffic by a full height kerb. A buffer may be located between the carriageway and cycle track.

Suitable for most roads in urban areas with speeds limits of up to 60 km/h.

Can be either one-way or two-way cycle facilities.

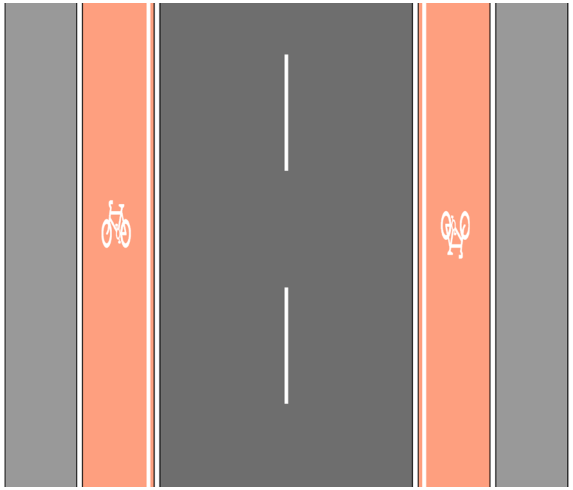


Stepped Cycle Track

Segregated cycle facilities that are raised by 60-75mm above the carriageway surface and typically 60mm below the adjacent footpath. Generally no buffer between cycle track and carriageway

Suitable for roads with speed limits up to 50 km/h.

Only suitable as one-way cycle facilities. Two-way stepped cycle tracks should not be used.

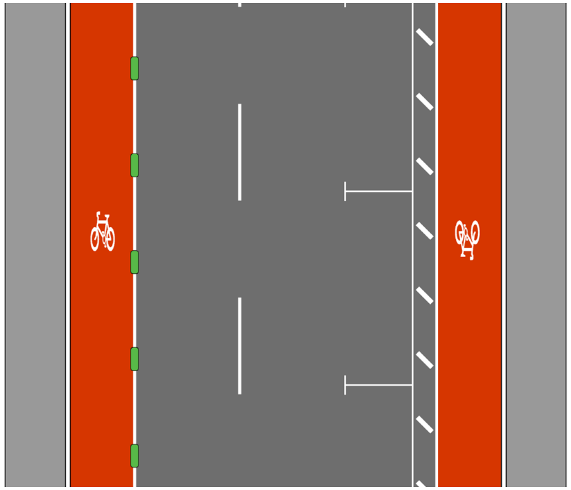


Protected Cycle Lane

At-grade (carriageway level) cycle facilities that are physically separated from vehicular traffic. Separation is typically achieved via light segregation devices e.g. bollards, planters or modular units, or achieved by locating cycle lanes behind parking bays.

Effective for protecting existing cycle lanes and for quickly reallocating road space.

Suitable on urban roads with speed limits up to 50km/h (depending on traffic volumes). Can be either one-way or two-way cycle facilities.

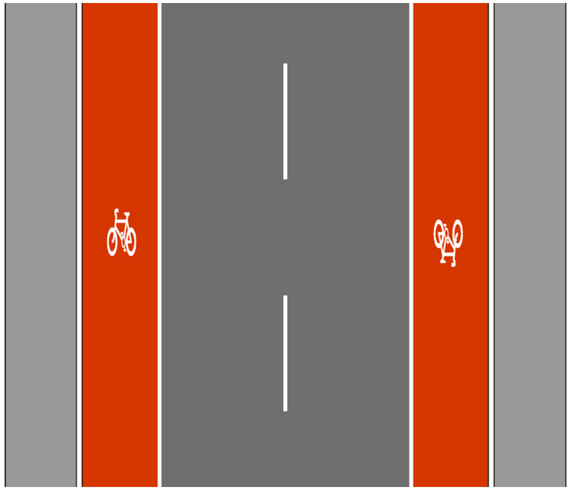


Mandatory Cycle Lane

Mandatory Cycle lanes are marked on carriageways by a continuous white line and not physically separated from motor traffic. Motor traffic is legally prohibited from entering mandatory cycle lanes, except for access purposes.

Only suitable on roads with low motor traffic volumes and speeds.

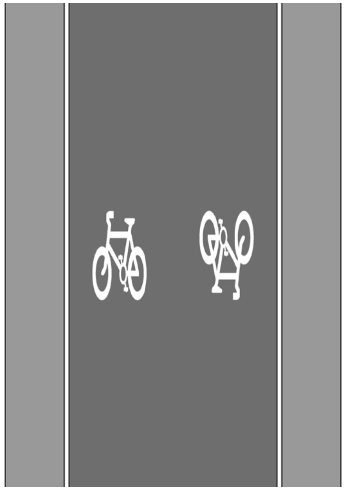
Only suitable as one-way cycle facilities. Also suitable to provide contra-flow cycle lanes on one-way streets.



Mixed Traffic

Cyclists share the carriageway with vehicular traffic. Only suitable for roads with low traffic speeds and volumes such as quiet residential or access streets. Traffic management or calming measures are likely required to ensure low traffic speeds and/or volumes.

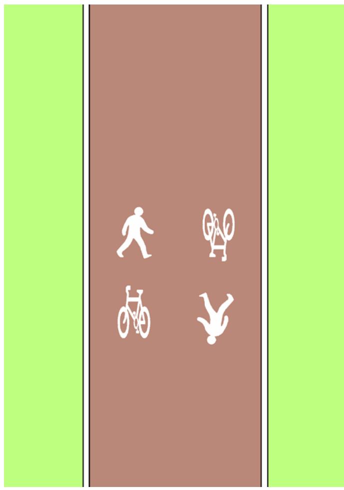
Cycle streets can be considered on residential access streets where the volume of cyclists is typically greater than the volume of motorists.



Shared Active Travel Facility / Greenway

Two way cycle route, typically shared with pedestrians, but segregation is also possible. Typically located off-line (away from vehicular carriageway) or sometimes adjacent to a rural roads.

Greenways, particularly those in rural locations, may be primarily intended for recreational use, however they can generally still perform an important transport function.



2.5 Choosing Appropriate Facilities

Table 2.1 shall be used to guide designers in the selection of suitable cycle facilities based on the traffic regime and intended cycle users. The table is colour-coded as shown below to indicate the suitability of each provision for users based on traffic regimes.

(green)	Provision should be suitable for most users.
(amber)	Provision may not be suitable for all users and may exclude some potential users.
(pink)	Provision not suitable for a range of users.
(dark grey)	Provision not suitable.

In addition to motor traffic speeds and volumes, designers should also consider the following when selecting the most appropriate type of cycle facility:

- What is the classification of the cycle route and will the facility provide the quality expected for the route type?
- Does the composition of motor traffic (e.g. high volumes of HGV's) increase the risk to cyclists even where motor traffic speed and volume conditions are met?
- Does the presence of kerbside activity such as loading, parking and bus stops increase the risk to cyclists?
- Are there any other site specific issues that could increase the risk to cyclists and warrant greater protection from motor traffic?

This manual advocates for cycle facilities that are inclusive and suitable for users of differing ages and abilities therefore the default position should be that facilities that are suitable for most users (green category) should be provided.

The provision of facilities that may not be, or are not, suitable for a range of users, i.e. amber or pink categories, shall be a departure from standard and should only be implemented with the written approval of the relevant approving authority.

The dark grey category is used to indicate where facilities are not suitable based on the traffic regime and shall not be used.

How to use Table 2.1

Table 2.1 can be used in two ways as follows:

i. **Determine the existing or intended vehicular traffic speeds and flows and select a suitable cycle provision.**

   For example, if the existing speed limit is 50 km/h and traffic volumes are >600 pcu/peak hour and these are likely to remain the same, a stepped cycle track or a standard cycle track would be considered suitable provision.

ii. **Choose the type of cycle facility that is desirable and adapt the vehicular traffic speeds and volumes to suit.**

   For example, if a mixed traffic street is desirable but current traffic speeds are too high (e.g. 50 km/h) for this to be a suitable provision for most users, for a mixed street to be suitable, the scheme must be designed so that traffic speeds and volumes are reduced to a level that complies with the relevant thresholds in the table.

Table 2.1 - Cycle facilities selection guide

Speed Limit[1]	Two-way traffic flow (peak hour pcus)	Remote Cycleway/ Greenway	Standard cycle track (incl. two-way tracks)	Stepped cycle track	Protected Cycle Lane	Mandatory Cycle Lane	Mixed Traffic
20 km/h	< 200						
	200-400						
	> 400						
30 km/h	< 200						
	200-400						
	> 400						
40 km/h	< 200						
	200-400						
	> 400						
50 km/h	< 200						
	200-400						
	> 400						
60 km/h	Any						
≥ 80 km/h	Any						

Provision should be suitable for most users.

Provision may not be suitable for all and may exclude some potential users (Departure required).

Provision not recommended as it’s unlikely to be suitable for a range of users (Departure required).

Provision not suitable.

Notes:
1. If the 85th percentile motor traffic speed is more than 10% above the speed limit, the next highest speed limit should be applied.

2.6 Width Calculator

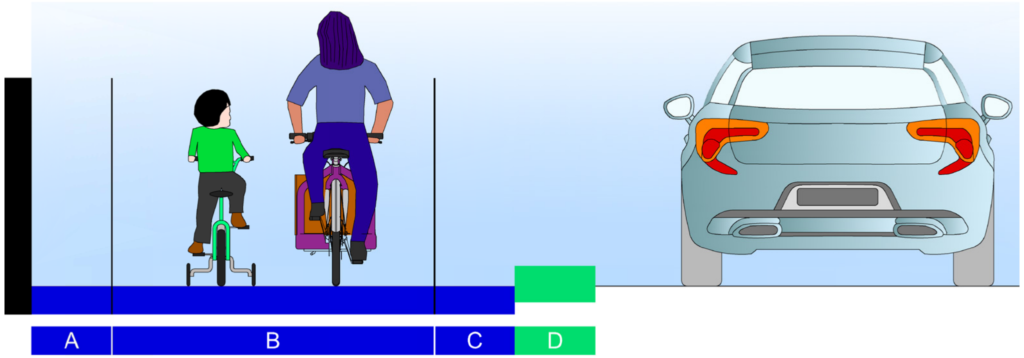
The width of cycle facilities should be calculated in accordance with Table 2.2. The width required is made up of the four basic elements (A, B, C, D) shown below. Additional width may also be required to cater for steeper gradients and drainage systems (refer to width calculator notes).

A = Inside Clearance; the space to the left of cyclists which is determined by the inside edge/boundary of the cycle facility.

B = Central Width; the space required for cycling which depends on the type of facility, direction of flow and anticipated volume of cyclists.

C = Outside Clearance; the space required to the right of cyclists which is determined by outside edge/boundary of the cycle facility.

D = Buffer; the horizontal separation required between the cycle facility and traffic, which is determined by the speed limit of the road.



Calculating the width of a cycle facility

The required width of a cycle facility is calculated using the following equation: **Total width = A + B + C**. When calculating widths, the following should be taken into account:

- Desirable minimum widths from the table should be used. Where desirable values cannot be achieved, incremental reductions towards absolute minimum values should be considered.
- The use of widths below absolute minimum values is not recommended. However, in exceptionally constrained circumstances, where continuity of the cycle network is paramount, the use of non-standard widths may be acceptable subject to a departure being approved by the relevant Approving Authority.
- The absolute minimum width of a cycle track at pinch points, preferably over short lengths only, is 1.25m.
- Where a cycle track has an outside kerb flush with the cycling surface, the kerb is considered to be included within the width of the cycle facility.
- Longitudinal road markings that form part of cycle facilities are considered to be included within the width of cycle facilities.
- The maximum width of a cycle lane should be 2.5m, to avoid confusion with a traffic lane.

Determining Cycle Flows

To determine the value for 'B' it will be necessary to estimate future cycle flows along the route under consideration. To estimate future flows it is recommended that a 'Decide and Provide' approach (see Section 3.1.3) is adopted. In this approach it should be decided, on a policy basis, what the most desirable future might be and then the infrastructure to try deliver that scenario should be provided. In some cases, the desirable future scenario (e.g. future cycling mode share targets) may already be identified in a Local Transport Plan or Development Plan and these can be used to develop future cycle flows.

Where future cycling mode share targets are not readily available, the NTA Cycle Propensity Scenarios (available **here**), which provide a set of possible future cycling scenarios for the entire country, can be used to determine cycling mode share targets to develop future flows.

It should be noted that the use of existing cycle flows to determine the value for 'B' is not recommended. The measurement of existing flows can be helpful to gain an understanding of current volumes, however, in most cases these numbers are unlikely to reflect the full potential for cycling due to inadequacies of the existing route and/or surrounding network. Similarly, the use of local transport models to estimate future cycle flows is not generally recommended as some factors that encourage cycling are not typically captured in standard transport models so future cycle flows may be underestimated.

Determining Buffer Width

The required buffer width (D) is also determined from the Table 2.2 and is based on the speed of adjacent traffic. Wide buffers can help to improve the cycling experience, e.g. by reducing cyclists exposure to air and noise pollution from traffic, so values wider than the desirable minimum below are to be encouraged wherever possible. Buffers may also provide ideal locations for introducing landscaping or nature based drainage solutions (note - verges less than 0.5m may not be suitable for landscaping as they may be difficult to maintain so a hard/paved verge may be necessary). Where desirable values cannot be achieved, incremental reductions towards absolute minimum values should be considered. Where buffer widths cannot comply with this guidance, a departure must be approved by the relevant Approving Authority.

It should be noted that a buffer is always required adjacent to a two-way cycle facility to provide separation between cyclists and on-coming motor traffic and prevent cyclists from veering out onto the carriageway. Refer to section 4.2.6 for further details.

Table 2.2 - Width Calculator

A. Inside Clearance	
Feature	**Additional width required (m)**
Flush or near-flush surface including low and splayed kerbs up to 60mm high	0.00
Kerbs 61mm to 150mm high	0.20
Vertical feature from 151mm to 600mm high	0.25
Vertical feature above 600mm high	0.50

B. Central Width			
Type of Facility	**Flow (cycles per peak hour)**	**Desirable minimum width (m)**	**Absolute minimum width (m)**
One-way cycle track	<300	2.00	1.50*
	>300	2.50	2.00
Two-way cycle track	<300	3.00	2.00
	>300	4.00	3.00
Cycle lane	All	2.00	1.50
Shared Active Travel Facility	<300	4.00	3.00
	>300	5.00	4.00

*May not cater for comfortable overtaking or cycling two abreast

C. Outside Clearance	
Feature	**Additional width required (m)**
Flush or near-flush surface including low and splayed kerbs up to 60mm high	0.00
Kerbs 61mm to 150mm high	0.20
Vertical feature from 151mm to 600mm high	0.25
Vertical feature above 600mm high	0.50

D. Buffer Width	One-way cycle track		Two-way cycle track	
Speed limit (kph)	**Desirable min buffer (m)**	**Absolute min buffer (m)**	**Desirable min buffer (m)**	**Absolute min buffer (m)**
≤30	0.00	0.00	0.50	0.30
40/50	0.50	0.00	0.50	0.30
60	1.00	0.50	1.00	0.50
80	2.00**	1.50**	2.00**	1.50**
100	3.50***	1.50***	3.50***	1.50***

Including any hard strip * Excluding any hard shoulder

Notes:

i. Desirable minimum widths should be used when calculating required widths of facilities. Where desirable values cannot be achieved, incremental reductions towards absolute minimum values may be considered.

ii. The use of widths less than the above guidance should be avoided. In exceptional circumstances where widths cannot comply with the guidance, the designer should seek a departure from standard and this should be approved by the relevant Sanctioning Authority prior to incorporation into the design.

iii. On gradients greater than 3%, cycle track width should be increased by 0.25 m to allow for greater lateral movement.

iv. Where gullies are present on a cycle track that do not allow cycles to easily overrun, the cycle track width should be increased by the widths of the gully.

3

Planning for Cycling

3.1 Cycle Network Planning

3.1.1 Introduction

Developing cycle network plans is an important initial step to delivering connected and coherent cycle infrastructure. As with developing networks for other transport modes e.g. road or rail networks, a cycle network should identify the key routes that are required to enable people to make their everyday journeys to work, schools, shops etc. by cycling and should not contain gaps.

Cycle network plans are important as they provide a basis for prioritising cycle investment programmes. They are also important for the purposes of guiding development outside of cycling investment programmes e.g. ensuring cycle provision is integrated within other public investment programmes and private developments as necessary.

A number of Cycle Network Plans have been developed in recent years and more are currently being developed. The NTA developed the Greater Dublin Area (GDA) Cycle Network Plan, originally published in 2013 and updated in 2023, in conjunction with the GDA Local Authorities. This plan outlines the cycle network for counties Dublin, Meath, Kildare and Wicklow. Cycle network plans have also been developed for a number of regional cities including Cork, Galway, Limerick and Waterford.

In 2022, the NTA published a draft National Cycle Network Plan, CycleConnects: Irelands Cycle Network, comprised of 22 networks for the 22 counties outside of the GDA (see extract in Figure 3.1). These regional networks, which were developed in collaboration with the respective local authorities, are a combination of urban networks for larger towns and interurban routes connecting settlements and key destinations at a county and intercountry level. It is anticipated that the final CycleConnects Network will be published during 2023.

Separately, Transport Infrastructure Ireland (TII) are currently developing a National Cycle Network to act as the national network of routes connecting towns, cities and destinations across Ireland. This network will complement the 22 network plans in CycleConnects and is anticipated that the final plan will be published during 2023 also.

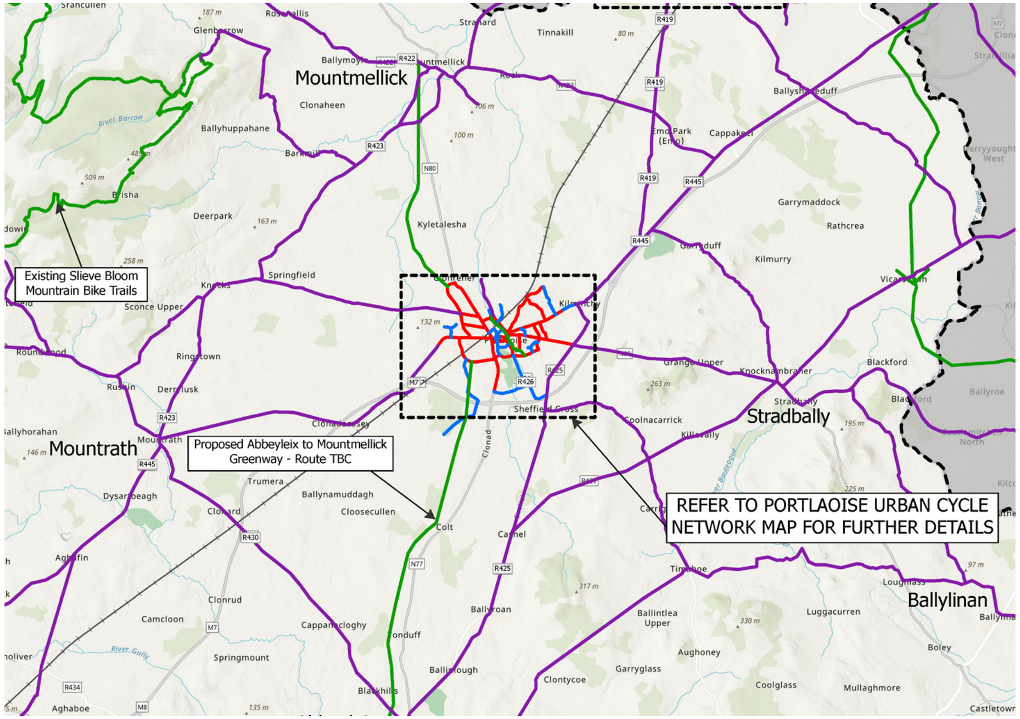


Figure 3.1: Extract of Draft Laois Cycle Network from CycleConnects.

3.1.2 Hierarchy of routes

In order to make cycling an attractive and feasible mode of transport for as many people as possible, at a basic level the aim should be to make as many roads, streets and paths as possible suitable for cycling.

However, it is useful for cycle network plans to classify individual cycle routes depending on their strategic importance within the network, similar to how our roads are classified. In Ireland the following classifications for cycle routes are typically used:

» **Primary routes**: Main cycle arteries connecting main origins and destinations. Typically the highest quality routes that carry the highest volume of cyclists;

» **Secondary routes**: Cycle links providing connections between primary cycle route and connecting local zones to primary routes;

» **Feeder routes**: Cycle routes within local zones, and/or connections from zones to the network levels above;

» **Greenways**: Off-line routes typically through green spaces or adjacent to watercourses. Typically developed for leisure purposes however they can also provide key transport links, particularly in urban areas;

» **Interurban routes**: Rural routes connecting settlements to each other and to other key destinations such as schools and services; and

» **Basic network**: All other roads and streets that are suitable for cycling. These are not generally identified on cycle network plans because of the volume of them, however they play a crucial role in enabling local cycling trips and connecting local areas to the cycle network.

3.1.3 Developing the network

As mentioned above, a significant number of cycle networks plans have been, or are currently being, developed in Ireland at the time of publication of this manual, including cycle network plans for all towns with a population of 5,000 or more under the NTA's CycleConnects Plan. Once these network plans are completed, it is not envisaged that many other cycle network plans will be required in the short-medium term in Ireland. However, should the need arise to develop a cycle network plan e.g. for a large development scheme, it is recommended that the following approach is taken.

1. **Decide and provide**
   Traditionally, transport planning in Ireland, including cycle network planning, was based on analysing historic trends and using those to forecast what is likely to happen in the future – a business as usual or "predict and provide" methodology.

   A more recently developed approach sets out an alternative process of deciding, on a policy basis, what the most desirable future might be, and then providing the infrastructure and services to deliver that scenario i.e. "Decide and Provide". It is recommended that this approach should be applied to the development of any future cycle networks.

2. **Network density**
   A cycle network should be sufficiently dense so that all potential origins and destinations are within a reasonable distance of cycle routes. In urban areas, a grid size of between 300-500m will typically be suitable however in very dense location e.g. city/town centres, the grid size may need to be smaller to ensure good cycle provision to all destinations.

3. **Determine origins and destinations**
   A detailed analysis should be undertaken to identify all the key origins and destinations where people will need to cycle to/from. Key origins and destinations will likely include where people live, work, shop, educational facilities, access healthcare, recreational facilities, public transport hubs and a variety of local/community services. The use of digital mapping systems and tools can assist in this regard. Engagement with local communities and interested stakeholders will also assist in identifying both existing and future origins and destinations.

4. **Route selection**
   Once all origins and destinations have been established, key desire lines linking the origins and destinations can be developed. The most optimum routes that best cater for the desire lines must then be identified through a suitable assessment process. These routes should be categorised using the classification

system above, depending on their strategic importance within the network.

3.1.4 Low traffic neighbourhoods

Low traffic neighbourhoods are area-wide schemes which control motor traffic movements and speeds and make travelling through the neighbourhood by sustainable modes safer, more convenient and more direct than car based travel. They generally comprise of groups of residential streets, bordered by distributor roads, where residents can still drive to their house and deliveries can still be made etc. but through traffic ("rat-running") is restricted. Figure 3.2 illustrates a simple low traffic neighbourhood layout.

Low traffic neighbourhoods can be an effective way of delivering a dense network of quiet streets in urban areas without the need for protected cycle infrastructure. These quiet streets can provide the basic level of a cycle network referred to above, to enable local cycling trips and provide connections to the surrounding cycle network. They can also form important parts of higher level routes in the cycle network e.g. a secondary route may traverse through a low traffic neighbourhood to provide a connection to cycle tracks on the boundary roads.

By removing through traffic, low traffic neighbourhoods can also provide a number of other benefits to local residents such as reduced air and noise pollution, improved road safety, more social interaction and stronger and healthier communities.

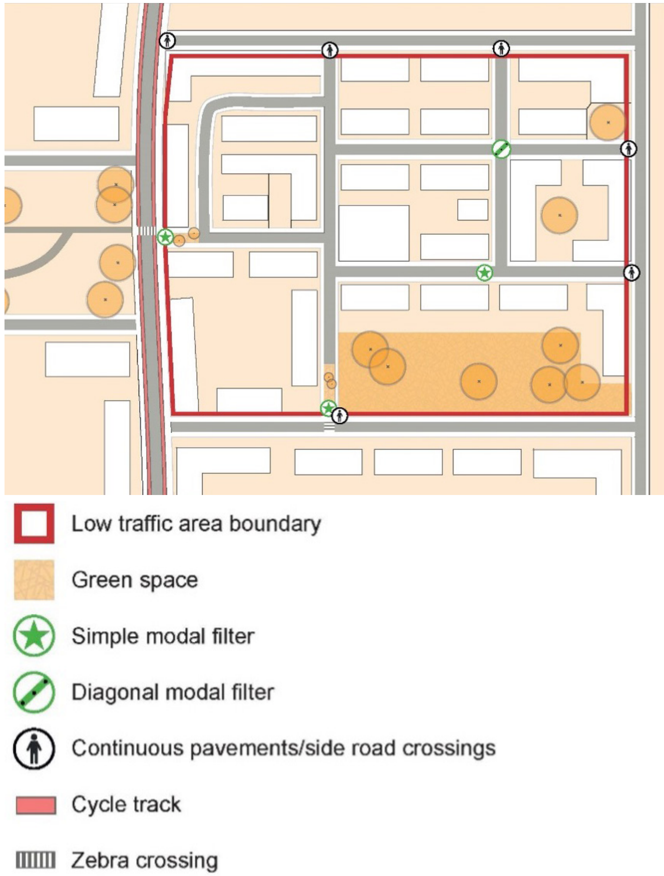


Figure 3.2: Example Low Traffic Neighbourhood layout.

For a low traffic neighbourhood to be successful it is important that measures are implemented to control both the volume and speed of motor traffic. Table 3.1 lists a number of interventions that could be considered in this regard.

Table 3.1: Typical measures to reduce the volume and speed of motor traffic.

Measures to reduce the volume of motor traffic	Measures to reduce speed of motor traffic
Modal filters	Narrow carriageways
Bus gates	Horizontal deflections e.g chicanes, buid-outs
Turning bans (with exemptions for cyclists)	Vertical deflections e.g raised tables, ramps
One-way streets (with exemptions of cyclists)	Refuge islands
Pedestrianised areas	Surface treatments e.g textured or coloured surfacing
Time-based traffic restrictions e.g. school streets	Raised median strips

Further guidance on measures to reduce the speed and volume of motor traffic is contained in section 4.2.9 of this manual. DMURS also contains further guidance on traffic calming and area-wide permeability measures.

The NTA Permeability Best Practice Guide also contains detailed guidance on implementing permeability measures such as modal filters and should be consulted when Low Traffic Neighbourhoods are being considered.

3.2 Planning for Cycling in Private Developments and Other Public Infrastructure Projects

Cycle facilities are often provided through projects that are not specifically cycling, or active travel, related and this can be very beneficial in developing cycle networks. Such projects might include:

» Residential developments.

» Commercial/Industrial developments.

» Urban regeneration/Public Realm schemes.

» New/improved transport infrastructure.

Where such developments are located on routes identified in cycle network plans, high-quality cycle infrastructure should be provided as part of the development proposals where appropriate. Planning Authorities play a key role in this regard and should ensure that facilities are provided in accordance with relevant cycle network plans and as per guidance in this manual.

If the provision of cycle facilities is not deemed appropriate by the planning authority for valid reasons, as a minimum developments should be future-proofed to ensure that they do not obstruct or hinder the provision of future cycle facilities. For example, if a development is being proposed on lands adjacent to an identified cycle route but cycle infrastructure is not being provided as part of the development, the lands should be developed in such a way that the appropriate space to provide cycle facilities in future along the route is secured as part of the development e.g. by setting back boundaries or building lines sufficiently.

3.2.1 Large scale developments

Where new large scale developments (residential/commercial/industrial) are being planned that are not governed by existing cycle network plans, it will be necessary to plan a network of cycle routes that connect all parts of the development to each other and also routes that connect the overall development into existing and planned cycle networks.

Where new developments are being delivered in greenfield sites, which are generally less constrained environments, the expectation should be that high-quality cycle facilities are provided as standard (see Figure 3.3). In this regard, when designing such cycle facilities, the desirable minimum values given in this manual should be achieved as a minimum.

Larger residential developments may provide a new main street or spine road serving facilities at the centre of the new community such as shops, schools and employment. The speed and volume of motor traffic on these routes will often mean that segregated cycling infrastructure is required.

Figure 3.3: High-quality segregated cycle tracks delivered as part of a large residential development in Maynooth, Co. Kildare.

Many larger developments also provide significant areas of new open space for the benefit of residents. These areas provide opportunities to create new cycling and walking routes between different parts of the development and to the areas beyond the site, unbundling walking and cycling from motor traffic (see example in Figure 3.4). Traffic free routes should be reasonably direct and form a connected part of the overall network, with a cross-section that meets the level of use that is expected. Designers should consider the personal security issues that may be associated with cycle routes away from buildings, and routes should be designed with lighting, surfacing and drainage that ensures they are useable at all times and in all seasons.

Figure 3.4: Cruagh Greenway, Stepaside, Dublin delivered as part of a large residential development.

In industrial and commercial developments, the high percentage of HGV traffic, results in geometry (wide roads and sweeping corners) to accommodate larger vehicles, enables higher speeds by other vehicles. The combination of high speeds and HGV traffic means that segregation is required for cyclists even though the flows of traffic may be low.

3.2.2 Urban regeneration/public realm schemes

Urban regeneration and public realm schemes are typically located in city/town centre environments with many key destinations therefore appropriate cycle facilities should be provided for within such schemes.

It is recognised that in town centre environments in particular there are likely to be many competing demands on the space available. The street cross-section will typically incorporate many requirements appropriate to the context, such as street trees, verges and car parking, but the need for these features should not lead to the omission of an appropriate provision for cycling that could create a gap in the overall cycle network.

3.2.3 New/improved capital transport projects

The provision of active travel facilities including cycle facilities should be considered for all new/improved capital transport projects e.g. road and public transport projects.

The relevant Approving Authority should determine if the provision of cycle routes as part of specific projects is necessary based on a number of factors including the location of the project, the intended cycle network in the area, key desire lines, opportunities for interchange and multimodal travel etc.

The provision of ancillary cycle facilities such as cycle parking, repair stations etc. should also be considered for new/improved capital transport projects. This will be particularly important for rail and bus projects to facilitate multi-modal trips in accordance with national policy.

4

Designing for Cycling

4.1 Geometric Requirements

This section sets out the basic geometric requirements which should be used when designing cycle facilities. The requirements are based on the need to cater for the Cycle Design Vehicle discussed in Section 2.

4.1.1 Design Speed

Cycle speeds can vary significantly depending on location and type of cycle facility/user/vehicle. Designing for appropriate cycle speeds is important so that facilities are safe, comfortable and attractive for all anticipated users. The design speed determines the horizontal and vertical geometric requirements for cycle facilities.

It is recommended that the design speeds in Table 4.1 are used when designing cycle facilities.

Table 4.1: Recommended Design Speeds.

Circumstance	Design Speed
Standard design speed for all cycle facilities	30 km/h
On approaches to junctions and obstacles	10 km/h
Downhill gradients >3%	40 km/h
Downhill gradients >5% and longer than 150m	50 km/h

4.1.2 Sight Distance

4.1.2.1 Dynamic Sight Distance

The Dynamic Sight Distance is the advance distance a person cycling requires to see ahead so that they can make safe and comfortable progress on their journey. The desirable minimum values for Dynamic Sight Distance in Table 4.2 are based on the approximate distances covered by a cyclist in eight seconds when travelling at the speeds shown.

Dynamic Sight Distance should be measured from an eye height range of 0.8 m to 2.2 m, to a target height range of 0.8 m to 2.2 m, as illustrated in Figure 4.1

Table 4.2: Desirable Minimum Dynamic Sight Distances.

Design Speed	Dynamic Sight Distance
10 km/h	15 m
20 km/h	40m
30 km/h	65 m
40 km/h	90 m
50 km/h	110 m

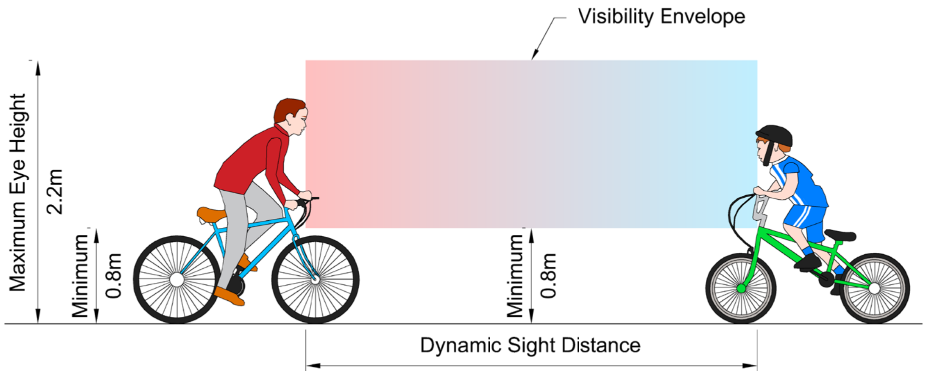


Figure 4.1: Dynamic Sight Distance Envelope.

4.1.2.2 Stopping Sight Distance

Stopping Sight Distance is the distance required to perceive, react and stop safely i.e. the distance covered in the perception/ reaction time (two seconds) plus the actual braking distance (deceleration rate of 0.15g). Desirable minimum stopping sight distances are shown in Table 4.3.

Stopping Sight Distance should be measured from an eye height range of 0.8 m to 2.2 m, to cater for the various eye heights of people cycling including children, to an object height range of 0 to 2.2 m, as illustrated in Figure 4.2.

Table 4.3: Desirable minimum Stopping Sight Distances.

Design Speed	Stopping Sight Distance
10 km/h	15 m
20 km/h	17 m
30 km/h	35 m
40 km/h	47 m
50 km/h	60 m

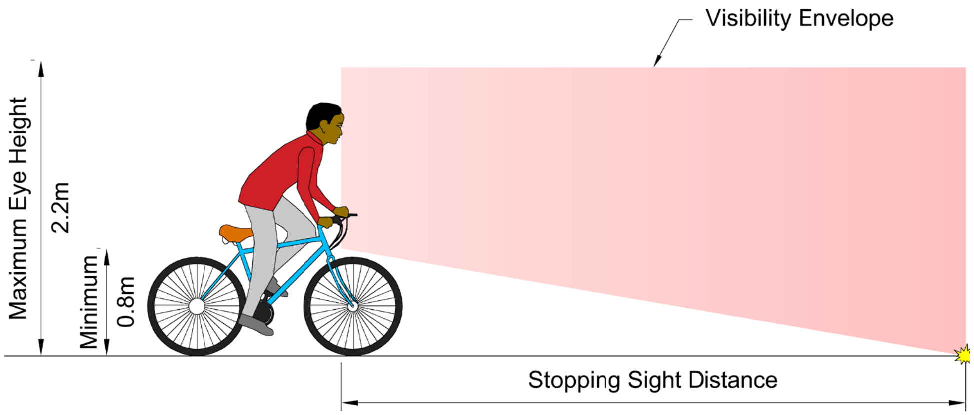


Figure 4.2: Stopping Sight Distance Envelope

4.1.3 Visibility Splays

Ensuring adequate visibility splays where cycle facilities intersect with roads and other active travel infrastructure is an important safety aspect. Where two roads intersect, including roads with cycle facilities along their length, the visibility splay requirements relate to those for motor vehicles which exceed those of cyclists. In such cases designers should refer to the visibility requirements in DMURS or TII Standards as appropriate.

It is important to note that the visibility splay requirements in this section do not apply to signal-controlled junctions.

Visibility splays requirements are composed of two elements; the X (setback) distance and the Y distance, as illustrated in Figure 4.3.

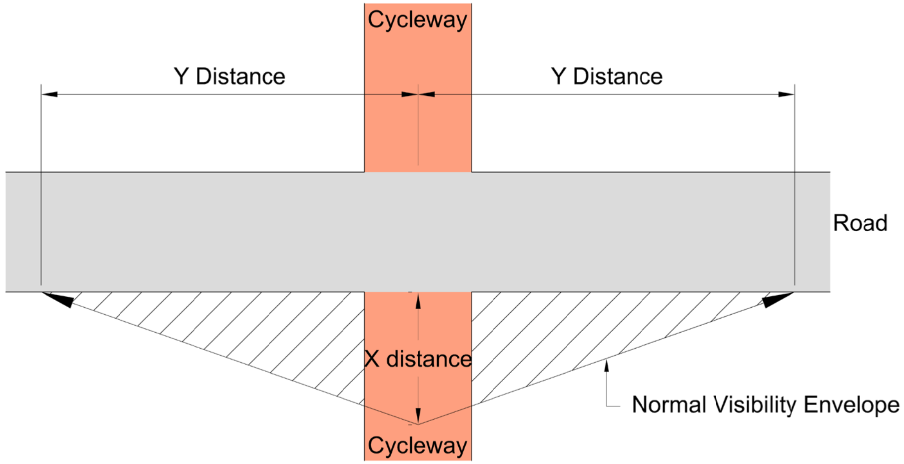


Figure 4.3: Visibility Splays.

The X distance is the setback distance along the cycle facility from which visibility is measured. It is measured along the centre of the facility from the nearside edge of the intersecting route. If the intersected route is a road, the X distance is measured from the nearside edge of the paved surface (including hard strip or hard shoulder).

The Y distance is the distance a cyclist exiting the facility can see to the left and right along the route and depends on the design speed (or posted speed limit for an existing road) of the route being intersected.

4.1.3.1 Visibility requirements at crossings

Where a cycle facility intersects a road at an uncontrolled or controlled crossing, the recommended X distances are given in Table 4.4. The visibility should be measured from an eye height range of 0.8 m to 2.2 m from this setback 'X' distance.

Table 4.4: Recommended 'X' Distances at crossings.

Parameter	'X' Distance
Desirable Minimun	4.0 m
Absolute Minimun	2.0 m

The desirable minimum 'Y' distances at uncontrolled and controlled crossings are given in Table 4.5. These correspond to stopping sight distances for motor traffic on the main road based on requirements in DMURS, for design speeds up to 60 km/h, and TII Standards, for design speeds greater than 60 km/h.

Table 4.5: Desirable minimum 'Y' Distances at crossings

Design Speed (km/h)	'Y' Distance
10	7 m
20	14 m
30	23 m
40	33 m
50	45 m
60	59 m
85	160 m
100	215 m

4.1.3.2 Visibility requirements where two cycle facilities intersect

Where a cycle facility is required to cross two adjacent facilities, the visibility splay may have to be measured at both interaction points. In such situations, visibility has to be provided from the edge of the first facility encountered, using appropriate X and Y dimensions. Subsequently, appropriate visibility also has to be provided where the second facility is encountered. This is illustrated in Figure 4.4. This situation may arise on entry to shared use waiting areas and at continuous cycle tracks and footways.Where a cycle facility intersects with another cycle facility that has priority, the recommended 'X' distances are those stated in Table 4.4 and the desirable 'Y' distances are shown in Table 4.6.

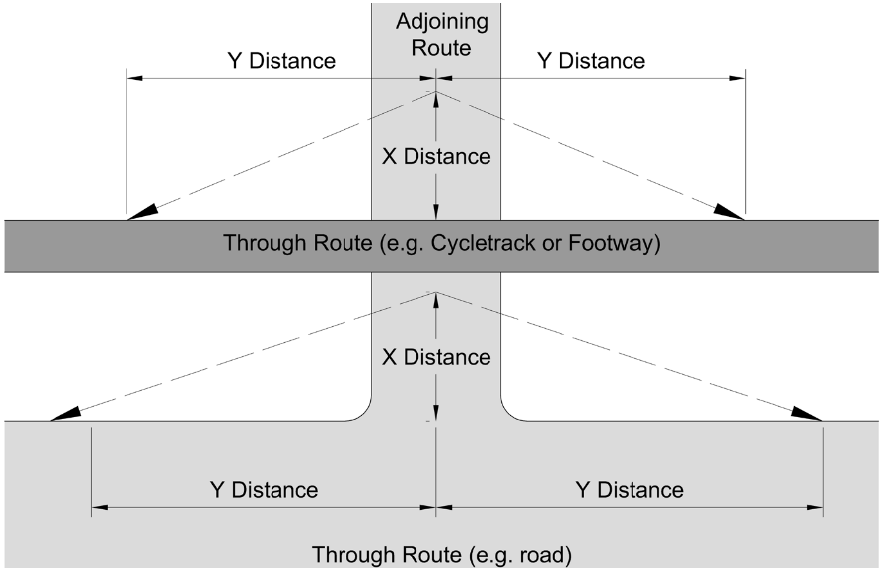


Figure 4.4: Visibility Splays at adjacent intersected routes.

Table 4.6: Desirable minimum 'Y' Distances where two cycle facilities intersect.

Design Speed of Cycle Facility with priority (km/h)	'Y' Distance
10	15 m
20	17 m
30	35 m
40	47 m
50	60 m

4.1.4 Hortizontal Alignment

Sufficient horizontal radii are required on cycle facilities to ensure facilities are safe and comfortable to use. Horizontal radii below the values recommended may mean users have difficulty keeping their balance or lose momentum. Changes in horizontal alignment should be via simple curves, typically circular.

Table 4.7 provides minimum horizontal radii which should be used on cycle facilities. These radii are based on being able to accommodate the turning space required by the cycle design vehicle (i.e. the actual turning radius of the vehicle) and to provide adequate stopping sight distance at typical cycling speeds. Objects such as walls, fences and trees should not be sited close to the cycle track on the inside of bends as this will potentially affect the visibility.

Table 4.7: Desirable Minimum Horizontal Radii.

Design speed (km/h)	Desirable Minimum Horizontal Radius
10	4 m
20	15 m
30	25 m
40	40 m
50	94 m

It may be desirable in some situations to employ tight horizontal radii as a speed-reducing safety measure e.g. on approach to junctions, obstacles or conflict points. In such situations the recommended radii in Table 4.8 should be used. Appropriate signage and line markings may also be required at speed reducing curves.

Table 4.8: Recommended radii for speed reducing back-to-back curves.

Circumstances	Radius
On approach to crossings	6-8 m
Absolute minimum radius	4 m

4.1.5 Vertical Alignment

4.1.5.1 Vertical Curves

Vertical curves shall be provided at all changes in longitudinal gradient. Crest curves represents a negative change in gradient (e.g. over the top of a hill) and a sag curve represents a positive change in gradient (e.g. through the low point of a valley) as illustrated in Figure 4.5.

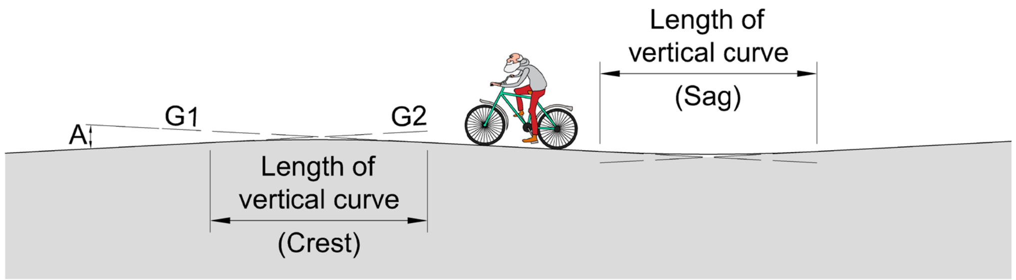


Figure 4.5: Vertical curvature on cycle facilities.

Crest curves affect forward visibility and their values are therefore determined on that basis. Sag values generally do not affect visibility and are therefore based on comfort.

Vertical curvature is calculated using the minimum ‘K’ values in Table 4.9. The minimum curve lengths can be determined by multiplying the K values shown by the algebraic change of gradient expressed as a percentage, e.g. +3% grade to -2% grade indicates a grade change of 5%. Thus for a Design Speed of 30 km/h, the desirable minimum length of a crest curve would be 8 (K Value) x 5 (algebraic change in gradient) = 40m.

Table 4.9: Minimum 'K' Values.

Design speed (km/h)	Desirable Minimum Crest K Value	Desirable Minimum Sag K Value
10	6	5
20	6	5
30	8	5
40	12	5
50	15	5

The Stopping Sight Distance should always be checked because it is affected by the interaction of vertical alignment with the horizontal alignment of the cycle route, the presence of crossfall, superelevation or verge treatment and features such as signs and structures adjacent to the route.

4.1.5.2 Gradient

The longitudinal gradient along a cycle route is an important design consideration as it affects the comfort and attractiveness of a cycle facility. Gradient impacts on two issues; the physical limitations of a cyclist to climb steep inclines and maintain speed, and their safety when descending steep inclines. Steep gradients are not welcomed by people cycling and have the potential to make routes unusable for some users. Steep inclines generate high downhill speeds increasing the potential for conflict with other users.

On existing roads and paths, gradients will generally have to follow existing topography although there may be opportunities to reduce gradients through appropriate design measures where sufficient space is available. Where steep gradients cannot be avoided due to existing topography, mitigation measures e.g. resting places, increased widths to mitigate conflicts, or alternative routes should be considered.

The recommended gradients for cycle facilities are given in Table 4.10.

Designers should also have regard to the Irish Wheelchair Association's Great Outdoors Access Guidelines for Trails, Greenways, and Public Parks when developing the vertical alignments.

For effective drainage, a resultant gradient (combined effect of longitudinal and transverse gradients) below 0.5% should be avoided. For further information, refer to TII Standard DN-GEO-03031.

Table 4.10: Recommended gradients for cycle facilities.

Parameter	Gradient
Desirable minimum	0.5%
Desirable maximum	3%
Absolute maximum	5%

4.1.6 Surface Crossfall

Cycling surfaces need to be adequately drained to avoid the difficulties that standing water and ice can create for cyclists. Cycle facilities can be constructed with either a crossfall across the whole width (to either side) or a central camber, to help surface water to clear.

Excessive crossfall can cause wheels to slide in icy conditions and make steering more difficult, particularly those using three, or four-wheel cycles or trailers.

The recommended crossfalls for cycle facilities are given in Table 4.11.

Superelevation is not typically required on cycle facilities, however negative camber that falls to the outside of a bend should be avoided.

Table 4.11: Recommended crossfalls.

Parameter	Crossfall
Recommended crossfall	1.0 - 2.0%
Desirable maximum	2.5%

4.1.7 Clearances

The required clearances to be used for calculating the width of cycle facilities, based on the different types of edges/boundary treatments, are given in the Width Calculator in Section 2.

In addition, a desirable minimum clearance of 500mm is recommended from the edge of a cycle track/ lane to any vertical poles, columns, handrails, bins etc., with an absolute minimum clearance of 250mm. This does not apply in respect of low height bollards and separators used as part of the cycle track edge.

4.1.8 Headroom

General recommendations on headroom clearances are given in Table 4.12. The recommendations for headroom at grade separated structures is given in Section 4.5.8.

Table 4.12: Recommended headroom clearances.

Parameter	Headroom clearance
Desirable minimum	2.7 m
Absolute minimum	2.4 m
Absolute minimum (existing structures)	2.2 m

At existing structures, lowering the minimum headroom to 2.2m may be acceptable but decisions will need to be taken on a case by case basis, based on relevant factors such as the forward visibility. Where the minimum headroom cannot be achieved (e.g. at a low railway bridge), appropriate hazard warning signage should be erected.


GRÁINSEACH GHORMÁIN
Cyclists dismount at exit

4.2 Cycle Links

4.2.1 Introduction

Links are the physical cycling infrastructure that join origins to destinations. They can take a variety of forms depending on the road conditions. They fall into two broad categories:

» **Segregated cycle facilities** – cycling on dedicated facilities that are separated from the general traffic by a physical barrier or located away from the road corridor. Options include Cycle Tracks, Protected Cycle Lanes, Greenways and Shared Active Travel Facilities.

» **Integrated cycle facilities** – cycling with the general traffic, with or without delineated lanes. Options include Cycle Lanes and cycling in mixed traffic.

The optimum link design at a given location will depend on, inter alia, the traffic regime (refer to the cycle facilities selection guide in Section 2.5), the space required for cycling (refer to the width calculator in Section 2.6), the frequency of side road junctions, kerbside activities (such as parking, loading and bus stops), pedestrian crossings, and driveway crossovers.

Designers should aim for cycling provision that is suitable for most people exclude potential users.

Links on residential streets with low traffic flows and speeds may be suitable for cycling with the general traffic (with or without marked cycle lanes) due to the low speed differential and low number of potential conflicts between cycles and motor vehicles; whereas on roads with higher traffic flows and/or traffic speeds, dedicated cycle tracks or other facilities that are separated from general traffic by a physical barrier will be more safe and attractive to cyclists.

As well as separation from motor traffic, the space for cycling along links should be separate from pedestrian space, where possible, (such as the cycle track layout shown in Figure 4.6). Designers need to consider how to define the space for each mode and how to manage conflict where pedestrians need to cross or where there is kerbside activity.

In summary, the key objectives when designing cycle links include:

» Providing for side-by-side cycling where possible – this makes cycling more enjoyable, but the wider cycle facility also makes it safer, more visible, and more attractive;

» Providing consistently for cyclists – along a cycle route, there may be different options chosen for different links; however, designers should minimise the need for cyclists to make transitions from one type of link to another and make the overall facility predictable and legible; and

» Providing a coherent facility approaching and exiting junctions.

Figure 4.6: Cycle Track, Hanover Street, Carlow.

4.2.2 Segregated Cycle Facilities

Segregated cycle facilities adjacent to the carriageway are dedicated cycle tracks or cycle lanes that are physically separated from adjacent traffic lanes.

The benefits provided by segregated cycle facilities include enhanced safety and comfort due to the physical protection from motor traffic and the ability to bypass queuing vehicles thus improving journey time reliability and overall quality of service.

The segregation can be continuous or intermittent (light segregation), with varying degrees of protection provided depending on the material and the horizontal (buffer width) and vertical separation.

This section provides guidance on the key design considerations for the different types of segregated cycle facilities adjacent to the carriageway set out in Section 2.4, namely: protected cycle lanes, stepped cycle tracks, and standard cycle tracks.

4.2.2.1 General Design Considerations

The following should be considered when designing segregated cycle facilities:

- **Type of segregation** – the design of the segregation between the cycle track/lane and the vehicular traffic lane influences the level of comfort experienced by cyclists. For example, a kerbed buffer with infill paving or landscaping provides higher levels of comfort than bollards;
- **Widths** – the width requirements for segregated cycle facilities are covered in Section 2.6. On retrofit schemes, where practicable, the space required for the cycle facility should generally be reallocated from the carriageway and not taken from the footpath;
- **Movement and place** – the context of the road should inform the design of the appropriate type of cycle facility and type of segregation to be used (see DMURS, Section 3.2);
- **Legibility** – segregated cycle facilities should be legible to all road users. Access and egress arrangements, crossing locations, user priority, and interfaces/thresholds should be clearly identified and self-evident;
- **Pedestrian interactions** – interactions between pedestrians and cyclists should be minimised with each having their own space, to the greatest extent practicable, ideally separated by a change in level. Designers should examine pedestrian desire lines and behaviours and, where segregation is provided between the cycle lane/track and the traffic lanes, incorporate appropriately located gaps in the segregation and accessible crossings into the design. Designers should consider increasing legibility by having a strong colour contrast at interfaces/thresholds;
- **Two-way cycling** – facilities for two-way cycling should be protected with a verge, raised kerb or other suitable vertical elements. Two-way cycle facilities are likely to place cyclists adjacent to oncoming traffic lanes and therefore a physical buffer is required. Stepped Cycle Tracks (i.e. segregation with low-height 60mm kerbs) are not suitable for two-way cycling;
- **Cycling surface** – all new segregated cycle facilities should have a red coloured surface. Where an alternative colour is proposed, a departure should be sought in accordance with the requirements stated in the Department of Transport circular “NGS Circular 2 of 2022” (See Section 1.3 regarding relaxations and departues). In the case of retrofit schemes, the existing surface should be milled down and inlayed with a new red asphalt surface course;
- **Drainage** – The drainage of a cycle facility must aim to remove surface water quickly and efficiently to avoid ponding. The cycle track should have a sufficient crossfall to allow for adequate drainage;
- **Parking and loading** – where there is a risk of persistent loading or parking on the cycle facility, the use of full-height kerb upstands or bollards should be considered. Where carriageway space is available, parking protected cycle facilities could be used;
- **Visual impact** – appropriate materials should be chosen to fit in with the aesthetics of the surrounding streetscape; and
- **Maintenance** – the width of the cycle facility and the type of segregation used will impact on the maintenance operations. Usually access to the road edge/kerb will be required for road sweeping, gully cleaning, lighting repairs, etc. The need for ongoing maintenance can be minimised at design stage by careful consideration of the type of segregation, materials and drainage.

4.2.2.2 Separation between Pedestrians and Cycle Users

Footpaths should be clearly separated from cycle lanes and tracks wherever practicable. This reduces potential conflicting movements between pedestrians and cycle traffic and provides a more comfortable facility for all users.

The preferred and most easily detectable form of separation is a change in level between the footpath and cycle surfaces of minimum 60mm. This allows people who are blind, or vision impaired, to detect the change in level. It is important that designers consider the legibility of the segregation kerb and change in level; legibility can be increased by having a strong colour contrast between the adjacent surfaces.

Where pedestrians need to cross the cycle facility (e.g. to access bus stops or at pedestrian crossings), there should be suitable gaps in any vertical segregation elements and dropped kerbs with tactile paving, should be provided at the interface between the footpath and the cycle facility. Alternatively, the cycle facility can be raised to the level of the adjacent footpath, with appropriate tactile paving provided at the crossing facility. The decision on whether to provide informal, uncontrolled, or controlled crossings of the cycle facility should be based on pedestrian and cyclist flows and the width of the cycle facility (e.g. a two-way cycle tracks will be wider and have cyclists travelling in both directions and may be more difficult to cross).

An alternative form of segregation is to use a central delineator strip between the pedestrian side and cycling side where both surfaces are at the same level. This form of segregation can be useful in urban streets where there are frequent movements across the cycle track for example, by people using wheelchairs, people with prams, or people using delivery trolleys.

Facilities where pedestrians and cyclists share the same space should be avoided, if possible. Possible situations where shared facilities may be appropriate include:

- Shared areas at road crossings (for example, Toucan crossings);
- Pedestrianised streets; and
- Shared Active Travel Facilities and Greenways.

Tactile paving should be provided as part of all Active. Travel corridors to facilitate the movement of people who are blind or vision impaired. The layout of the tactile paving should be in accordance with the UK Department of Transport Guidance on the Use of Tactile Paving Surfaces.

4.2.3 Standard Cycle Tracks (TL101)

Standard Cycle Tracks are segregated cycle facilities that are frequently raised above the adjacent carriageway and separated horizontally from the traffic lanes by a kerb and sometimes a buffer, as shown in Figure 4.7.

Ideally, the buffer should take the form of a kerbed verge infilled with paving, grass, or other soft landscaping. The width of the verge should be determined by using the Width Calculator. Where widths allow, parking bays may be used to form the buffer, as shown in Figure 4.10. Where a verge cannot be provided, a single separator kerb may be used.

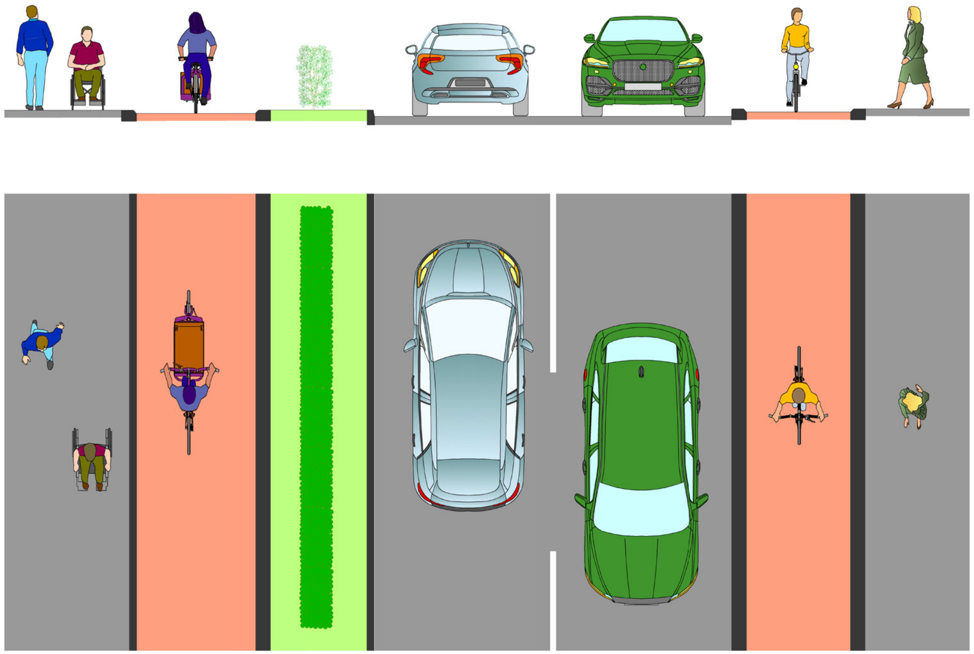


Figure 4.7: Standard cycle track typical layout.

The separator kerb between the cycle track and adjacent traffic lane may be:

- Flush with the raised cycle track surface; or
- Raised 60mm above the track surface with a splayed profile (full batter) on the cycle track side.

The kerb on the carriageway side should be a full-height kerb of 100mm high or more. The separator kerb options are shown in Figure 4.8.

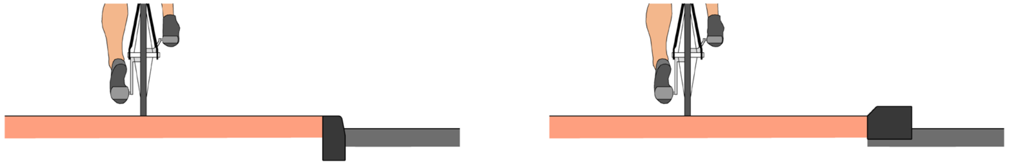


Figure 4.8: Separator kerb options: kerb flush with cycle track (left); and raised, splayed profile kerb (right).

Separator kerbs raised above the cycle track may not be suitable for locations with high levels of pedestrian activity, such as a busy retail street. In such situations, suitable gaps in the kerb should be provided at crossing locations. Legibility can be increased by having a strong colour contrast between the cycle track, kerb, and carriageway surfaces.

The kerb between the cycle track and adjacent footpath should have an upstand of minimum 60mm. The kerb may have:

- A vertical/half-batter upstand (i.e. kerb face at 90/75 degrees) – this profile is the most easily detected by blind and vision-impaired people; or
- A splayed profile (i.e. kerb face angled at 30 - 45 degrees to the horizontal) – this profile is more forgiving to cyclists and increases the effective width of the track of the track, as shown in Figure 4.9. It also allows those using the cycle as a mobility aid to easily join and leave the cycle track at destinations.

Figure 4.9: Splayed kerb between footpath and cycle track, Delft, Netherlands.

Figure 4.10: Standard cycle track with green buffer (left) and buffer provided by parking bays (right), Maynooth, Co. Kildare.

Cyclists should be able to join and leave a raised track at junctions and transitions between the track and a cycle lane or the carriageway. Where access to and from side roads to the right is required, dropped or shallow bevelled kerbs should be used on the carriageway side so that cyclists can enter and leave the cycle track relatively easily.

The cycle track should have a sufficient crossfall to allow for adequate drainage. Crossfall away from the carriageway is more comfortable for cyclists. However, this requires gullies on the inside edge of the cycle track in addition to gullies at the carriageway edge. In such cases where 'double drainage' is required, a side-entry drainage system on the cycle track is preferred so that the entire track surface is available for cycling and not interrupted by gullies, interrupted by gullies, as shown in Figure 4.11. If gullies are used on the cycle track, they should have a cycle-friendly grates to avoid the risk of catching cycle wheels. While super-elevation is not typically required along a cycle route, negative camber that falls to the outside of a bend should be avoided.

Where the cycle track is proposed to drain towards the carriageway, a kerb flush with the cycling surface will allow for drainage into the carriageway drainage system; a raised separator kerb should include a sufficient number of gaps to allow surface water to drain. Consideration should be given to the possible need for additional drainage capacity where new cycle tracks are constructed in existing grass verges.

Figure 4.11: Kerb-drain system, Grand Canal Cycleway, Dublin.

4.2.3.1 Standard Cycle Track at Footpath Level

It is less desirable to have cycle tracks at the same level as the footpath. As noted in Section 4.2.2.2 above, a kerb with an upstand of 60mm is the preferred form of separation between cycle track and footpath.

Where cycle tracks at footpath level are provided, they should be clearly distinguishable from the footpath so that each mode has its own defined space and people who are blind and vision impaired can detect and negotiate the track. The photograph shown in Figure 4.12 shows a cycle track with a different colour and texture to the adjacent footpath and the drainage channel forms the interface between the two surfaces.

Where possible, horizontal separation in the form of a paved or landscaped buffer should be provided between the cycle track and footpath. Wider buffers may offer the potential to accommodate planting and sustainable drainage. Where there is high demand for parking, a buffer may also be required to accommodate measures such as bollards to prevent parking on the footpath/cycle track.

Figure 4.12: Cycle track at footway level, Parnell Place, Cork.

In certain situations, a suitable horizontal buffer between the footpath and cycle track may not be achievable (due to physical constraints) or desirable (due to frequent movements across the cycle track). In this case, a raised delineator strip, in the form of a trapezoidal shape kerb, can be used to provide the separation, as shown in Figure 4.13. The delineator strip should be 12mm to 20mm high (preferably 20mm), 150mm wide with sloping sides and a flat top of 50mm see **Guidance on the Use of Tactile Paving Surfaces**.

It is important that there is a strong colour contrast between the cycle track, buffer or delineator strip, and footpath surfaces. Different surface materials, such as asphalt on the cycle track and concrete flags on the footpath, can help provide colour, texture and tonal contrast between the footpath and cycle track. White line markings separating the 'walking side' from the 'cycling side' are generally ignored and are not recommended.

Where trapezoidal delineator strips are used, designers should ensure that gaps are left in the strips as necessary to cater for access and pedestrian desire lines, particularly where access might be required by wheelchair users e.g. adjacent to accessible parking bays.

Figure 4.13: Example of trapezoidal delineator strip between footpath and cycle track.

4.2.4 Stepped Cycle Tracks (TL102)

Stepped Cycle Tracks are segregated cycle facilities that are raised by 60mm to 75mm above the carriageway surface and a minimum of 60mm below the adjacent footpath. Figure 4.14 shows a typical layout on a suburban cycle route. The footpath kerb options are similar to those for cycle tracks, that is, a vertical kerb or a splayed kerb.

Figure 4.14: Stepped cycle track, Stillorgan, Dublin.

The low height difference between the adjacent surfaces makes Stepped Cycle Tracks ideal for locations with off-street accesses and driveways. The footpath and cycle track can continue at the same height rather than drop to carriageway level. This provides a much smoother ride for cyclists and wheelchair users and helps to reinforce priority of people travelling along the street. The provision of bevelled cycle track kerbs at accesses allows for the occasional turning vehicle movements, as shown in Figure 4.15.

Figure 4.15: Bevelled cycle track kerb at side street access, Templeville Road, Dublin.

The low height of the cycle track kerb can lead to the cycle track being used for parking and loading. Bollards, or increased parking enforcement, may be required in certain locations to deter this behaviour.

The track should be wide enough to allow for overtaking, otherwise the step down to the carriageway can present a hazard to cyclists exiting and entering the track.

Stepped Cycle Tracks are generally not suitable for two-way cycling and should be one-way only. The degree of protection provided by the low-height kerb is not suitable for cycling adjacent to oncoming traffic on busy roads.

4.2.5 Protected Cycle Lanes (TL103)

Protected Cycle Lanes are at-grade (carriageway level) cycle facilities on existing carriageways that are physically separated from adjacent traffic lanes.

They can be an effective option for retrofit schemes to provide protection to unsegregated cycle lanes or where existing carriageway space is to be reallocated for cycling. Implementation costs can be lower than other types of segregated cycle facility by retaining existing footpath kerbs, road drainage, and other infrastructure such as public lighting columns and utilities.

4.2.5.1 Design Features and Considerations

The preferred form of physical separation for a protected cycle lane is a full-height permanent separator kerb. This makes use of standard construction methods and materials and provides robust protection of the cycle lane. Wider kerbed buffers, constructed using kerbs infilled with concrete, setts or planting, may also be used to enable pedestrians to stand on them alongside parking and loading areas, or to provide sustainable drainage.

Other segregation options, such as modular islands, rubber separators, planters, flexible bollards with/without mini-islands, and parking protected facilities can be used. These options can be effective for low-cost or quick-build schemes; however, kerbed protection is recommended for permanent retrofit schemes.

Protected Cycle Lanes typically make use of the existing drainage gullies on the carriageway. Light segregation interventions typically have the least impact on existing road drainage.

The cycle lane should follow the width calculator guidance in Section 2.6 with a preferred width of 2.0m that allows for side-by-side cycling and overtaking. Protected cycle lanes typically retain the existing footpath kerb; therefore, it may not be possible to provide a low-upstand or chamfered kerb on the inside edge of the new cycle facility. Thus, the effective width of the protected cycle lane will be reduced.

The width of the protected cycle lane and the type of segregation elements used will impact on the future maintenance requirements. Access to the carriageway edge/kerb will be required for road sweeping, gully cleaning, public lighting repairs, etc. The absolute minimum width to enable access by a mechanical sweeper is 1.3m.

At side roads it is important to have tight corner radii and to allow a gap for access in the segregation opposite the side road.

4.2.5.2 Continuous Separator Kerbs

A continuous separator kerb typically comprises an extruded, or cast in-situ, concrete kerb raised above carriageway, such as the example shown in Figure 4.16. level. Ideally the separator kerb width should be 250mm or wider but may be reduced in width on physically constrained routes. A wider kerb is more visible to cyclists and pedestrians. It can also be used as a refuge by pedestrians crossing the road (who tend to step up, onto, and over the kerb). Wider separation can be achieved using precast kerbs infilled with concrete, paving setts, or planting.

Separator kerb upstand heights are typically 100mm to 125mm above the carriageway surface. It is recommended that the kerb has a splayed (full batter) profile on the cycle track side. This increases effective width of cycle facility (i.e. cyclists will be less likely to strike their pedals and shadows on the cycle lane caused by the kerb face will be reduced) and this kerb profile is more forgiving if struck by a cyclist.

The provision of gaps in the segregation should be designed to optimise protection for cyclists while also providing adequate breaks for drainage, access to side roads, bus stops and parking/loading areas.

Figure 4.16: Concrete separator kerb, Victoria Quay, Dublin City.

Continuous separator kerbs may not be suitable for locations with high levels of pedestrian activity, such as a busy retail street, due to the potential tripping hazard for pedestrians. In such situations, suitable gaps in the kerb should be provided at existing crossing locations, or intermittent segregation alternatives should be considered. Legibility can be increased by having a strong colour contrast between the cycle lane, kerb, and carriageway surfaces.

Access and egress for cyclists should also be considered and appropriately located gaps in the separator kerb should be provided.

The kerb can be supplemented with bollards at intervals to provide a vertical feature to highlight the presence of the kerb to drivers, cyclists and pedestrians. Bollards can be fixed to the top of the kerb, if width allows, or installed in drainage gaps.

The existing road drainage can be utilised by providing gaps in the separator kerb to allow surface water to flow from the carriageway.

4.2.5.3 Modular Islands and Separators

Modular separators comprise a single-piece unit of concrete, reconstituted stone, or rubber material. They are suitable for rapid deployment or interim schemes. This option has great flexibility in terms of design layout and can easily be modified during, or after, construction.

Figure 4.17: Rubber separators, Coastal Mobility Route, Glasthule, Dublin.

Installation of concrete and reconstituted stone units typically includes milling of the carriageway, laying on mortar bed and fixing with bolts. Rubber units (as shown in Figure 4.17) are typically bolted down onto the existing carriageway surface, with no excavation required.

Units come in standard widths ranging from approximately 235mm up to 600mm. Units typically have a 125mm high vertical face on the traffic side and chamfered edge on the cycle lane side.

Drainage slots are sometimes built into the units; however breaks can be provided at intervals to suit the drainage requirements of the road.

Similar to permanent separator kerbs, modular units may not be suitable for routes with high levels of pedestrian activity, such as a busy retail street. Rubber units are typically black or grey in colour and may need to be supplemented with reflective strips and flexible bollards to increase visibility to all users.

4.2.5.4 Discrete Vertical Elements

Vertical elements such as flexible bollards (as shown in Figure 4.18) and delineators provide intermittent (light) segregation from traffic. They can be a quick and cost-effective means of providing a protected cycle lane; however, they do have ongoing costs resulting from the need to frequently replace damaged bollards.

Figure 4.18:Flexible bollards providing light segregation, Green Road, Carlow.

Bollards are an ideal option for rapid deployment or interim schemes as they can easily be modified during, or after, construction.

Bollards are typically 80mm in diameter. They are available in various heights including low-level bollard (typically 300 – 500mm high) and mini-island units. The recommended bollard height is 800mm as this reduces the risk of handlebar strikes while being high enough to be easily detectable by all users.

A minimum longitudinal spacing of 2m is recommended to deter other vehicles from entering the cycle lane. On constrained routes where there is a high likelihood of emergency vehicles (for example, on a main route to a hospital or near fire stations), consideration could be given to using a spacing of 8m to enable drivers to pull into the cycle lane and allow an emergency vehicle to pass.

As with any vertical element used to segregate cyclists, the height of the bollard will impact on the effective width of the cycle facility. Where bollards are above 600mm high it is desirable to provide an additional outside clearance of 500mm (refer to the Width Calculator in Section 2.6).

The use of bollards placed at intervals can be preferable to continuous forms of segregation on routes with high pedestrian activity and informal crossings as it provides gaps for crossing the facility.

They are generally considered to be more visually intrusive and less aesthetically pleasing than other forms of segregation and may not be appropriate in conservation areas.

4.2.5.5 Planters and Other Intermittent Landscaping Features

Planters offer an attractive and sustainable solution for many situations, where space allows; however, they have an additional maintenance requirement when compared to other separation options. This option has great flexibility in terms of design layout and can be easily modified during or after construction.

Planters are available in a range of unit widths and heights depending on the supplier. Units can be placed together to form continuous segregation (as see Figure 4.19) or can be spaced apart according to the traffic conditions and pedestrian activity. Care should be taken when providing gaps to ensure that crossing pedestrians and cyclists can be seen by approaching traffic.

Figure 4.19: Planters forming continuous segregation from motor traffic, Inns Quay, Dublin.

Planters are typically raised above the carriageway on feet to allow for drainage; however, additional breaks can be provided at intervals to suit the drainage requirements of the road and allow access for maintenance.

4.2.5.6 Parking Protected Cycle Lanes

Parking protected cycle lanes are a cost-effective means of separating cyclists from traffic. Existing carriageway space can be rearranged to make use of existing on-street car parking as an effective protective barrier.

Figure 4.20: Parking protected cycle lane, Merrion Square, Dublin.

This type of segregation can be provided on wide carriageways with existing on-street parking bays that are required to be retained (see Figure 4.20). It is suitable for rapid deployment, or interim schemes, as it comprises relatively minor works (mostly road markings) and can easily be modified during, or after, construction.

A buffer (0.75m recommended width) should be provided between the cycle lane and parking bays to allow for passenger access/ egress, loading, and to prevent 'dooring' of cyclists. The buffer can be a hatched road marking or wide kerbed island. A wider buffer of at least 1.2m should be provided at disabled persons parking bays.

Parking bays should be sufficiently wide to reduce encroachment of vehicles into the buffer zone.

4.2.5.7 Road markings for Protected Cycle Lanes

Road markings should be provided on the carriageway to demarcate the cycle lane. The outer edge of the cycle lane should be indicated by a continuous white line (refer to **Traffic Signs Manual**, Chapter 7).

Edge line markings may be used on both sides of the segregation where a widened buffer zone is required or to enhance visilbility of the segregation. Figure 4.21 shows example road marking layouts where cycle lanes are protected by bollards or continuous segregation.

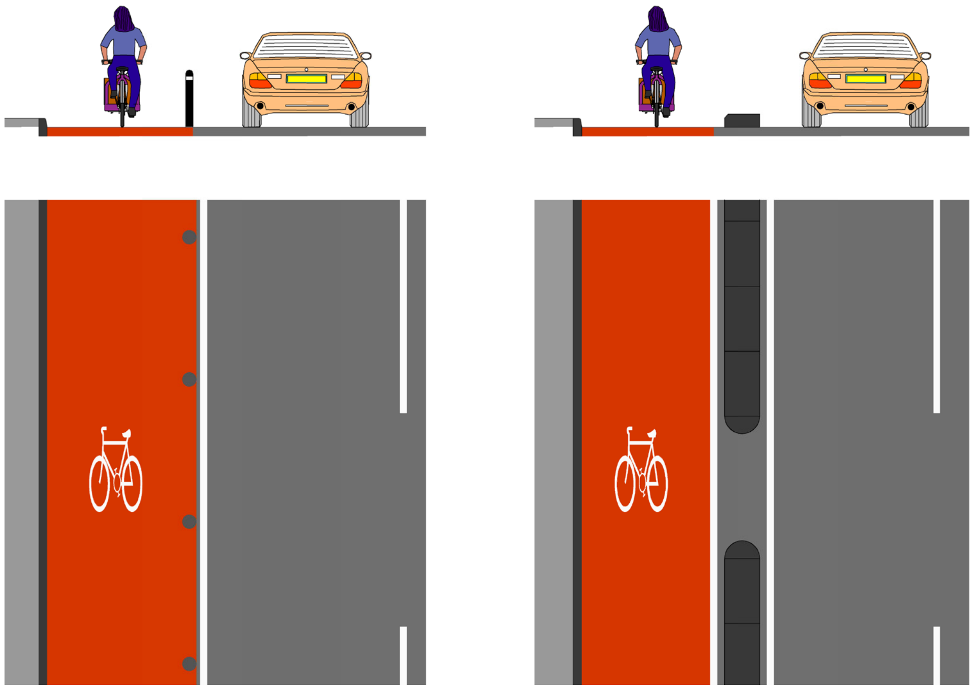


Figure 4.21: Edge line markings on protected cycle lanes.

4.2.6 Two-way Cycle Tracks (TL107)

4.2.6.1 Design Considerations

Two-way cycle tracks (as shown in Figure 4.22) can be well suited to inter-urban routes and other locations where there are few side roads.

Situations where two-way tracks may be more appropriate than one-way cycle tracks in urban areas include:

» **Constrained routes** – two-way cycle tracks require less overall width than one-way tracks. For example, a 2.0m wide one-way cycle track will be needed on both sides of the road to enable safe overtaking and side-by-side cycling but a 3.0m wide two-way track can cater for a significant flow of cycle traffic with space for faster cyclists to overtake slower cyclists;

» **Routes with tidal flows** – where cycle flows are tidal (with significantly larger flows in one direction during the peak periods), two-way tracks can represent a more flexible use of space than one-way tracks as cyclists can move out into the 'opposing lane' within the cycle track to overtake. Two-way cycle tracks also allow for side-by-side cycling when flows in the opposite direction are low;

» **Routes with kerbside activity predominately on only one side** – two-way tracks can be useful when there are greater levels of kerbside activity and side roads on one side than the other (such as promenades and riversides). The two-way cycle track can be located on the side with less activity and conflict; and

» **Alongside busy roads** – providing two-way cycle tracks on both sides of busy roads with destinations on both sides has the advantage that it reduces the need for people to cross the road.

The opportunities and design challenges associated with providing two-way tracks are summarised in Table 4.13.

Table 4.13: Opportunities and challenges of two-way cycle tracks

Opportunities	Challenges
» Require less overall width than one-way tracks; » Allows more flexible use of space where cycle flows are tidal; » Can provide a higher level of service when provided on the side of the road with significantly less kerbside activity and/or junctions; and » Where width allows, providing two-way track on both sides of a busy road can reduce the need for people to cross.	» Transitions between the cycle track and the carriageway are more difficult for cyclists travelling against the flow of traffic; » The interface between the cycle track and major junctions along the route can be more complex, typically resulting in more delay for all users; » More risks associated with retaining priority over side roads or busy accesses; » Access to premises along the route on the opposite side of the carriageway is reduced; and » More difficult for pedestrians to cross a two-way cycle track where they do not have priority.

Figure 4.22: Two-way cycle track, Wilton Terrace, Dublin.

4.2.6.2 Design Guidance

The width requirements for two-way cycle tracks are set out in the Width Calculator (see Section 2.6). The buffer width on two-way cycle tracks requires careful consideration, as cyclists on the outside lane of the track will be adjacent to oncoming traffic. The preferred form of buffer on two-way cycle tracks is a raised (see Figure 4.23) or planted verge, which provides separation between cyclists and oncoming traffic and prevents cyclists from veering out onto the carriageway.

Figure 4.23: Two-way Cycle Track with raised buffer, Springfield Avenue Dublin.

Parking or loading bays can provide good protection from moving traffic, provided a sufficient buffer (0.75m wide) can be provided between the parked vehicle and cycle track. (see figure 4.24)

Centre line markings and cycle logos should be used on two-way cycle tracks so that it is readily apparent to all road users that the track is two-way.

Directional arrow markings are generally not required on links as the direction of the cycle logo indicates the direction of flow.

The design of two-way cycle facilities across side roads requires careful consideration. Refer to Section 4.3.3.5 for further details.

Figure 4.24: Two-way parking protected cycle lane, South Mall, Cork.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4.2.7 Greenways and Shared Active Travel Facilities (TL106)

Greenways and Shared Active Travel Facilities offer the greatest protection for cyclists and pedestrians from motor traffic as they are typically mostly offline, away from road corridors. Facilities along waterways, shorelines and disused railway lines, and paths through parks and other public open spaces can provide important links for everyday trips away from motorised traffic. These facilities may be shared between pedestrians and cyclists or have separate space for each mode.

The surface should be sealed, and machine laid to offer the same quality and comfort as other urban cycle routes. Lighting will help users to access the route at all times of day throughout the year. Frequent access points connecting to adjacent roads can help improve connectivity and feelings of safety to ensure motor traffic-free routes provide a high level of service for utility cycling. Routes that provide direct connections between journey attractors with good connectivity to other parts of the network will achieve high usage.

The key design considerations for these facilities include:

- Plan and design for all kinds of users – the facility should be multi-access;
- The design should incorporate safe systems principles and meet the requirements for cyclists;
- Protect users from motor traffic;
- Separate users (people cycling, walking and wheeling) where necessary;
- Make it intuitive and clear which space is allocated to different users;
- Reduce the need to slow down/stop; and
- Design with maintenance in mind.

Designers should also refer to TII Publication DN-GEO-03047 Rural Cycleway Design (Offline).

Figure 4.25: Shared Active Travel Facility, Curraheen, Cork.

4.2.7.1 Segregation

Shared-use facilities (see Figure 4.25) are often suitable where:

- The density of users is low meaning less interactions and potential conflict;
- There is low speed differential between users (e.g. area with high place function or at road crossings);
- Where segregation results in facilities that are too narrow for cyclists and pedestrians; and
- Where segregation may make the layout too confusing and result in users straying into each other’s space, increasing potential conflict.

Where significant flows of pedestrians and/or cyclists exist, or are forecast, consideration should be given to providing separate facilities for walking and cycling. Types of physical separation include a landscaped/grass verge (minimum 1 m wide) as shown in Figure 4.26 or raised central delineator strip (with regular gaps for drainage) between the cycle track and footpath; or a raised adjacent footpath with a minimum 60mm high kerb (straight edge or splayed), as shown in Figure 4.27.

Table 4.14 provides recommended arrangements depending on the density of pedestrians using the facility.

Table 4.14: Pedestrian Densities (Source: TII PE-PMG-02045).

Density of Pedestrians (users/hr/m)	Recommended Arrangement
< 100	Shared-use usually appropriate
101 – 199	Segregation may be considered
> 200	Segregation should be considered

Figure 4.26: Baldoyle Greenway, Dublin.

Figure 4.27 Castletroy Urban Greenway, Limerick.

4.2.7.2 Width

Greenways in urban areas will generally be busier than in rural areas. All routes should meet the absolute minimum widths set out in Table 4.15 to be able to comfortably accommodate larger cycles and mobility scooters and designers should also consider the current, forecast and any target increase in users. A width greater than the minimum will increase the level of service, enable sociable (side by side) cycling and walking, and help minimise conflicts between users.

Table 4.15: Shared Active Travel Facility and Greenway Widths

Location	Desirable minimum width	Absolute minimum width
Urban areas	4.0m	3.0m
Rural areas	3.0m	2.5m

4.2.7.3 Speed Control Measures

Speed control measures can be uncomfortable and difficult to navigate for disabled cyclists and people using non-standard cycles. They should only be proposed where excessive speeds have been shown to be an issue, where gradients or bends prevent minimum stopping sight distances being provided or where there is the potential for conflict such as junctions where these issues cannot be addressed in another way.

Staggered barriers should not be used to reduce cyclist speeds. Speed humps are preferable and should have a sinusoidal profile covering the full width of the cycle track. Rumble strips can be painful for cyclists who are unable to stand out of the saddle and should be avoided.

Deliberately restricting space, introducing staggered barriers or blind bends to slow cyclists is likely to increase the potential for user conflict, creates a hazard (particularly at night) and may prevent access for disabled people and nonstandard cycles, and so should not be used.

Signage reminding users to keep left and pass on the right can also help minimise conflict (see Figure 4.28)

Figure 4.28 Signage on the used to remind users to keep left to minimise conflict, Cork to Passage West Greenway.

4.2.7.4 Access Controls

Access controls to shared active travel facilities and Greenways should only be provided where necessary to prevent inappropriate vehicular access. Where they are required, the controls should be suitable to achieve consistent universal access to all such active travel facilities.

Designers need to consider the design access controls with the following in mind:

» Shared active travel facilities and Greenways are to be welcoming and fully inclusive facilities;

- Access points should be designed to provide Universal Access with particular emphasis on usability by a wide range of mobility equipment;
- Access points should be attractive and inviting for users of the facility; and
- There is a presumption against restrictive access control of any type on active travel facilities.

Reference should be made to NTA Advice Note ATAN-2022-01: Access Controls of Active Travel Facilities.

Access controls can reduce the usability of a route by all cyclists and may exclude some disabled people and others riding non-standard cycles. Access controls in the form of barriers, kissing gates and chicane features that require the cyclist to dismount, or cannot accommodate the cycle design vehicle, are not inclusive and should not be used unless there is a persistent problem that cannot be addressed by any other design feature (such as bollards), or periodic enforcement.

Bollards to prevent entry by motor traffic should be placed at a minimum of 1.5m spacing and oriented in a way that allows users to approach in a straight line to permit all types of cycle and mobility scooter to gain access (see Figure 4.29). If access is required by maintenance vehicles, a lockable removable bollard can be used.

Bollards and barriers should contrast with the background colours and may be fitted with retroreflective material to ensure they can easily be seen in all conditions.

Figure 4.29 Bollards providing an accessible entrance to shared active travel facility, Rathfarnham, Dublin.

Where it is necessary to control the movement of livestock, a cattle grid should be used, in preference to a gate which will cause delay and be inaccessible to some cyclists and wheelchair users. A cattle grid with closely spaced (100mm) threaded rod bars can be crossed by cycles without undue difficulty (see Figure 4.30).

Figure 4.30: Cattle grid at Greenway access, Cambridge, UK.

4.2.7.5 Shared-use Paths Adjacent to Carriageway

Shared facilities between pedestrians and cyclists generally result in a reduced offer for both modes and should not be considered as a first option.

Shared facilities may be appropriate in certain contexts, such as along busy inter-urban and National Roads where pedestrian flows are low (see Figure 4.31). They must be designed to meet the needs of cycle traffic with appropriate separation from fast moving vehicles, width, alignment and treatment at side roads and other junctions. The design approach should be to provide a cycle track that may be used by pedestrians, not a typical footpath that may be used by cyclists.

The use of white line markings to separate pedestrians and cyclists are not recommended. Even when accompanied with good signage, white lines are not well observed, cannot be detected by vision impaired people and can even lead to greater conflict due to increased cycling speeds.

Figure 4.31: A 4m wide shared facility, Dunkettle to Carrigtwohill Cycleway, Cork.

Shared facilities should be avoided in busy urban areas with high flows of pedestrians and/or cyclists because they result in a reduced quality of service for both modes. Although instances of actual conflict may be rare, interactions between people moving at different speeds can be perceived to be unsafe and inaccessible, particularly by pedestrians. This adversely affects the comfort of both pedestrians and cyclists.

However, shared facilities may be acceptable in the following situations if well-designed and implemented:

- At heavily constrained junctions where the space does not exist to maintain segregation between pedestrians and cyclists;
- Where a length of shared use may be the only practical way of achieving a continuous cycle route; and
- Where high cycle and high pedestrian flows occur at different times.

Designers should be realistic about cyclists wanting to make adequate progress and shared facilities should ideally provide enough space for cyclists to overtake groups of pedestrians and slower cyclists.

Recommended minimum widths for shared facilities carrying up to 300 pedestrians per hour are given in Table 4.16. Wherever possible, and where pedestrian flows are higher, greater widths should be used to reduce conflict.

Table 4.16: Recommended minimum widths for shared-use path.

Flow	Desirable minimum width	Absolute minimum width at pinch points
≤ 300 pedestrians and ≤ 300 cyclists per hour	4.0m	3.0m
≤ 300 pedestrians and > 300 cyclists per hour	4.5m	4.0m

4.2.8 Cycle Lanes (TL104)

Cycle lanes are marked lanes on the carriageway that are reserved either exclusively or primarily for the passage of cyclists.

Motor vehicles are prohibited from driving along or across a cycle lane, except for access to or egress from a place adjacent to the cycle lane.

They are normally located on the left or kerb side of the road (see Figure 4.32) and benefit from utilising the existing road drainage system and being included within the normal road maintenance programme.

Cycle lanes do not provide any physical protection from motor vehicles so many people do not perceive them as being safe enough. They are generally suitable for roads where the speed does not exceed 30km/h.

Mandatory cycle lanes are marked by a continuous white edge line which prohibits motorised traffic from entering the lane except for access. The use of narrow advisory cycle lanes with dashed edge lines are no longer recommended.

Figure 4.32: Mandatory cycle lanes, Grove Road, Dublin.

The design of cycle lanes requires consideration of the following:

» **Traffic Conditions** - cyclists are not physically protected, so it is important that traffic speed and volume is appropriate for all potential cyclists to use the carriageway. Designers should refer to Section 2.5 to determine the suitability of cycle lanes on a particular link;

» **Turning movements** - the design of cycle lanes needs to consider the turning movements of both cyclists and other traffic;

» **Kerbside activity** - cycle lanes may conflict with other kerbside activities such as parking, loading, taxi ranks and bus stops. Careful attention to this design issue is required particularly on busy retail streets and around school entrances;

» **Hours of operation** - cycle lanes should operate 24 hours a day so that the facility is available to cyclists at all times during peak traffic periods, cyclists can use cycle lanes to filter past queuing traffic (see Figure 4.33); and

» **Lane width** - the carriageway needs to be sufficiently wide to accommodate the cycle lane/s and vehicle running lane/s. The recommended width of 2.0m allows space for overtaking within the lane. The minimum width of 1.5m enables the use of the facility by larger cycles and trailers. Widths below 1.5m are therefore not inclusive and can encourage ‘close-passing’ of cyclists by motorists, who tend to drive close to the lane edge marking.

Figure 4.33: Mandatory cycle lanes can help cycle traffic to filter past other slow-moving traffic, Grand Canal, Dublin.

4.2.9 Cycling in Mixed Traffic (TL105)

On local roads, residential streets and rural lanes, where traffic volumes and speeds are generally lower, many people are likely to be willing to cycle on-carriageway in mixed traffic or in unprotected cycle lanes as the perceived risk of injury is low. Designers may still choose to provide dedicated cycle facilities to address other requirements for cycle-friendly infrastructure, such as attractiveness or coherence. In some locations, a shared street may represent the best way to reconcile the conflicting needs of different users and different activities taking place within the street.

Traffic management or calming techniques may be used to reduce traffic speed and/or volume to the point where cycling conditions are inclusive and suitable for most people. This may also be associated with the removal of non-local, through-traffic to reinforce the primary function of local access. Possible measures can range from a bypass for through-traffic at town or village level, to simple measures such as turning bans at a neighbourhood level.

4.2.9.1 Cycling Positions

People adopt two main positions when cycling in mixed traffic - the primary and secondary positions as shown in Figure 4.34.

Designers need to be aware of these riding positions and design on-carriageway cycle routes with the following in mind:

» Primary position – Cyclists will move into a primary position (i.e. "take the lane") on narrow roads, at pinch points such as pedestrian refuges, and when passing side roads on their left. The intention of this position is to make overtaking drivers aware that they will either need to move out of the traffic lane to overtake or wait until there is space to overtake safely; and

» Secondary position – In the secondary position, cyclists are between 0.5m-1.0m from the kerb, a position that ensures they are far enough out to be able to avoid drains or debris but can also move in either direction to avoid surface hazards.

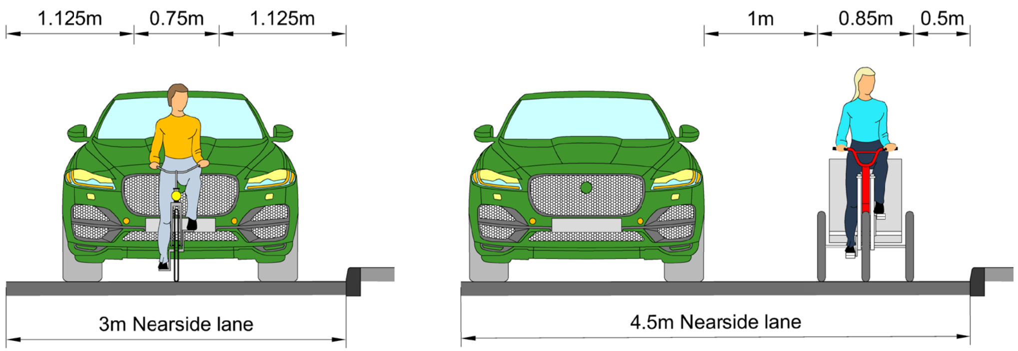

Figure 4.34: Primary and secondary cycling positions.

"Defensive riding" in the primary position can be safe, but children and more risk-averse, less experienced people are likely to feel vulnerable in the primary position and some drivers can react aggressively if they misinterpret the actions of the cyclist. Mixed traffic streets should therefore aim to offer conditions where most people would feel confident and comfortable enough to use the primary position when necessary.

4.2.9.2 Reducing the Speed of Motor Traffic

Cycle traffic can integrate with general traffic at speeds of up to 30km/h but whether or not this 'feels' safe will depend on the width of the carriageway and the proximity of overtaking vehicles (particularly buses and HGVs); the volume of traffic (frequency of overtaking); and the frequency of side roads, parking and loading activities that can introduce other conflicts. Cyclists will usually benefit from measures that reduce the speed differential between them and the motor traffic, such as the following:

» **Lower speed limits**

Reducing the actual speed of traffic to 30km/h or less can provide benefits in terms of safety, comfort and attractiveness, and reduce the difference in travel time between driving and cycling. This is not just a matter of applying lower speed limits. When considering how to effectively implement reduced speed limits, designers should consider the context and function of the street and the associated speed reduction measures. A combination of place-based psychological measures and more traditional physical measures (described further below) can be used to create a self-regulating street environment. Guidance on self-regulating streets is provided in DMURS Section 4.1.

All Local Authorities are required to use and adhere to The Guidelines for Setting and Managing Speed Limits in Ireland (Department of Transport) when setting Speed Limits in their Administrative areas.

» Carriageway widths

Narrow carriageways are one of the most effective design measures that calm traffic. Reallocation of carriageway space can be used to reduce carriageway and traffic lane widths, helping to reduce traffic speeds and freeing up additional space for cycle tracks and/or widened footpaths. Designers should minimise the width of the carriageway.

Arterial and link streets should have traffic lane widths in the range of 2.75m to 3.5, with preferred values of 3.0m and 3.25m. The standard carriageway width on local streets should be between 5.0m and 5.5m. (Refer to DMURS Section 4.4.1)

» Horizontal deflections

Kerb build outs, parking bays and bus stops can be used to create chicanes and deflections in straight sections of carriageway to help reduce speed (see Figure 4.35). They should have a tapered approach to reduce the risk of cyclists moving suddenly into the path of following vehicles. Build outs can also create space for cycle parking, street trees and rain gardens that can increase the sense of place and help lower vehicle speeds.

Figure 4.35: Chicanes, Charleville Mall, Dublin.

Cycle bypasses may be provided alongside horizontal measures such as chicanes or narrowing; the gap should be at least 1.5m wide to accommodate all types of cycles and to allow access by sweeping machinery. Where debris is likely to collect in the bypass at carriageway level, an alternative is to ramp up the cycle lane across the top of the buildout. The bypass should be arranged so that cyclists re-entering the carriageway are protected and not placed in conflict with passing vehicles (see Figure 4.36).

Figure 4.36: Cycle Bypass at road narrowing, Kilmacud, Dublin.

» Vertical deflections

Raised tables and platforms may be used to reduce traffic speeds, slow turning vehicles at junctions and enable pedestrians to cross at carriageway level. Raised tables are recommended at zebra crossings, and on minor side roads and property accesses in conjunction with a continuous footpath.

Where speed ramps are required, a sinusoidal shaped ramp should be used. These are more comfortable for cyclists to ride over due to the smooth transition profile on both sides of the hump. Speed cushions should be avoided because the cyclist may not be able to choose their preferred riding position in the carriageway.

» Side road entrances

Tight kerb radii and entry treatments such as raised tables and continuous footpaths across the mouth of the side road will help reduce turning vehicle speeds, making it safer for cyclists passing through the junction and pedestrians crossing the side road and should be the default on cycle routes. Further details on recommended layouts at priority junctions are given in Section 4.3.

» Surface treatments

Textured surfaces such as block paving can be used on low traffic streets to provide a visual and audible reminder that the section of carriageway is a low-speed environment. They need to be laid and maintained to a high standard to ensure they are comfortable for all users. In heritage areas, stone setts have a similar effect but can be more uneven and uncomfortable for cycling on.

An alternative approach is to use distinctive coloured surfacing (for example, red coloured asphalt) to convey to drivers that they are entering a street environment in which cyclists have priority.

On asphalt carriageways, applying a median strip with contrasting colour and/or texture that is flush with the carriageway can provide cost-effective visual narrowing of the carriageway and still allow for larger vehicles to overrun if required.

» Centre line removal

On quiet, narrower streets where the carriageway width is less than 5.5m in width, there should be no centre line marking, thereby ensuring all road users in either direction yield to each other. Removing the centre line acts as a speed reduction measure by visually narrowing the carriageway to a single undivided traffic lane. Large cycle logos can be marked on the carriageway to emphasise the correct cyclist position.

This arrangement is only suitable on residential streets or local roads with low traffic volumes (400 pcus per hour or less) and vehicle speeds less than 30 km/h. With higher volumes of traffic there is a higher risk of conflict with cyclists.

4.2.9.3 Reducing the Volume of Motor Traffic

Reducing motor traffic volumes enable cycling in mixed traffic streets can be achieved through a range of measures involving area-wide treatments across a neighbourhood, village or town centre. Motor traffic is directed onto main roads, reducing traffic volumes (and often speeds) on local and residential streets. It also gives an advantage to cycling and walking over driving through the creation of short connections only available to cyclists and pedestrians.

Traffic management measures that can reduce traffic volumes include:

- Point closures which physically prevent access by motor vehicles;
- Bus gates or other modal filters;
- Turning bans (with exemptions for cyclists);
- One-way streets (with two-way cycle access);
- Parking controls; and
- Car-free streets (pedestrianised areas).

» Modal filters

Bollards and planters can be used to quickly and cost effectively introduce point closures which prevent access for motor vehicles while retaining access for pedestrians and cyclists (see Figure 4.37). They are often introduced across an entire neighbourhood to provide a dense network of cyclable streets to connect to secondary and primary routes along busier corridors.

Figure 4.37: Modal filter, Convent Road, Navan, County Meath.

» Bus gates

Where traffic volumes are an issue on bus routes, bus gates can be used to prevent access by general traffic (see Figure 4.38).
Bus gates can improve the reliability and journey times of bus services by exclusion of other vehicles which also improves conditions for cycling. If bus traffic signals are used, they must also be able to detect cyclists, or a cycle bypass should be provided.

Figure 4.38: Bus Gate, Main Street, Tallaght, Dublin.

» Turning bans and one-way streets

There should be a presumption to exempt cyclists from any restrictions including turning bans and one-way restrictions unless there are overriding safety reasons for not doing so. Permitting contraflow cycling in one-way streets and using point closures to remove motor vehicle through traffic from certain streets will generally provide a more direct route for cyclists and should always be considered. On quiet, low speed streets, contraflow cycling without a dedicated cycle lane has been found to be successful even on narrow streets with on-street parking.

» Parking controls

Controlling car parking through charges, limiting capacity and/or duration of stay can be an important element in reducing private car traffic in town centres and other urban areas to free up space for cycling (including cycle parking) and other sustainable transport modes. Parking control can also be used to support workplace travel plans or to protect residential areas from excessive traffic by removing long-stay commuter parking.

» Traffic-free streets (pedestrianised areas)

Streets and places where motor vehicles are excluded for some or all of the time, often referred to as 'pedestrianised' streets, can create high quality environments for pedestrians and cyclists (see Figure 4.39). The main purpose of traffic-free streets is to provide an environment where pedestrians can move around freely without fear and intimidation from motor vehicles. Pedestrian Zones are indicated by appropriate traffic signs.

Traffic-free streets are often important destinations for access to shops and services by cyclists, and for through cycle traffic so it is important that cyclists are exempted from the restrictions unless there is good evidence that this would cause significant safety problems. Pedestrian and cyclist flows, street widths, the availability and safety of alternative cycle routes and the demand for cycling through the area should be considered when deciding whether including cyclists in the restrictions is justified.

Figure 4.39: Car-free street, Capel Street, Dublin.

Figure 4.40: Shared Street, Templeogue, Dublin.

4.2.9.4 Shared Streets and Cycle Streets

Shared streets are suitable in low traffic single lane environments where cyclists take precedence over vehicular traffic. The key feature from a cycling perspective is that cyclists “take the lane” in line with vehicles.

Where such streets are less than 5.5m in width, there should be no central lane marking, thereby ensuring all road users in either direction yield to each other. For widths between 5.5m and 6.5m, a centre line marking should be provided to separate opposing traffic. Large format cycle logos may be marked on the carriageway to increase driver awareness (see Figure 4.40).

Cycle streets are access-only streets for motor vehicles which also serve as a primary route within the cycle network. A cycle street should have a two-way traffic flow of less than 400 pcus in the peak hour and, ideally, volumes of cycling should exceed motor traffic levels, to provide cyclists with a level of comfort comparable to that provided by a traffic-free route.

The design of cycle streets should ensure they are attractive to both experienced cyclists and less confident cyclists. Priority for cyclists should be provided using self-enforcing design. Coloured pavement surfacing and a mountable (at-grade) textured central strip can be used to emphasise that such streets are low speed environments where motor vehicles should not attempt to overtake cyclists (see Figure 4.41).

Figure 4.41: Cycle Street, Delft, Netherlands.

4.2.9.5 Shared Bus Lanes

Cyclists are usually permitted to use with-flow and contraflow bus lanes. Whilst not specifically a cycle facility, bus lanes can offer some degree of protection for cyclists as they significantly reduce the amount of interaction with motor traffic. However, not all users will feel comfortable sharing space with bus traffic. Bus lanes also allow taxis to use them, which can significantly increase traffic flows, increasing the risk of conflict.

Where cyclists are sharing bus lanes with buses, the lane should, preferably, be 4.5m wide, to enable buses to pass cyclists with sufficient room. Cycle lanes or protected space for cycling may be provided within bus lanes where the overall width available is 4.5m or more. Bus lanes widths in the range of 3.25 m and 3.9m wide should not be used as shared facilities. In this case, the bus lane should be reduced to 3.0m to 3.25m wide and the remaining space hatched out using road markings. Large format cycle logos should be marked in the shared bus lane to increase driver awareness (see Figure 4.42).

Figure 4.42: Shared bus lane, Merrion Road, Dublin.

4.2.9.6 On-street Tramways (Shared Running)

Where tram routes have on-street sections, cyclists often have to cross the tram lines or share the carriageway with trams and general traffic (see Figure 4.43).

Some of the potential hazard for cyclists can include:

- Cycle wheels dropping into rail grooves causing the cycle to come to a sudden stop;
- Tyres skidding on the metal surface of the rail, especially in wet conditions; and
- At tram stops, the lateral clearance between the rail and kerb typically reduces to bring the platform closer to the tram doors. Also, higher kerbs are required at tram stop platforms, further reducing the space for cyclists.

These hazards can lead to sudden falls at speed and serious injury. It is therefore important that routes that run along or traverse tramways are carefully considered to minimise the risk to cyclists. At locations where this is a potential issue, consideration should be given to marking the correct path for cyclists to take or highlighting the presence of the tram rails. Good street lighting is important as tram rails can be difficult to see at night. The provision of alternative route options for cyclists should also be considered.

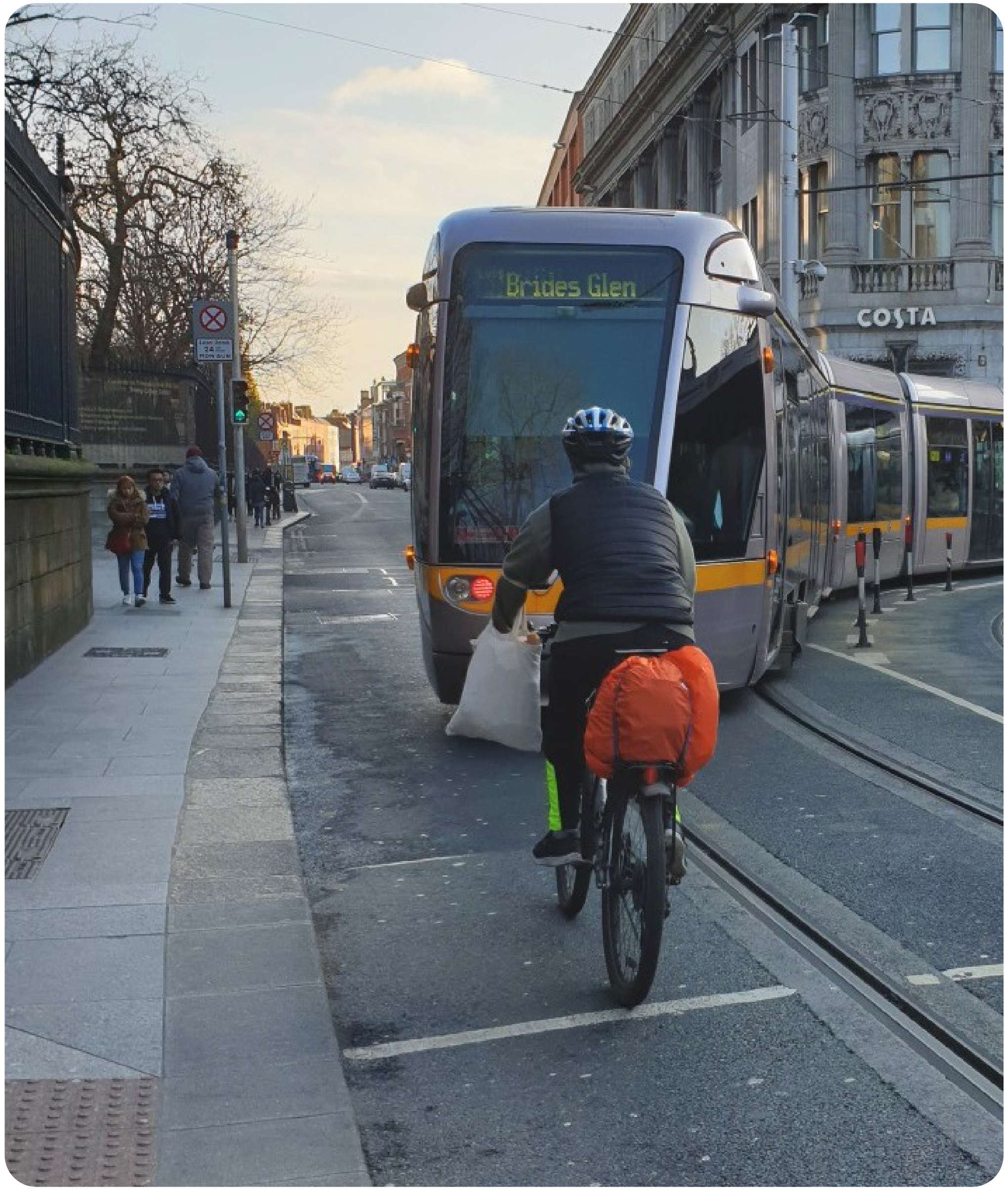

Figure 4.43: Cyclist sharing carriageway with tram, Nassau Street, Dublin.

Where cycle lanes or tracks cannot be provided adjacent to the tramway, the clearance between rail and footpath kerb should be a minimum of 1.0m, and consideration should be given to maximising the effective width (e.g. by removing gullies, channels and traffic sign poles). This clearance is not intended to allow cyclists to travel alongside the tram. Cyclists should travel in front of or behind a moving tram.

Where cycle routes cross the tracks, they should ideally have a crossing angle of 90 degrees, or at least 60 degrees to the rails. Road markings should be provided to direct cyclists across the track as shown in Figure 4.44.

Figure 4.44: Road marking directing cyclists across tram tracks, Nassau Street, Dublin.

4.2.10 Contraflow Cycling

Contraflow cycling allows cyclists on a one-way street to travel in the opposite direction to all other traffic, effectively allowing cyclists to use a one-way street in both directions.

One-way streets can present a significant barrier to cyclists by reducing permeability and making journeys longer. Cyclists may risk cycling against oncoming traffic or use footpaths to avoid detouring around a one-way street. Therefore, one-way streets can encourage risky behaviour, negatively impact the quality of service, and may discourage cycling.

The introduction of contraflow cycle facilities within an urban one-way system can significantly improve the directness of a route and make the journey safer and more attractive for cyclists. Contraflow cycling can create a dense network by ensuring as many streets are usable for two-way cycling as possible.

Therefore there should be a general presumption in favour of facilitating contraflow cycling on one-way streets.

The level of segregation required between contraflow cyclists and oncoming traffic can vary depending on the intended traffic regime. Generally, contraflow cycling on a Shared Street (without cycle lanes or tracks) is suitable only on low-speed, low-traffic streets, such as access and residential streets. Table 4.17 provides guidance on the appropriate cycling facility for different traffic conditions.

Table 4.17: Appropriate contraflow cycling facilities.

Contraflow Cycling Facility	Speed Limit	One-way Traffic Flow (peak hour pcus)
Contraflow cycling on Shared Street	≤ 30km/h	≤ 100
Contraflow Cycle Lane	≤ 30km/h	≤ 200
Contraflow Cycle Track	≤ 60km/h	Any

All contraflow cycle facilities should have regulatory traffic signs facing oncoming traffic at the entry points to the one-way street, in accordance with the Traffic Signs Manual. The road markings required vary according to the type of contraflow facility (see Traffic Signs Manual, Chapter 7).

Contraflow cycle facilities should be legible to all road users. There may be conflicts if other road users are not aware that cycling is permitted in both directions. This could include crossing pedestrians, particularly on busy retail streets, and drivers turning into and out of side streets across the cycle track. Road markings, traffic signs and coloured surfacing can be used to highlight the presence of cyclists travelling in a contraflow direction (see Figure 4.45).

Figure 4.45: Contraflow protected cycle lane using bolt-down rubber kerbs and flexible bollards, Blackrock, Dublin.

4.2.10.1 Contraflow Cycle Tracks (TL108)

Fully kerbed contraflow (or two-way) cycle tracks offer cyclists a high level of comfort and protection from oncoming traffic on one-way streets. The design of the physical protection should be based on the intended traffic conditions. Similar segregation options to those provided for Standard Cycle Tracks and Protected Cycle Lanes can be used. An example layout is shown in Figure 4.46.

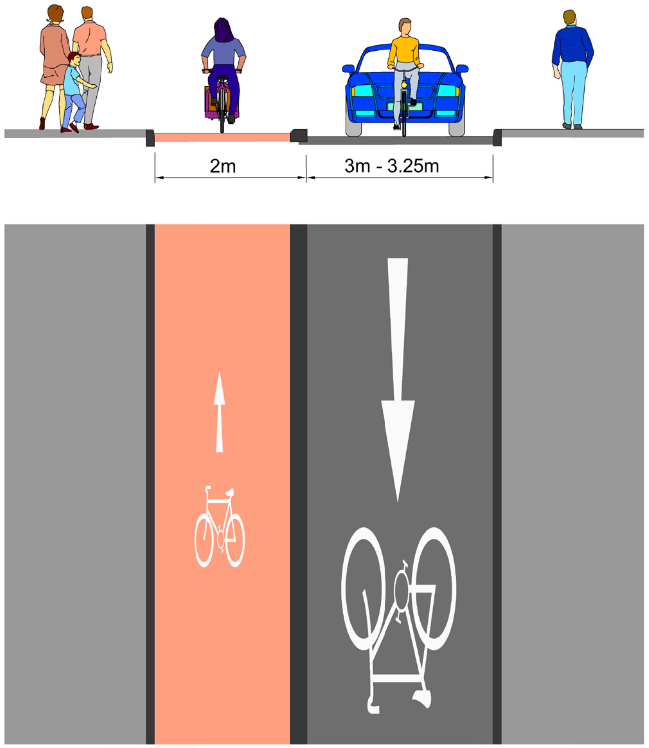

Figure 4.46: Contraflow cycle track typical layout.

The key issues to be considered when designing Contraflow Cycle Tracks include:

- » The facility should be legible to all road users. The contraflow arrangements should be clearly identified and self-evident. Consideration should be given to the entry and exit treatments at the start and end of the contraflow cycle facility;
- » At side roads and accesses, the contraflow cycle track should have priority over traffic turning in and out. The design of the facility across a side road junction should include warning signs and road markings to increase driver awareness of cyclists travelling in a contraflow direction;
- » The Width Calculator (Section 2.6) should be consulted when designing a contraflow cycle track as the design requirements are similar to with-flow cycle facilities. The track should be wide enough to provide space for overtaking and separation from oncoming traffic. On higher speed streets, the buffer width may need to be wider to increase safety and comfort for cycling adjacent to oncoming traffic;
- » Designers should assess the demand for loading and parking on the contraflow side of the street. Physical barriers may be needed to prevent parking/loading on the cycle track or, if space allows, a parking protected contraflow facility could be provided; and

The type of segregation used needs to take account of pedestrian crossing demands. Appropriately located gaps in the segregation and accessible crossings should be incorporated into the design. Where low-height segregation is used, designers should consider increasing legibility by having a strong colour contrast at interfaces between the carriageway, segregation, and footpath.

4.2.10.2 Contraflow Cycle Lanes (TL109)

Contraflow cycle lanes should be mandatory cycle lanes, marked with a continuous white line. Advisory cycle lanes with dashed edge lines are not recommended.

A 2.0m lane width provides space for overtaking and separation from oncoming traffic. The desirable traffic lane width is 3.0m – 3.25m to discourage drivers from overtaking with-flow cyclists and to allow enough space to prevent vehicle encroachment onto the contraflow cycle lane (see Figure 4.47).

Contraflow cycle lanes may not be suitable where there is a risk of vehicles parking or loading on the contra-flow side of the street, or generally encroaching onto the cycle lane. In this case, a contraflow cycle track may be more appropriate.

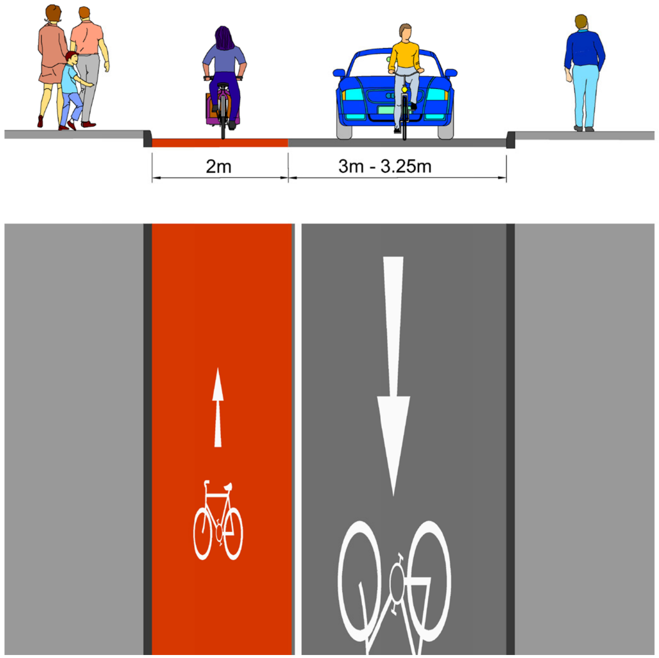

Figure 4.47: Contraflow cycle lane typical layout.

4.2.10.3 Contraflow Cycling on Shared Streets (TL110)

Where traffic conditions are suitable, it may be possible to introduce contraflow cycling without the need for marked cycle lanes or segregated tracks. This can be an effective way to provide two-way cycling on narrow residential streets with on-street parking. Where there is good visibility, cyclists and on-coming drivers should be able to negotiate passage safely. Regulatory traffic signs are still required (see Traffic Signs Manual, Chapter 5) but cycle lane edge line markings can be replaced by cycle logos placed at intervals on the carriageway to highlight the presence of cyclists travelling in the contraflow direction.

Designers should consider the possible interactions with pedestrians crossing the street. Additional traffic signs may be needed at crossing locations to increase awareness of cyclists travelling in both directions.

The following minimum carriageway widths are recommended for two-way cycling on one-way shared streets:

» 2.6m with no car parking;
» 3.9m based on car passing cycle, no car parking;
» 4.6m with car parking on one side of the road; and
» 6.6m with car parking on both sides of the road.

On narrow one-way streets where parking is allowed on both sides of the carriageway, regularly placed gaps in the parking bays can be provided to allow contraflow cyclists to pull over to the kerb and let larger oncoming vehicles pass (see Figure 4.48).

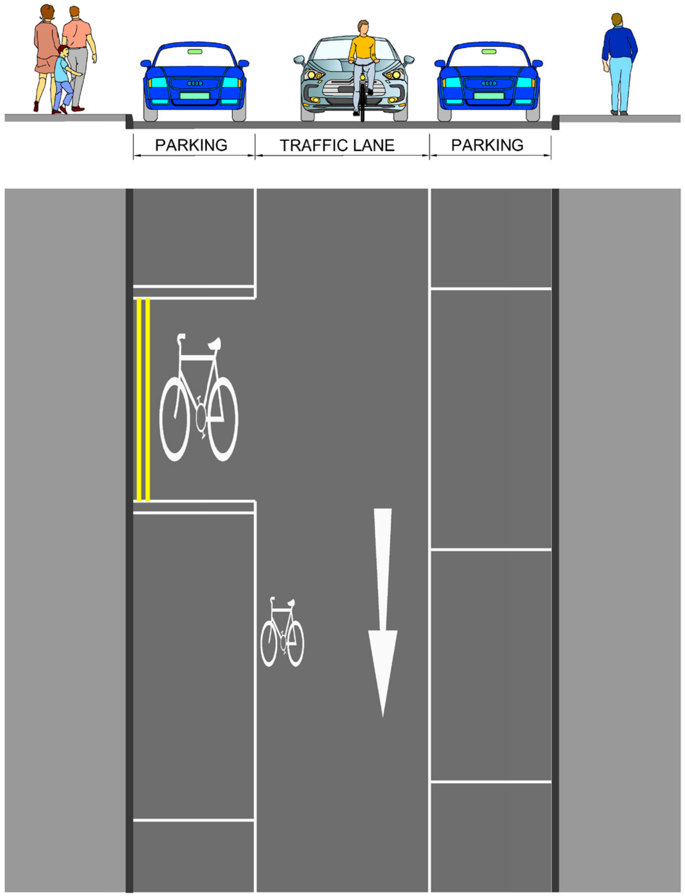

Figure 4.48: Contraflow cycle facility on shared street – typical cross section and plan layout.

4.2.10.4 Contraflow Entry and Exit Treatments

A traffic island, refuge or other kerbed feature should be used at the start and end of the contraflow cycle facility to provide an entry/exit cycle gate. The cycle gate assists drivers and cyclists to observe the rules of the road (i.e. cyclists keep to the left and oncoming traffic passes to their right) and gives protection to cyclists against encroachment by turning vehicles.

Where traffic conditions allow, the gate can be provided by light segregation, such as a flexible bollard. On shared streets, an unsegregated entry/exit treatment comprising a cycle logo marking and a short length of dashed edge markings may be sufficient (see Figure 4.49).

Figure 4.49: Contraflow entry treatment on a shared street, Leinster Street North, Dublin.

Where a contraflow cycle facility enters a signal-controlled junction, cyclists should be provided with a dedicated signal phase to allow them to safely exit the one-way street (see Figure 4.50).

Figure 4.50 Contraflow exit treatment at signal-controlled junction, Bull Alley Street, Dublin.

4.2.10.5 Contraflow Bus Lanes

Shared bus and cycle lanes can be used in the contraflow direction. The desirable width is 4.5m wide or greater to allow buses to comfortably overtake cyclists. A cycle lane may be marked within this space.

Where this width is not achievable, the shared bus and cycle lane should be 3.0m to 3.25m wide to discourage unsafe overtaking of cyclists. Bollards may need to be placed along the outside edge of narrow bus lanes to ensure that buses do not leave the bus lane to pass cyclists, increasing the risk of collision with oncoming traffic (see Figure 4.51).

Figure 4.51: Contraflow shared bus and cycle lane, Winetavern Street, Dublin.

4.2.11 Parking and Loading on Links

The nature of parking and loading on streets means that drivers and passengers will interact with a cycle track or cycle lane, whether that is driving into/out of the space or when trying to get to/from the footpath.

On-street parking and loading directly alongside a cycle facility can be hazardous for cyclists especially in a street with high parking turnover rates where there is a higher risk of vehicle doors being opened into the path of cyclists.

4.2.11.1 Protected Cycle Tracks and Lanes (TL111)

On road and streets where on-street parking is justified, the preferred layout for on-street parking is to have the cycle track or cycle lane between the parked vehicles and the footpath. Where loading bays are required, the cycle track should also be placed behind the loading bay. This offers a higher level of service in terms of safety and comfort compared to cycling adjacent to the moving traffic.

Cyclists, drivers and passengers should have sufficient visibility to be aware of each other's presence. This includes a contrasting cycle track colour and cycle markings, and high-visibility crossings of the cycle track (e.g. zebra markings).

A buffer should be provided between the cycle facility and parked vehicles to allow for car doors to be opened safely without compromising the safety of cyclists. A cycle track of 2m wide will provide additional evasion room. The buffer should provide enough space for drivers and passengers to comfortably get in and out of a vehicle, including people using wheelchairs or people unloading prams, etc. The buffer may be used as a path to access a dropped kerb on the footpath, provided that the buffer is suitably wide and free of obstacles. The desirable minimum buffer width is 0.75m (and an absolute minimum width of 0.5m in locations with lower turnover of spaces). Where bollards or other vertical elements are placed in the buffer, they should be positioned so that they do not block vehicle doors (see Figure 4.52).

Figure 4.52: Protected (contraflow) cycle lane, Hume Street, Dublin.

At side roads, it is essential to provide clear inter-visibility between cyclists and turning vehicles. Parking/loading bays should be terminated at least 10m in advance of the junction and commence at least 5m following the junction.

Designers will also need to ensure that any parking/loading bays do not impact on sight visibility requirements at junctions (refer to Section 4.1.3).

The commencement of the parking or loading bay should include physical delineation, to orient moving traffic to the right of parking, and cyclists to the left. This can be a series of reflective bollards or a commencing traffic island. Street lighting is important at the commencement, conclusion and any interim junctions or accesses along the facility.

Parking protected cycle tracks/lanes are not typically suitable in conjunction with taxi bays, due to the higher frequency of taxi doors opening and people crossing the cycle facility. Where parking bays are intended as late night, or part time, taxi ranks, a permanent buffer (minimum of 1.3m wide) should be provided between the cycle track and taxi rank.

Electric vehicle charge points should not be placed where parking protected cycle facilities are provided, as the cable connecting the car to the charge point on the footpath extend across the cycle lane. The problem could be overcome by installing the charge point on a traffic island within parking area. TfL have **standard details** for such an installation.

4.2.11.2 Disabled Person's Parking Bays

Disabled person's parking bays can be accommodated within a parking protected arrangement as shown in Typical Layouts **TL111** and **TL114**.

A clear, level width of 2.0m is required alongside disabled person's parking bays to allow people to unload a wheelchair and turn within the space. Users should have a clear route and level access to the footpath.

The buffer between the parking bay and cycle track should be made wide enough to facilitate comfortable movement for wheelchair users to travel along the buffer to a suitable crossing location to access the footpath. Localised narrowing of the cycle track/lane may be required to provide a widened buffer (see Figure 4.53). Dropped kerbs should be provided at crossing locations to allow access to the footpath. If a raised buffer is used, the cycle facility should be raised to provide a level crossing to the footpath.

Figure 4.53: Disabled person's parking bay with widened buffer (note dished footpath opposite rear of bay), Fitzwilliam Street Lower, Dublin.

4.2.11.3 Loading in Constrained Spaces

On narrow streets where a cycle track behind a standard loading bay cannot be accommodated, the options below may be considered.

- **Loading Island (TL112)** – A loading island may be considered in urban centres where daytime deliveries are required but space is restricted. The island allows delivery vehicles to park off the carriageway and allows cyclist to retain the right of way. The loading bays hours of operation should be off-peak to avoid conflict with cyclists during the busiest traffic periods.

- **Partial Loading Island (TL112)** – In some circumstances, where a full-width loading island cannot be accommodated and traffic volumes are low, a reduced-width partial loading island may be considered. It requires delivery vehicles to park partially on the carriageway. The loading bay should be clearly marked to allow drivers to correctly position the vehicle. The cycle track should be raised to the same level as the footpath and the partial loading island to allow cyclists to get around parked delivery vehicles that may encroach onto the cycle track. The cycle track, footpath and loading island should have strong colour contrast and use different materials to minimise conflict between the different users of the space. The kerb between the partial loading island and the carriageway should have a splayed profile to facilitate rolling of hand trucks onto the footpath.
- **On-Road Loading Bay (TL113)** – The loading bay must be clearly marked on the carriageway adjacent to the cycle track. Good intervisibility between cyclists and people undertaking loading activity is required. Dropped or splayed kerbs should be provided on both sides of the cycle track to facilitate rolling of hand trucks onto the footpath and to allow potential evasion routes for cyclists. Stepped cycle tracks are more suitable for on road loading bays due to the lower level difference between the carriageway and track compared to standard cycle tracks. Motor traffic must pass the loading vehicle in the opposing traffic lane; therefore, this layout is suitable only on streets with low speeds and traffic volumes.

4.2.11.4 Cycle Lanes on the Traffic Side of Parking

In exceptional circumstances, a cycle lane may be positioned on the traffic side of parking bays however in such circumstances, a departure from standards should be sought and approved prior to implementation.

Situations where this layout may be preferable include where the parking bays have numerous buildouts making construction of a parking protected facility impractical or too costly; where electric car charging points are located; or if there are particular requirements for disabled persons parking.

Where a cycle lane is transitioned to the right to the offside of parking bays, protection should be provided. A buffer with a desirable minimum buffer width of 0.75m (and an absolute minimum width of 0.5m) should be provided between the parked vehicles and the cycle lane, and the cycle lane should be 2.0m wide to allow evasion room from opening doors.

4.2.12 Bus Stops

4.2.12.1 Introduction

Where cyclists and bus services use the same route, an integrated design for the users of both modes is required and should address safety, comfort, directness, and avoid unnecessary delays.

Some of the key components of high-quality bus stop infrastructure includes:

- Being fully accessible for all bus passengers;
- Having a bus shelter for waiting passengers;
- Having both timetable and real time passenger information (RTPI) available to passengers;
- Having sufficient footpath space to allow the free movement of pedestrians past the bus stop;
- Continuous cycle facilities past the bus stop; and
- Provision of cycle parking at, or close to, the bus stop.

A significant amount of road space is required to accommodate all, or most, of these elements. Therefore, the space requirements should be carefully considered when providing, or retro-fitting, bus stops on cycle routes.

The ideal bus stop spacing is 400m in suburban locations, and 250m in urban centres – this means that on most bus routes interactions between road users at a bus stop is generally unavoidable.

From the cyclist's perspective, possible interactions include:

- Passengers waiting at the bus stop;
- Passengers alighting from or entering the bus;
- Buses pulling into or away from the bus stop;
- Interaction between waiting passengers and other pedestrians;
- Pedestrians on an adjacent crossing point, especially if these are obscured by other traffic, including a stationary bus; and
- General traffic movements in the adjacent carriageway.

While it is recognised that it will not always be possible to provide conflict-free access for all users to and from bus stops, designers will need to balance the need to provide safer conditions for cyclists with the resulting interactions between pedestrians and cyclists caused by providing the protected cycle facility.

4.2.12.2 Design Considerations

The number of passengers waiting/alighting, frequency of bus service, cyclist flows, traffic conditions and available road space will determine the best design solution, but key issues to take into consideration include:

- Ensuring there is available space for cyclists to pass a stationary bus (either in the carriageway or on the footpath side of the bus stop) so that momentum is maintained;
- Making it clear that cyclists must adjust their behaviour and speed to avoid conflict with pedestrians around bus stops;
- Providing adequate, conflict-free space for people to wait for the bus;
- Providing sufficient safe space within a bus stop, including on the island, if a bypass is provided, for a person using a wheelchair to board or alight and turn;
- Providing good intervisibility between pedestrians (those waiting for a bus as well as those passing) and cyclists, to minimise potential for conflict; and
- Providing clear routes to and across the cycle track crossing for vision impaired people.

The main design solutions for bus stops on cycle routes are detailed in the following sections.

4.2.12.3 Island Bus Stop (Bus Stop Bypass) (TL201, TL203)

At an Island Bus Stop, the cycle track is taken around the rear of the stop adjacent to the footpath, bypassing the stop and thus removing conflict between cyclists and stopping buses (see Figure 4.54).

This is the preferred bus stop type for multi-modal corridors, and appropriate for bus stops on downhill sections, new developments, or outside central areas where space permits. However, the island arrangement increases the potential for conflict between pedestrians and cyclists, particularly vision impaired people who find it difficult to know when cyclists are approaching the crossing points.

The island between the cycle track and the carriageway needs to be wide enough for people to stand and wait for a bus and to site a shelter if one is to be provided. The island should ideally be at least 3m wide, which will accommodate parents and buggies, people with a guide dog or a person using a wheelchair to allow a bus wheelchair ramp to be deployed and sufficient space to turn the wheelchair.

All bus-related passenger activity (waiting, boarding, alighting) takes place on the island, and does not generally create any interference with the cycle bypass.

There should be good inter-visibility between passengers (those waiting for a bus), pedestrians (those walking past) and passing cyclists, to improve avoidance of collision.

Figure 4.54: Island Bus Stop, Tallaght.

Cyclists' speeds can be reduced through a combination of narrowing the track to single file, and vertical and horizontal transitions so that cyclists approach the bus stop at an appropriate speed to allow them to yield to crossing pedestrians.

The island is connected to the footpath by a raised crossing, over which cyclists must yield to crossing pedestrians. Priority can be given to pedestrians by means of a raised zebra crossing. In some circumstances where the designer wishes to further strengthen the crossing facilities, consideration can be given to using an alternative low level cycle signal, which provides a dedicated red signal stage, with audible warning, for the blind and partially sighted pedestrians wishing to cross the cycle track, more details are available in Section 4.4.5.2.1.

A width of approximately 6.5m to 7m is required from the back of the footpath to the edge of carriageway to create a bus stop bypass. Removing an existing bus layby can help provide space for these arrangements and provides benefits to bus services by reducing delay.

Where road space is available, landscaping elements such as rain gardens can be incorporated into the bus stop island (see Figure 4.55).

Figure 4.55: Planting in bus stop island, Manchester.

4.2.12.4 Shared Bus Stop Landing Zone (TL202)

Where space constraints do not allow for the provision of an island bus stop, a shared bus stop landing zone may be considered (see Figure 4.56).

Conflicts between cyclists, stopping buses and other motor traffic are removed by ramping cyclists up onto a footpath-level cycle track which passes through the bus stop.

This creates potential pedestrian-cyclist conflict at the landing area where people board and alight the bus. To mitigate the risk of conflict, the cycle track should be narrowed through the bus stop (to an absolute minimum of 1.3m) to encourage single file cycling and the track should be bent out from the kerb to create a boarding/alighting zone (maximum 1.0m) wide for bus passengers.

The landing zone is connected to the footpath (and bus shelter if one is provided) by a raised crossing, over which cyclists must yield to crossing pedestrians. Bus passengers wait on the footpath and move to the boarding area when a bus arrives. Cyclists must yield to passengers, and this should be reinforced with road markings and signs where necessary.

The use of contrasting materials for the boarding area and cycle track, both in colour and texture, is useful to highlight the difference between the two, to both pedestrians and cyclists. The boarding/alighting zone should be flush with the cycle track to avoid creating a tripping hazard and to enable wider cycles to straddle the zone.

This layout should only be considered in constrained locations with low pedestrian and cycle flows and low frequency bus routes where other bus stop options are less suitable, and bus stop relocation is not feasible.

Good intervisibility is required between pedestrians (those waiting for a service as well as those passing) and cyclists. This minimises the potential for conflict and the stop should be apparent to cyclists, who will need to be able to adjust their behaviour and speed, particularly when a bus is at the stop. Sufficient lighting should be provided at these locations to ensure that all road users can maintain intervisibility during the hours of darkness.

Figure 4.56: Shared Bus Stop Landing Zone, Cork.

The minimum off-carriageway width to accommodate this type of bus stop arrangement is 4m. More space may be required to accommodate wider footpath in areas with moderate to high pedestrian activity or where a bus shelter is required. Designers should avoid using hard street furniture (poles, bins, bicycle stands) in vicinity of bicycle narrowing area and the landing zone.

In determining the widths of the constituent parts (footpath, cycle track and landing zone) in the vicinity of the bus stop, the designer should take into account existing and projected demand for each and ensure that:

- the footpath width complies with DMURS requirements;
- the cycle track is not narrower than 1.3m; and
- the landing zone is minimum 1.0m wide.

4.2.12.5 In-Line Bus Stop (TL204)

In-line bus stops can be a suitable option at locations with space constraints where other layouts which maintain segregation between buses and cyclists are not possible, and/or where conflict-free bus passenger movement is necessary. At an in-line bus stop the cycle lane is stopped at the bus cage. Any physical protection (e.g. bollards) provided along the cycle lane must also be stopped in advance of the bus cage to allow buses to access the kerb (see Figure 4.57).

This layout does not remove the conflict between cyclists, buses, and motor traffic. When a bus is stopped, cyclists yield priority and wait behind the bus or, if sufficient space is available, cyclists may be able to overtake the stopped bus.

This layout is only suitable on mixed traffic streets and in the most constrained locations on very low frequency bus routes (e.g. 2 to 4 buses per hour) and where the duration the bus stopped is short (i.e. predominantly a bus passenger drop-off location).

Figure 4.57: In-Line Bus Stop, Dublin.

Cyclist and bus drivers should be made aware of the conflict by use of red surfacing on the approach to the cage and cyclists discouraged from overtaking by use of road markings such as a yield marking.

To deter vehicles overtaking buses at the stop, consideration could be given to including some “centreline hardening” measures (e.g. using a raised median strip or installing a row of reflective bollards with a double solid centreline).

4.2.13 Transitions

The points at which a cycling facility alternates between the carriageway and a separated cycle track can introduce potential for conflict.

The cycle route may move on or off-carriageway at constrained sections, junctions and crossings or where traffic conditions or the balance of the street functions changes (e.g. at parking bays, loading areas, bus stops). The transition usually involves a change in level and/or direction and needs to be anticipated and understood by the other road users, as well as the cyclist.

Combination transitions – where vertical and horizontal transitions occur in the one location – should be avoided. Historically, they have been difficult to construct correctly, and equally difficult for cyclists to use them. These movements should be dealt with sequentially, but not at the same time.

4.2.13.1 Cycle track to carriageway transitions (TL301, TL302)

Cyclists leaving an off-carriageway facility to re-join the carriageway can be at risk of conflict with motor traffic. Where a cycle track merges back to the carriageway, the merge should be designed so that cyclists do not need to give way to general traffic and are physically protected until safely established on their new alignment. This will reduce the risk of cyclists being struck by motor traffic from behind.

Where the cycle facility is being shifted to the right, a physical barrier such as a kerb or traffic island should be used to protect cyclists from motor traffic behind them. For legibility, the island should have a vertical element (e.g. reflective bollard or planter) to make it obvious to approaching motor traffic. Reverse curves should be used so that the cyclist is tangential/parallel to traffic flow before and after the transition to the right (see Figure 4.58).

Figure 4.58: Transition to carriageway, Main Road, Tallaght.

Where a cycle track or cycle lane transitions into a narrow, shared street (mixed traffic) environment, cyclists should be protected as they merge from their own space into the mixed traffic lane. Consideration should be given to providing a physical shuttle to make drivers approach the transition area at an appropriately low speed. The feasibility of providing the shuttle will depend on the space available, motor traffic flows and the balance of those flows. If the shuttle is to operate on a priority basis (i.e. not signal controlled) then it is important that opposing drivers can see each other on approach. The shuttle can also act as a gateway which reinforces to drivers that they are entering a street environment with a different context and function (see Figure 4.59).

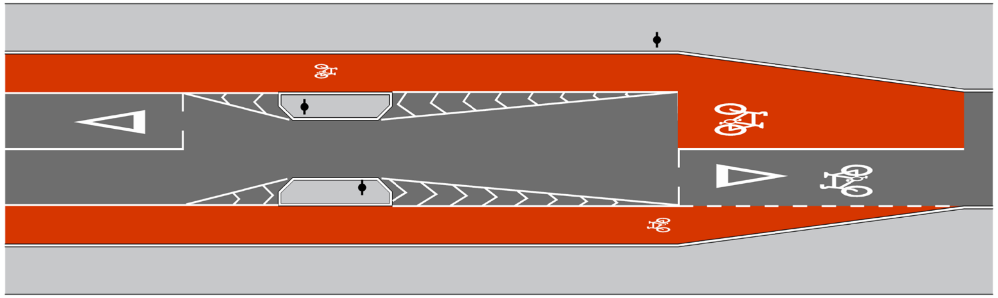

Figure 4.59: Shuttle transition to mixed traffic street.

4.2.13.2 Carriageway to cycle track transitions

Transitions from a carriageway to a cycle track usually present fewer safety problems for cyclists but need to be designed to avoid the need for any sharp turns, steep ramps or kerb upstands. This may be achieved with a kerb build out that is preceded by a section of mandatory cycle lane or taper markings. The build-out may need a bollard to ensure that it is visible to road users (see Figure 4.60).

Where the cycle track is immediately adjacent to the carriageway, the kerb build out may precede the diverge point. Alternatively, protection may be offered simply by the kerb line of the existing verge/footway, with a gentle diverge away from the carriageway.

Figure 4.60: Transition from carriageway to cycle track.

4.2.13.3 Transitions between pedestrian priority areas and cycling infrastructure

There are various situations where separate cycle tracks and footpaths merge into a single shared surface. The most common situations are where width is restricted such as near bus stops or at toucan crossings. The transition may also occur at the interface of a built-up area and an interurban shared footpath where low pedestrian and cyclist use is anticipated (see Figure 4.61).

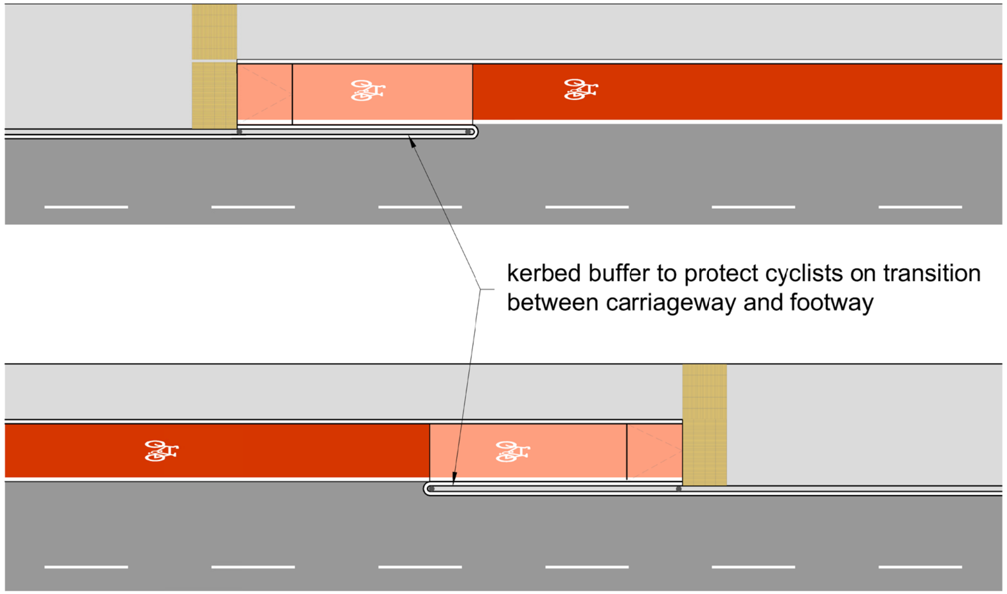

Figure 4.61: Typical vertical transitions to and from pedestrian priority areas.

If the transition introduces cyclists into a shared (pedestrian-priority) facility, it is important that the correct tactile paving type (ladder and tramline, as shown in Figure 4.62) and layout is used so that visually impaired people are aware that they are sharing the space with cyclists, and that this is also clear to the cyclist. Refer to **Guidance on the Use of Tactile Paving Surfaces**.

Figure 4.62: Typical tactile paving layout at transition to a Toucan crossing, Scholarstown, Dublin.

4.2.14 Pedestrian Crossings of Cycle Tracks

This section provides design guidance on the crossing of cycle tracks by pedestrians away from junctions. Guidance on crossings at junctions are provided in Section 4.3 and 4.4 There are a number of situations where pedestrians will need to cross over a cycle track, including at a parking protected cycle facility, loading island, bus stop island, or bus stop landing zone. The following items should be considered when designing crossings.

- The location of the crossing should meet existing or anticipated pedestrian desire lines;
- Priority should be clear to all users;
- The crossing should be fully accessible (e.g. flush kerbs, tactile paving); and
- There should be good intervisibility between cyclists and crossing pedestrians (See Section 4.1 for sight distance and visibility requirements).

In addition, it is recommended that designers also consult with local community/interest groups to identify any particular issues at a scheme level that should be considered.

4.2.14.1 Uncontrolled Pedestrian Crossings

At uncontrolled crossings, the footpath is dished to the cycle track level and dropped kerbs and appropriate tactile paving are provided (see Figure 4.63). Uncontrolled crossings operate in a similar way to uncontrolled crossings of road carriageways. People using the cycle track have priority to proceed and pedestrians wait for a suitable gap to cross.

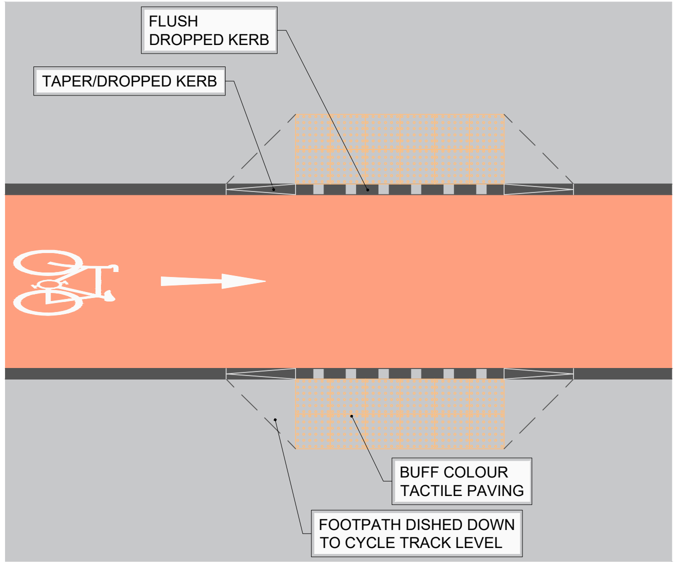

Figure 4.63: Layout at uncontrolled (cyclist priority) crossing of cycle track.

4.2.14.2 Raised Uncontrolled Pedestrian Crossings

At uncontrolled crossings the cycle track can be raised to footpath level at the crossing in locations where cycling speeds may need to be reduced and/or in areas with higher pedestrian activity to increase awareness of potential conflict (see Figure 4.64). Triangular road markings (“sharks’ teeth”) should be provided on the approach ramp to warn cyclists of the vertical transition.

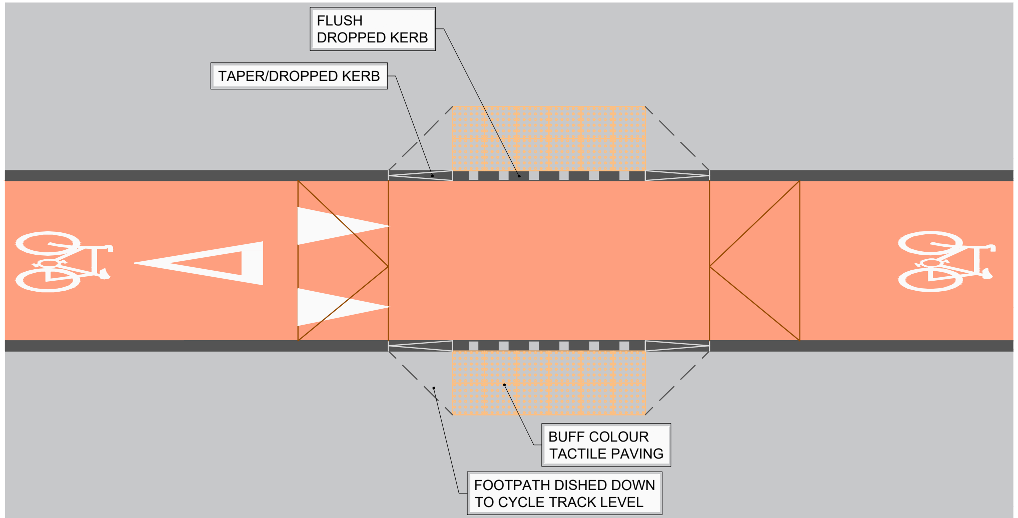

Figure 4.64: Layout at raised uncontrolled crossing of cycle track.

4.2.14.2 Controlled Pedestrian Crossings

Priority can be given to pedestrians by means of a raised zebra crossing. The crossing should include red-colour tactile paving forming the standard L-shape pattern. The zebra markings can be supplemented with a triangular yield marking (see Figure 4.65).

In situations where road markings alone may not provide the required level of priority for pedestrians, zebra crossing traffic signs or belisha beacons can be provided. In this case the preferred option is to provide zebra crossing traffic signs. Ducting and pole sockets can be included in the works requirements so that belisha beacons can be retrofitted.

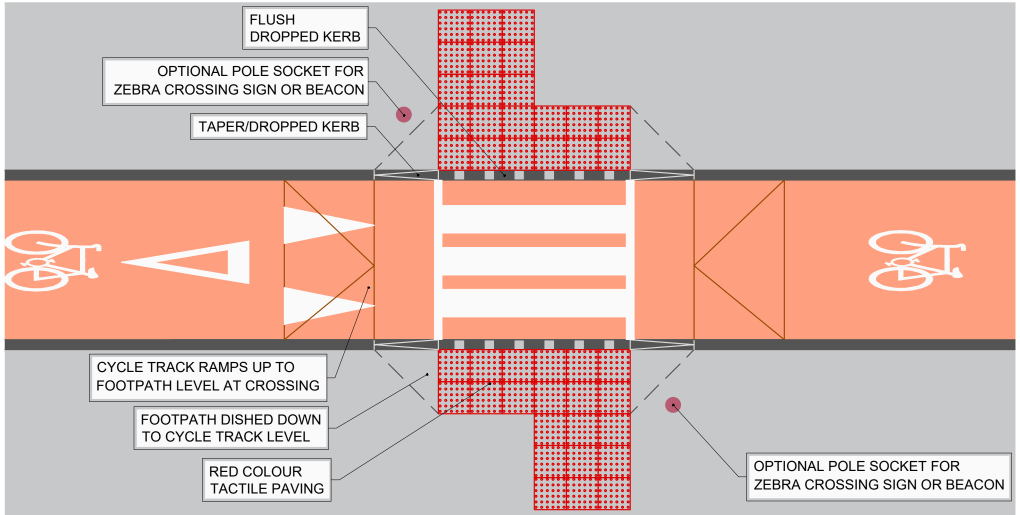

Figure 4.65: Layout at controlled pedestrian crossing of cycle track.

In some circumstances where additional control, or assistance, is warranted, consideration can be given to using an alternative low level cycle signal, which provides a dedicated red signal stage, with audible warning, for the blind and partially sighted pedestrians wishing to cross the cycle track, more details are available in Section 4.4.5.2.1.

4.3 Priority Junctions

4.3.1 Introduction

Priority junctions are the most common type of junction on our road network and cyclists are therefore likely to encounter multiple priority junctions on most journeys so it is crucial that cycle traffic is appropriately catered for in priority junction layouts. This manual provides updated guidance in relation to priority junction design, based on international best practice and recent experience of cycle infrastructure design in Ireland.

4.3.2 Key design considerations

Safety

Safety is one of the most critical consideration for priority junction design. Different modes will need to interact at priority junctions and, utilising a safe system approach, the key will be to manage these interactions as safely as possible so that:

- the potential for conflict is minimised, and
- if collisions do occur, outcomes are as benign as possible.

Importantly, junction layouts should also feel safe to use for cyclists of all ages and abilities. If junctions are not perceived to be safe, this will likely be a barrier to new and less confident cyclists. Minimising the exposure to vehicular traffic will be a key aspect in this regard.

Directness

Directness for cyclists is another important consideration for priority junction design. Cycling requires physical effort, particularly starting from a stationary position, therefore the number of stops along cycle routes should be minimised to reduce the physical effort and delays and provide the most direct cycling experience. Minimising the number of stops will also enhance the comfort and attractiveness of cycle facilities.

4.3.3 Cycle tracks at priority junctions

The following sections provide guidance on the design of priority junctions where cycle tracks are present on the approach roads (main road and/or side road).

4.3.3.1 Crossing set back

Where cycle tracks cross the mouth of side roads at priority junctions, there are a number of different layouts which can be adopted. The choice of layout will likely depend on a number of factors including the available space and the road function and context.

The recommended layouts are divided into three categories based on the crossing set back distance from the main road as shown in Table 4.18:

Table 4.18: Types of crossing set backs.

Crossing Type	Description
Full Set Back (TL401)	Crossing is set back 5 meters from the road edge
Partial Set Back (TL402)	Crossing is set back 1-5 meters from the road edge
No Set Back (TL403 and TL405)	Crossing is located within 1m of the road edge

Figures 4.66 to 4.68 illustrate the different types of crossing set back.

Figure 4.66: Full set back cycle track across a side road.

Figure 4.67: Partial set back across a side road.

Figure 4.68: No set back across a side road.

The preferred arrangement is that cycle facilities are fully set back 5m from the main road wherever possible. A full set back crossing located 5m from the road edge has a number of key advantages including:

- improving the conflict angle so motorists have better visibility of crossing cyclists and cyclists are kept out of blind spots (see Figure 4.69),
- provides additional deceleration space and reaction time for motorists,
- provides waiting space for cars to yield without blocking the cycle track or main road, and
- provides space to incorporate additional yield markings if required between the crossing and main road.

To achieve the 5m set back distance, it may be necessary to bend out the cycle track on the approach to the junction. In such situations, reverse curves using radii given in Table 4.7 should be used.

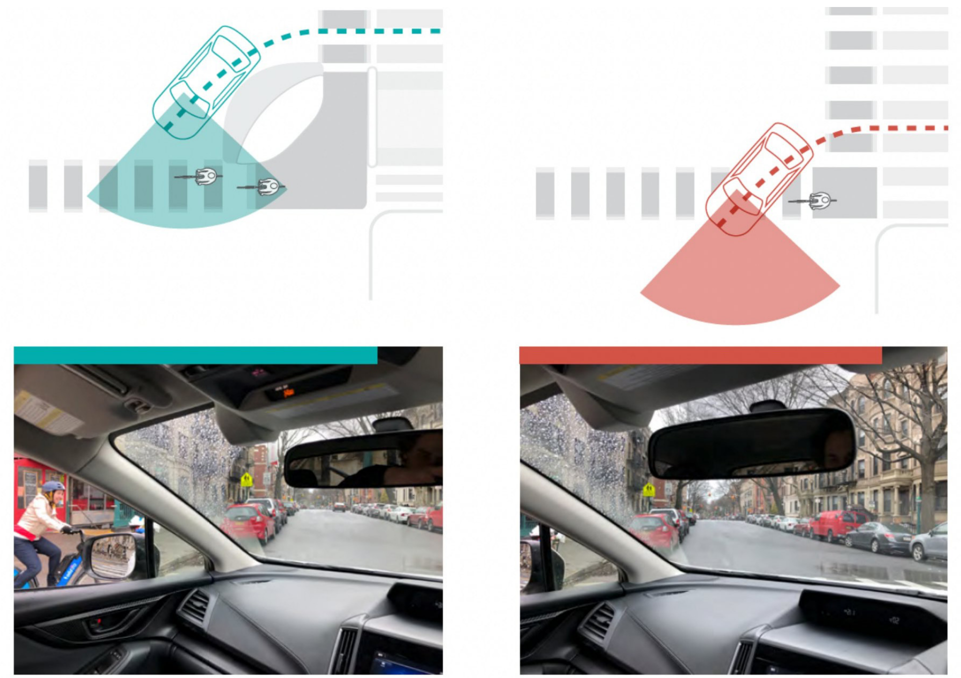

Figure 4.69: At a full set back crossing, drivers have a better view of crossing cyclists (left) compared to a no set back crossing (right). (Source image: NACTO.)

Where a full set back of 5m cannot be achieved e.g. due to existing constraints, designers should aim to provide the largest possible set back between 0-5m and utilise a partial set back or no set back layout as appropriate.

4.3.3.2 Cycle Priority

In terms of priority, the preferred arrangement is that cycle tracks continue with priority across side road junctions in urban areas on a raised crossing. The adjacent pedestrian crossing should also be raised to enhance the comfort and priority of pedestrians.

Cycle tracks can be raised to the footpath level at the crossing point, as shown in Figure 4.70, or remain at an intermediate level between the footpath and road with ramps/beveled kerbs provided either side of the cycle track to facilitate access/egress from the side road, as shown in Figure 4.71.

Figure 4.70: Cycle Track raised to footpath level at a side road crossing in Amsterdam.

Figure 4.71: Cycle track at an intermediate level at a side road crossing with bevelled kerbs either side of the cycle track for vehicular access.

Cycle priority can be achieved in all three set back scenarios (full/partial/no set back) by utilising the design solutions and layouts presented in the Appendix. The use of road markings and signage should be used to indicate priority where possible; however it is important that junctions are designed so that priority for cyclists is reinforced by the junction layout itself, regardless of whether signage and markings are used to indicate priority. Key design elements in this regard may include:

- Using continuous footpath and cycle track designs;
- Omitting corner radii and continuing road kerbs straight through the junction;
- Providing clear visual contrast between the carriageway and footpath/cycle track surfaces;
- Ensuring slow vehicle speeds through the junction; and
- Ensuring good visibility for all users.

Whilst the preferred arrangement is for cycle tracks to be given priority across side roads, it is recognised that in some situations it may be considered desirable/necessary (e.g. from a road safety perspective) to retain priority for vehicles entering/exiting the side road. Such situations may include rural locations or minor roads with high HGV volumes in urban areas e.g. in industrial areas.

Table 4.19 provides a guide to assist designers in selecting whether or not cyclists should be given priority across side roads based on the movement function of the main road and place context of the location under consideration (refer to DMURS Section 3.2 for guidance on movement and place).

Where cycle tracks lose priority at side road crossings, this should be clearly indicated using appropriate markings and signage, and an uncontrolled crossing will typically be provided (TL404). The use of refuge islands at uncontrolled crossings of side roads should be considered where possible to reduce the number of lanes to be crossed in a single movement and encourage slower vehicular traffic speeds at the crossing point.

Table 4.19: Sugested Cycle Priroity at Side Roads

Main Road Movement Function	Centre (≤ 50 km/h typically)	Neighbourhood/ suburban (≤ 50 km/h typically)	Business Parks/ Industrial Estate (≤ 50 km/h)	Rural fringe (≤ 60 km/h typically)	Rural (> 60 km/h)
Arterial	Cycle priority recommended	Cycle priroity should be considered	Vehicle priority recommended	Vehicle priority recommended	Vehicle priority recommended
Link	Cycle priority recommended	Cycle priority recommended	Cycle priroity should be considered	Vehicle priority recommended	Vehicle priority recommended
Local	Cycle priority recommended	Cycle priority recommended	Cycle priroity should be considered	Cycle priroity should be considered	Vehicle priority recommended

Place Context

- Cycle priority recommended
- Cycle priroity should be considered
- Vehicle priority recommended

Note: Designers should refer to DMURS Section 3.2 for guidance and definitions on movement function and place context.

4.3.3.3 Side Road Access/Egress

At priority junctions, designs will need to include a provision for cyclists to easily manoeuvre to/from the side road and the cycle track on the opposite side of the carriageway. The appropriate provision will depend upon whether the cycle track opposite is at- grade or raised.

If the cycle track opposite is at-grade and segregated from traffic, then a sufficient gap in the segregation should be provided opposite the side road, see example in Figure 4.72.

Figure 4.72: Gap in separator kerb provides access to at grade cycle track opposite the side road.

If the cycle track opposite is raised above the carriageway then a ramp or bevelled kerb with a maximum gradient of 5% (1:20) should be provided to facilitate access for people cycling to/from the side road, see example in Figure 4.73.

If a cycle crossing on the main road is located in close proximity, e.g. less than 25m, from the side road then it may be possible to omit the access point directly opposite the side road, however designers must ensure that all cycle movements are adequately catered for in such circumstances e.g. cycling in both directions.

Figure 4.73: Ramp provides access to raised cycle track opposite a side road.

4.3.3.4 Protected Priority Junctions (TL406)

Where two roads with cycle tracks intersect at a priority junction, the preferred arrangement is for a Protected Priority Junction as illustrated in Figure 4.74 to be implemented.

The layout is very similar to a signalised protected junction with protected corner islands and crossings set back 5m from the junction etc. The use of a protected priority junction layout has a number of key advantages including:

» Provides a dedicated space for cycling which caters for all cycle movements;

- Maintains segregation between all modes;
- Reduces crossing distances which minimises the potential for conflict with motorists; and
- Creates stacking space for cyclists waiting to cross.

The layout is similar to a signalised protected junction layout and so will be familiar to road users, thereby enhancing the consistency of the cycle network.

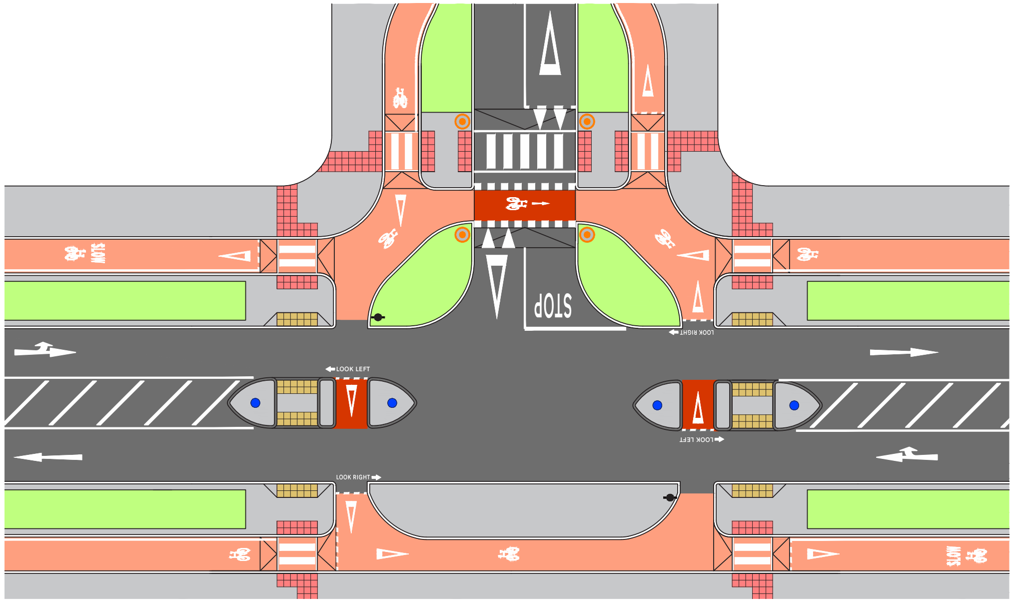

Figure 4.74: Example Protected Priority Junction Layout.

A protected priority junction layout should also be considered on schemes where cycle tracks are only being provided on the main road but the side road forms part of the overall cycle network. The provision of a protected junction layout would future-proof the junction for cycle infrastructure on the side road at a later stage.

4.3.3.5 Two-way cycle tracks (TL407, TL408, TL409, TL410)

The guidance in the preceding sections also pertains to two-way cycle tracks crossing side roads at priority junctions. As such, the preferred arrangement is for two-way cycle tracks to cross the side road with priority on a raised entry treatment. A full set back crossing is also the preferred arrangement as shown in figure 4.75.

Figure 4.75: Two-way cycle track with full set back at side road junction.

As mentioned in section 4.2, two-way cycle tracks can present additional challenges and risks which need to be considered. At side road crossings, the critical issue is that motorists entering/exiting the minor road may not anticipate cyclists travelling in the unexpected direction i.e. against the flow of the directly adjacent traffic.

The typical layouts for two-way cycle tracks at priority junctions in the Appendix include additional measures to manage these interactions and ensure they as safe as possible. The additional measures may include:

- » Additional signage to alert motorists that cyclists may approach from either direction, see Figure 4.70;
- » Hazard markings on the cycle track to alert cyclists of the crossing point and potential interactions with motorists;
- » Additional traffic calming measures to control motor traffic speeds approaching the junction, particularly for partial set back and no set back crossing layouts; and
- » The use of one-way traffic systems in combination with no set back layouts to reduce traffic volumes and simplify turning movements at junctions.

Figure 4.76 Sign W 143 with supplementary plate P005 may be used to warn motorists that cyclists may approach in either direction.

4.3.4 Cycle lanes at priority junctions (TL411)

Mandatory cycle lanes will typically continue across the mouth of side road junctions at carriageway level and be delineated using red surfacing and elephant's footprints markings. Consideration should be given to protecting the cycle lanes via bollards or similar on the approach to the junction to prevent vehicle encroachment.

Appropriate lane widths and corner radii in accordance with DMURS requirements should be adopted to manage traffic speeds through the junction.

Where cycle lanes cross side roads, the adjacent pedestrian crossing will typically be an at grade (dished) crossing however cycle lanes can also be used in combination with raised pedestrian crossings and zebra crossings as required.

Cycle lanes may also be transitioned to cycle tracks at side roads and a set back crossing provided in accordance with section 4.3.3 above, if it is consider appropriate/desirable.

4.3.5 Mixed Traffic Priority Junctions

Where traffic conditions are suitable to mix people cycling with motor traffic (see Table 2.1), such as on residential or access streets, priority junctions should be designed as per DMURS requirements. It is recommended that the following features are considered for inclusion in mixed traffic priority junction layouts to ensure good conditions for cycling:

- » Tight corner radii, including the use of overrun areas to accommodate the turning movements of larger vehicles if necessary (see example in Figure 4.77);
- » Narrow lane widths on all approaches;
- » Single lane exits from side road;

» Traffic calming measures on the approach to the junction and/or use of raised table junctions; and

» Large Cycle Symbols markings (M 116) placed on the approach roads.

Figure 4.77: Example of overrun area at a priority junction used to manage vehicle turning speeds and facilitate turning movements of larger vehicles (Source: André Pettinga).

4.3.6 Entrances & Driveways

Cyclists and pedestrians passing by private entrances have priority over traffic entering and exiting the property. Therefore it is essential that entrances are designed in a manner that provides for and reinforces this priority. As such, footpaths and cycle tracks should not be dropped/dipped across entrances or driveways as shown in Figure 4.78.

Figure 4.78: Cycle tracks dipped across private entrances is uncomfortable and potentially dangerous for cyclists and should not be used.

4.3.6.1 Cycle tracks passing entrances and driveways

Where standard or stepped cycle tracks cross entrances and driveways, continuous footpaths should be used for pedestrians, the level of the cycle track should remain constant and bevelled kerbs or short ramps should be provided for vehicles to cross over the footpath and cycle track. Corner radii should not be used, rather the kerb line should continue straight across the entrance.

Figure 4.79 illustrates how a cycle track with no buffer (i.e. cycle track is directly adjacent to carriageway) should be brought across a private entrance. The cycle track will typically be 60mm below footpath level and 60mm to 125mm above carriageway level. Bevelled kerbs (1:5 to 1:10 gradient recommended) should be provided at front and rear of cycle track for vehicular access. The cycle track may need to be narrowed slightly at an entrance to accommodate bevelled kerbs, depending on the kerb width and height difference. In such circumstances a minimum 1.5m cycle track should be maintained.

Figure 4.79 Cycle track with no buffer passing private entrance

Where a cycle track with a buffer passes a private entrance (Figure 4.80) a similar treatment should be used. The cycle track will typically be 60mm below footpath level and 60mm to 125mm above carriageway level. The road kerb line should continue straight across the entrance, without corner radii, and a ramp (1:10 gradient recommended) should be provided within the buffer zone.

The ramp surface should have a different colour to that of the carriageway and cycle track. Ideally the ramp will match the material and tone of the footpath. A bevelled kerb (1:5 to 1:10 gradient) should be provided between the cycle track and footpath for vehicle access over the footpath.

Figure 4.80: Cycle track with buffer passing a private entrance.


YIELD

4.4 Signal-controlled Junctions

4.4.1 Introduction

Signal-controlled junctions can be used to control traffic flows between intersecting routes with higher traffic volumes. Traffic signals are primarily used to control conflicting movements between road users and to make efficient use of the available road space.

Signal-controlled junction design is a complex task, often influenced by many site specific factors particularly in a retrofit scenario e.g. existing geometry and land constraints.

The typical layouts presented in this manual are generally of four-arm signal controlled junctions. The development of the layouts has been guided by the need to adopt a safe system approach, by the experience gained in the provision of cycle facilities at signal-controlled junctions in Ireland since the National Cycle Manual was first published in 2011 and influenced by best international practice.

The full junction arrangements presented in the manual should typically be achievable in new 'greenfield' developments however in retrofit situations, designers will typically need to tailor the junction layouts appropriately to cater for site specific circumstances. Also in certain circumstances, different approaches may need to be considered for different arms of a junction e.g. providing protected facilities on the main road but a lesser provision on the side road with low traffic volumes and no dedicated cycle facilities. Designers should be guided by the main requirements below when tailoring junction layout.

4.4.2 Main requirements for signal-controlled junctions

Safety

Junctions represent a particular risk for cyclists as almost half of serious collisions involving cyclists occur at junctions. Designers should adopt a safe system approach so that the potential for conflict is minimised and that if collisions do occur, that outcomes are as benign as possible. Key aspects in this regard will include:

- separating cyclists from motor traffic and pedestrians to the greatest extent possible;
- ensuring layouts are legible and forgiving;
- ensuring motor vehicles speeds are slow through junctions; and
- providing short crossing distances to minimise the potential for conflict.

Directness

Minimising delay is also an important aspect to ensure cycle routes through junctions are as direct as possible. Measures that can help reduce diversion and delay to cycle traffic should be integrated into the design where appropriate, such as:

- Detection of cycles on the approach and at the junction;
- Avoiding multi-stage and staggered crossings;
- Minimising the number of stages and overall junction cycle time; and
- Maximising green times for cyclists.

Coherence

Cycle facilities on the approaches to and through signal controlled junctions should be continuous, legible and easy to understand. Coloured surfacing and road markings as recommended in this manual should be used to assist cycle traffic to navigate through junctions.

Where a number of signal controlled junctions are present on a cycle route, similar junction arrangements should be adopted at all junctions wherever possible to provide a consistent approach along the route.

Comfort

Cycle facilities through junctions should be comfortable to use. They should have smooth surfaces and be of adequate width to cater for the anticipated cycle flows. Vertical and horizontal transitions should be smooth and cater for all types of cycles including larger and non-standard cycles. Additional facilities to improve the comfort of cyclists may also be considered such as footrests and balancing aids.

4.4.3 Protected Junctions

4.4.3.1 General

Protected signal controlled junctions are signalised junctions with segregated cycle tracks around the perimeter, typically located between the footway and carriageway. The inclusion of cycle tracks creates a dedicated space for cycling that is segregated from both pedestrians and motor traffic and that caters for all cycle movements. Importantly, a protected junction layout allows cyclists to make right turn movements protected from motor traffic.

Protected junction arrangements have been extensively used in The Netherlands, where the concept was originated, for many years and are being adopted by a growing number of countries globally including the UK, USA, Canada, Australia and New Zealand.

To date a small number of protected junction layouts have been implemented in Ireland including in Dundrum (Figure 4.81) and Ballymun in Dublin, and in Carlow Town (Figure 4.82). Many more protected junction layouts are currently being planned under Active Travel schemes around the country and on BusConnects corridors in Dublin and the Regional Cities. It is anticipated that the continued rollout of protected junctions will improve junction consistency and coherence on the cycle network.

Figure 4.81 Protected Junction at Drummartin Road/Lower Kilmacud Road, Dundrum.

Figure 4.82: Protected junction layout on Hanover Street, Carlow.

In order to provide junction layouts that can safely cater for all cycle movements and are suitable for use by cyclists of all ages and abilities, protected junction layouts are the preferred arrangements for signal-controlled junctions on cycle routes.

4.4.3.2 Key features of protected junctions

There are a number of variations of protected junction layouts presented in this manual to suit different circumstances and conditions. These are described in the following sections with typical layouts presented in the Appendix. However, there are a number of key features applicable to all the protected junction layouts as detailed in Table 4.20 below.

Table 4.20: Key features of protected junctions.

Orbital Cycle Track	
An orbital cycle track around the junction provides a dedicated space for cyclists, segregated from both pedestrians and motor traffic. The orbital track is typically level with the adjoining carriageway so if the cycle track is raised on the approach road it will be ramped down to carriageway level in advance of the junction.	
Protected Corner Islands	
Raised islands, typically elliptical in shape, located at junction corners that provide cyclists protection from turning vehicles and a safe space whilst waiting to cross. The islands also help to control motor vehicle turning speeds.	
Set Back Crossings	
The crossing is set back from the edge of the main road. This can improve visibility between straight-ahead cyclists and turning motorists at the conflict point, helping to reduce blind spots. Set back crossings can also help create stacking space for cyclists waiting to cross the junction.	
Parallel Crossings	
Cyclists and pedestrians cross the junction in their own dedicated space, avoiding the use of shared space. In some protected junction arrangements, cyclists and pedestrians can run in the same signal stage which can increase junction efficiency and reduce delays for all users.	

4.4.3.3 Protected Junction (TL501)

In a protected junction layout (see Figure 4.83), the cycle track is set back on the approach to the junction which creates space to manage the interaction between pedestrians and cyclists outside of the signal control.

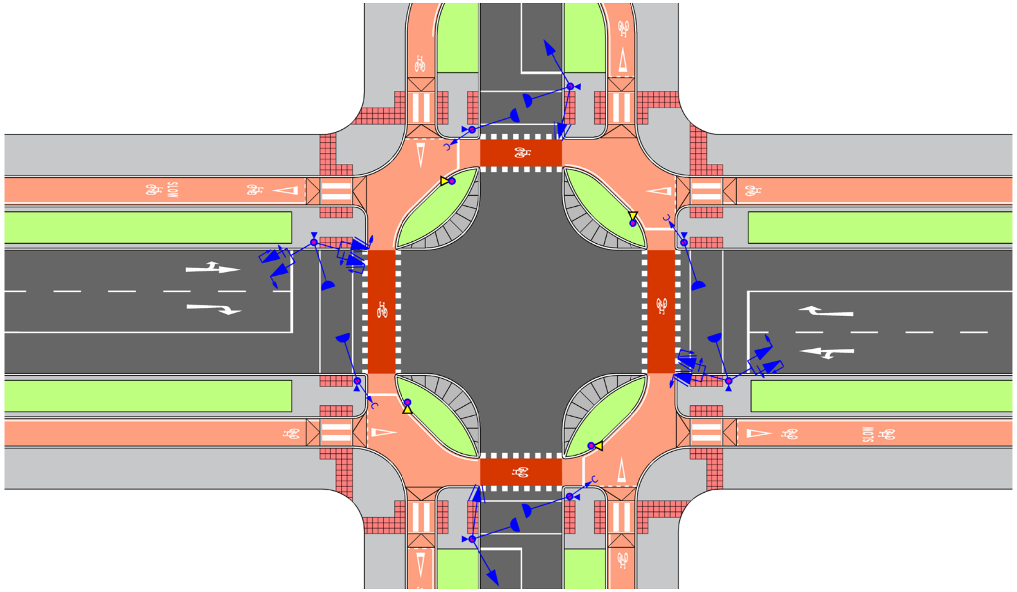

Figure 4.83: Typical layout of protected junction with zebra crossings of the cycle track.

Pedestrians cross the cycle track with priority on a mini zebra crossing and proceed to a landing area adjacent to the carriageway (see Figure 4.84). The landing area should be a minimum of 2.7m between kerbs to allow for tactile paving at each crossing point and an appropriate space between the tactiles. Cyclists yield to pedestrians at the zebra crossing and proceed up to a forward stop line adjacent to the carriageway if they are continuing straight-ahead or turning right.

Both pedestrians and cyclists then cross the junction under signal control, either in separate stages or in one combined 'wrap around' stage, depending on the volume of turning traffic (refer to section 4.4.4 for guidance on signal staging).

Left turning cyclist are not governed by signal controls so can proceed to make the left turn whilst yielding to any pedestrians at the zebra crossings. Right turning cyclists make a two stage movement and cross the two arms of the junction under signal control.

Figure 4.84: Example of mini zebra crossing of cycle track and pedestrian landing area (image: Google Street View).

In addition to the common features of protected junctions discussed in section 4.4.2.1, a protected junction with zebra crossings of the cycle track includes the following features:

- Shorter crossing distances for pedestrians and cyclists compared to other signal controlled layouts;
- Forward stop line for cyclists to increase their visibility;
- Free left turn for cyclists (not under signal control);
- Mini zebra crossings of the cycle track for pedestrians;
- Landing areas for pedestrians (2.7m minimum between kerbs); and
- Additional stacking space for cyclists adjacent to the pedestrian landing area.

Protected junctions with zebra crossings of the cycle track can provide an optimum solution for all road users by reducing delays, maintaining full segregation between all modes and minimising the potential for serious conflict between the different modes.

A potential disadvantage of the arrangement is that it can require more space to implement compared to other signal controlled layouts. In constrained locations, designers could consider an alternative solution to manage the pedestrian/cycle interaction whereby the red tactile stem of the pedestrian crossing is extended across the cycle track to the rear of the footpath and yield markings are placed on the cycle track to indicate pedestrian priority, as shown in Figure 4.85. The tactile area should be raised above the cycle track level and a clear colour contrast between the cycle track and pedestrian crossing should be maintained to highlight the changed environment to people cycling and that pedestrians have priority.

In such layouts it is recommended that a minimum width of 2 metres be maintained between the cycle track and carriageway to provide a refuge for pedestrians waiting to cross the carriageway.

Figure 4.85: Alternative pedestrian crossing detail at a protected junction.

4.4.3.4 Protected Junction - CYCLOPS layout (TL502)

A protected CYCLOPS (Cycle Optimised Protected Signals) layout, recently developed in the UK, is a variation of the protected junction layout where the cyclist and pedestrian positions are switched at the junction. The signalised pedestrian crossings are located inside the cycle crossings and the cycle track loops around the outside of the junction creating pedestrian refuge islands at the corners of the junction as shown in Figure 4.86.

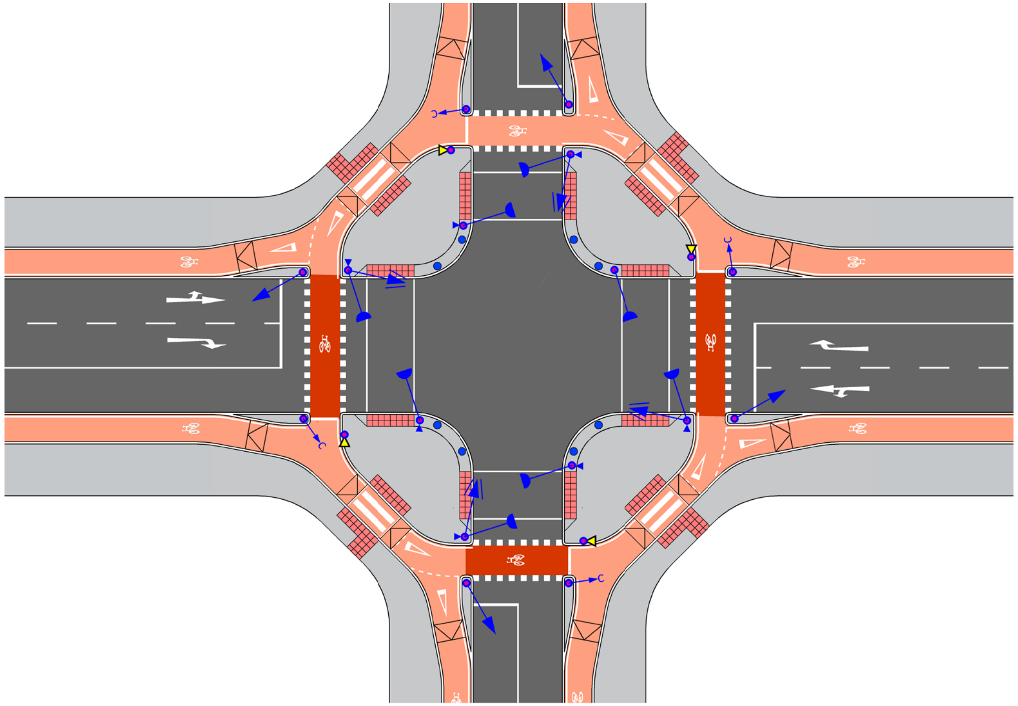

Figure 4.86: Typical layout of a protected junction with zebra crossings of the cycle track and inner pedestrian crossings (draw up 'clean' version without dims/labels).

Figure 4.87: Corner refuge island at CYCLOPS junction in Cambridge, UK.

Similar to the previous layout, the pedestrian and cyclist interaction is managed outside of the signal control operations. Pedestrians cross the cycle track with priority on a mini zebra crossing and proceed to the corner refuge islands (see Figure 4.87) where they cross the junction under signal control. Cyclists yield to pedestrians at the zebra crossing and proceed up to a forward stop line adjacent to the carriageway if they are continuing straight-ahead or wishing to turn right. Pedestrians and cyclists can then cross the road typically in one combined 'wrap around' stage however they may be separately staged depending on local traffic conditions (refer to section 4.4.4 for guidance on signal staging).

Left turning cyclist are not governed by signal controls so can proceed to make the left turn freely whilst yielding to any cyclists already on the orbital cycle track and any pedestrians at the zebra crossing. Right turning cyclists make a two stage movement and cross the two arms of the junction under signal control.

This type of junction arrangement has been implemented in a number of locations in the UK in recent years including in Greater Manchester Area and Cambridge.

The layout shares similar advantages to the previous layout. A further advantage of this junction layout is that it creates the opportunity to include diagonal pedestrian crossings within the junction if desired. Also the orbital cycle track is typically more circular in shape with larger radii which may provide a more comfortable route for cyclists. The layout also potentially reduces the number of zebra crossings of the cycle track.

Conversely, the CYCLOPS layout may present some potential disadvantages including: the potential for increased interaction between pedestrians and cyclists due to consolidation of zebra crossings; potential for pedestrians to feel less comfortable/ more isolated on corner refuge islands; and a slightly longer, more circuitous route for cyclists.

4.4.3.5 Protected Junction with full signal control (TL503)

In a protected junction under full signal control layout, see Figure 4.88, all movements are governed by the traffic signals including the interaction between pedestrians and cyclists. Pedestrians cross the road and the associated cycle track in a single movement.

For cyclists there are two stop lines. The first is located on the approach to the pedestrian crossing. Typically cyclists will only be required to stop here during the pedestrian stage which will generally result in a free left turn for cyclists, similar to other protected junction layouts.

The second stop line is located adjacent to the carriageway to be crossed where people cycling straight ahead will wait and cross the junction under signal control. The second stop line is also used for controlling right turning cyclists who typically cross the junction in a two stage movement.

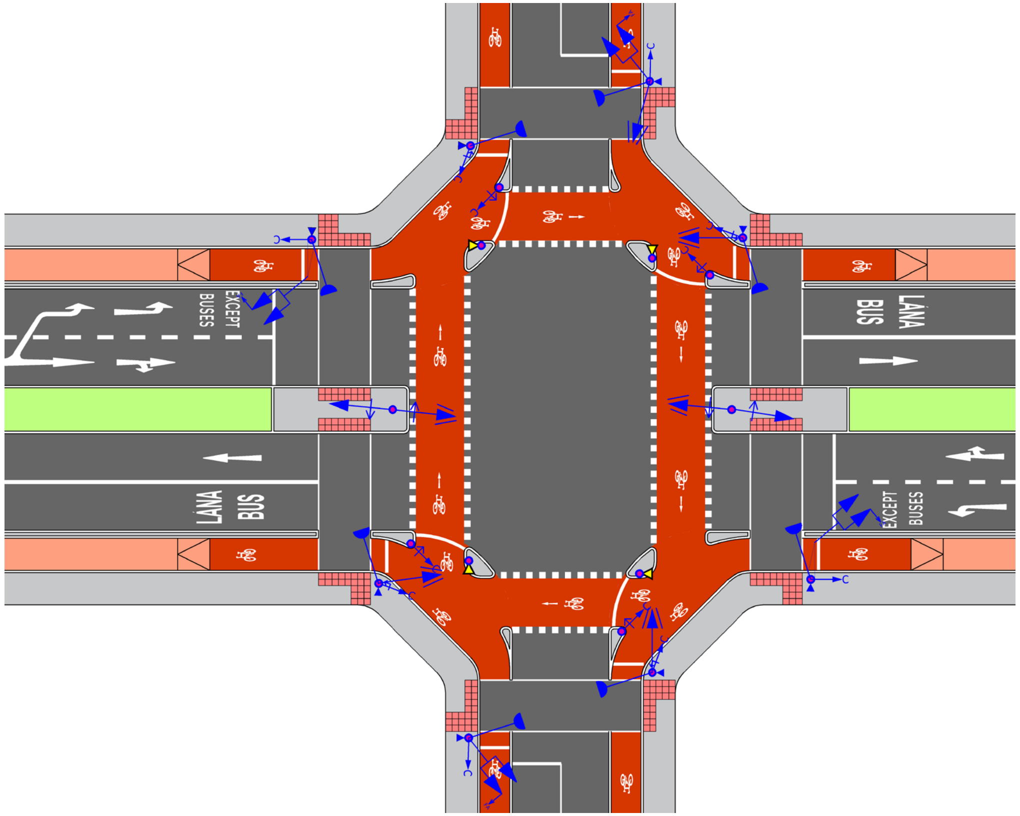

Figure 4.88: Protected junction with full signal control.

The main advantage of a full signal control layout compared to protected junctions with zebra crossings of the cycle track is that it requires less space. Another potential advantage is that pedestrians have more controlled priority over the cycle track as the interaction is signal controlled. A full signal control layout also has some disadvantages compared to other protected junction layouts including:

- Longer pedestrian crossing distancess;
- Longer pedestrian signal phase which may increase delays and reduce junction capacity;
- Full set back cycle crossings may be more difficult to achieve;
- Sharper turns potentially less comfortable for cyclists;
- Smaller protected corner islands may feel less safe for some cyclists;
- Less stacking space for cyclists due to smaller corner islands; and
- At busy junctions, pedestrians waiting to cross may block the footpath for other users.

In terms of signal staging, generally the layout should enable pedestrians and cyclists to cross the road in a single combined ‘wrap around’ stage. Crossing cyclists will need to stop at the pedestrian crossing on the far side if the pedestrian phase is still active. Depending on local traffic conditions, it may be possible to run cyclists with straight ahead and left turning traffic at quieter junctions (refer to section 4.4.4 for further guidance on signal staging) which would increase the amount of time for the cycle phase in the junction cycle.

4.4.3.6 Protected T-Junction (TL504)

Where two roads with cycle tracks intersect at a signal controlled T-junction, the preferred arrangement is for a protected signal controlled T-Junction, as illustrated in Figure 4.89, to be implemented. This layout contains the same features and uses the same principles as the protected junction, with zebra crossings of the cycle track layout in section 4.4.2.2, e.g. mini zebra crossings of the cycle track and landing areas for pedestrians, only in this instance applied to a three arm T-Junction Layout.

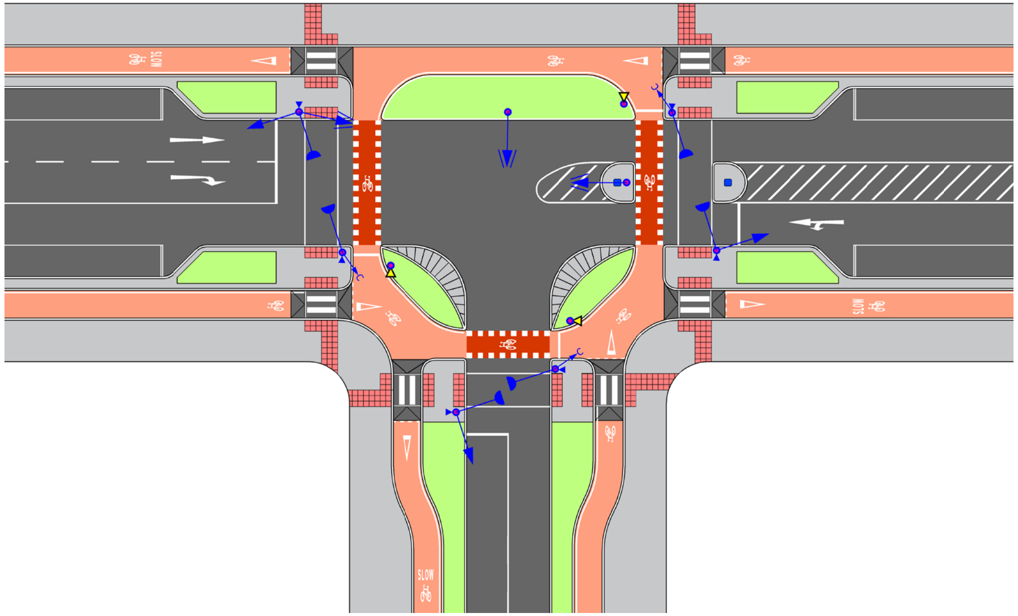

Figure 4.89: Protected Signal Controlled T-Junction.

This layout can provide an optimum solution at signalised T-Junctions for all road users by reducing delays, maintaining full segregation between all modes and minimising the potential for serious conflict between motorists and pedestrians and cyclists. However a potential disadvantage is that it can require more space to implement compared to other signal controlled T-Junction layouts owing primarily to the use of pedestrian landing areas. In constrained locations, designers could consider the alternative pedestrian crossing solution discussed in section 4.4.2.2.

4.4.3.7 Protected T-Junction with full signal control (TL505)

At more constrained signalised T-Junctions or where full signal control is desirable, a protected T-Junction with full signal control arrangement as shown in Figure 4.90 below could be considered. This layout contains the same features as the protected junction with full signal control layout in section 4.4.2.4, only applied to a three arm T-Junction Layout. It also generally has the same advantages and disadvantages as said layout.

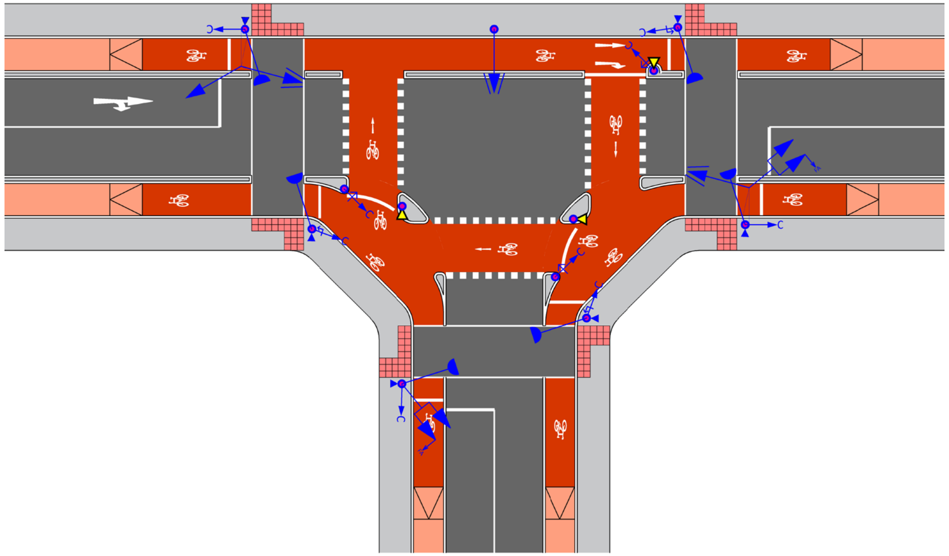

Figure 4.90: Typical layout of a Protected T-Junction in a constrained location.

not being implemented. In this arrangement, cyclists are provided with a dedicated cycle only phase, which can be demand dependent called by automatic detection or a push-button. Cyclists proceed through the junction in a separate phase whilst conflicting traffic streams or pedestrians are held on red. This maximises safety by reducing the potential for conflict, providing cyclists with protection under traffic control. Separate cycle phases may be useful in a number of situations including where:

- two-way cycle tracks intersect with signalised junctions;
- to remove conflict between straight-ahead cyclists and turning motor vehicles (Figure 4.91);
- diagonal cycle crossings are required (Figure 4.92);
- contraflow cycle facilities enter signalised junctions; and
- remote cycle facilities enter signalised junctions.

Figure 4.91: Example of dedicated cycle phase where left-turning and straight-ahead cyclists get their own phase in the signal cycle to provide protection.

If any layouts in this section are being proposed for use in circumstances outside of the above two scenarios, e.g. new developments or locations that are not heavily constrained, a departure from standards should be sought and approved prior to implementation.

Figure 4.92: A diagonal cycle crossing with separate cycle phase near Heuston Station, Dublin.

Separate cycle phases are generally bespoke arrangements, tailored to suit site specific circumstances therefore typical layouts are not presented in this manual. Designers should follow guidance in other sections of the manual including section 4.1 Geometric Requirements and section 4.4.6 Traffic Signal Operations and Components when developing bespoke solutions.

It is important to note that separate cycle phases can increase the complexity of the signal arrangement and therefore the junction signal cycle time and associated delay. The arrangement may also not provide protection from motor traffic for all cycle movements at a junction.

4.4.4.3 Signal-controlled junctions with toucan crossings (TL506)

Toucan crossings can be implemented at junctions under signal control to provide a shared facility for pedestrians and cyclists to cross the junction.

In this arrangement, pedestrians and cyclists may be segregated or in a shared space on the approach roads. If cyclists are segregated, they are transitioned to a shared space with pedestrians at the junction and both modes cross using the toucan crossing, see Figure 4.93. Appropriate tactile paving will be required to warn visually impaired users they are entering a shared space.

Figure 4.93: Example of signal controlled junction with Toucan crossings.

As shared facilities are generally disliked by both pedestrians and cyclists, signal controlled junctions with toucan crossings should only be used in exceptionally constrained environments or as part of an interim cycle scheme where a full junction redesign is not being undertaken. They may also be an acceptable arrangement where a shared pedestrian and cycle facility exists on the approach roads.

Shared use crossings should be a minimum of 4.0m wide to provide adequate width for both pedestrians and cyclists. Three-aspect pedestrian and cycle heads, RPC 004 and RTS 007, shall be used and no flashing amber traffic aspect is permitted where toucan crossings are included in a signal-controlled junction.

4.4.4.4 Two-stage right-turns (TL507)

A two-stage right turn layout, see Figure 4.94, can be used to facilitate right-turning cyclists at signalised junctions where a protected layout is not being implemented. The layout incorporates a marked waiting area for right-turning cyclists on the side road which is located between the pedestrian crossing and the main road alignment. The pedestrian crossing may need to be set back slightly to accommodate the waiting area. The vehicular stop line is also set back to improve visibility of waiting cyclists and to allow cyclists to advance ahead of motorists.

In this arrangement, cyclists share the road with motorists and move in the same signal stage, preferably with an early start for cyclists. The waiting areas provide an alternative facility for cyclists to turn right without having to wait in the centre of the carriageway for a gap in the traffic.

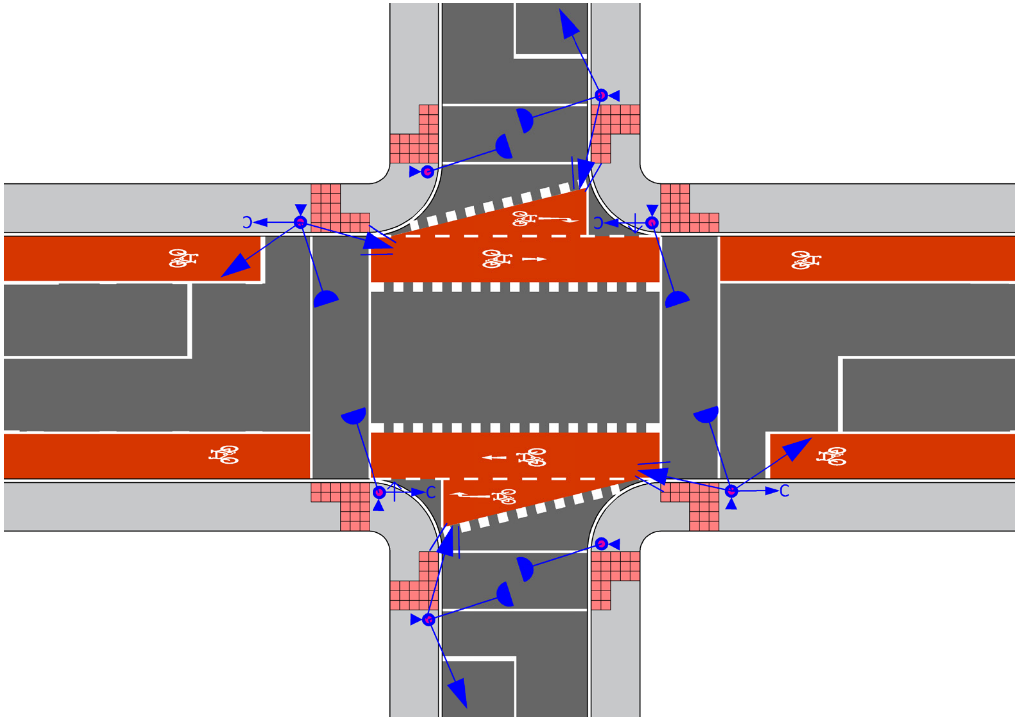

Figure 4.94: Typical layout of a Two-stage right-turn (box turn) junction.

Cyclists wishing to turn right can do so in a two-stage manoeuvre. They first enter the junction when their approach arm is given the green signal and proceed to pull into the waiting area in the mouth of the side road (see Figure 4.95). When the side road receives a green signal, cyclists can proceed to cross to the opposite side to complete their right turn manoeuvre.

A cycle loop detector should be installed in the waiting area to ensure that the cyclist can complete their two stage movement. This is particularly important on quieter side roads as if there is no vehicle waiting on the side road, a demand may not request the relevant phase and the cyclists may not get the green signal.

Where an early start is being provided for cyclists, a secondary cycle signal may be useful, depending on the geometry and signal head placements at the junction.

Figure 4.95: Example of waiting area for cyclists in a two-stage right-turn layout in Amsterdam.

4.4.4.5 Advanced Stop Lines (ASLs) (TL508)

Advanced stop lines (ASLs) can be used at signal-controlled junctions to provide a reservoir for cyclists to wait ahead of motor traffic when stopped at a red light. See typical layout in Figure 4.96. ASLs are primarily intended to allow cyclists to commence their movement ahead of motor traffic in a mixed traffic environment. They can assist right-turning cyclists to establish their position in the centre of the carriageway and also help increase the visibility of cyclists when stopped at a junction. Cycle loop detectors need to be considered in the design in order for the relevant phase to be requested to support cyclist movements.

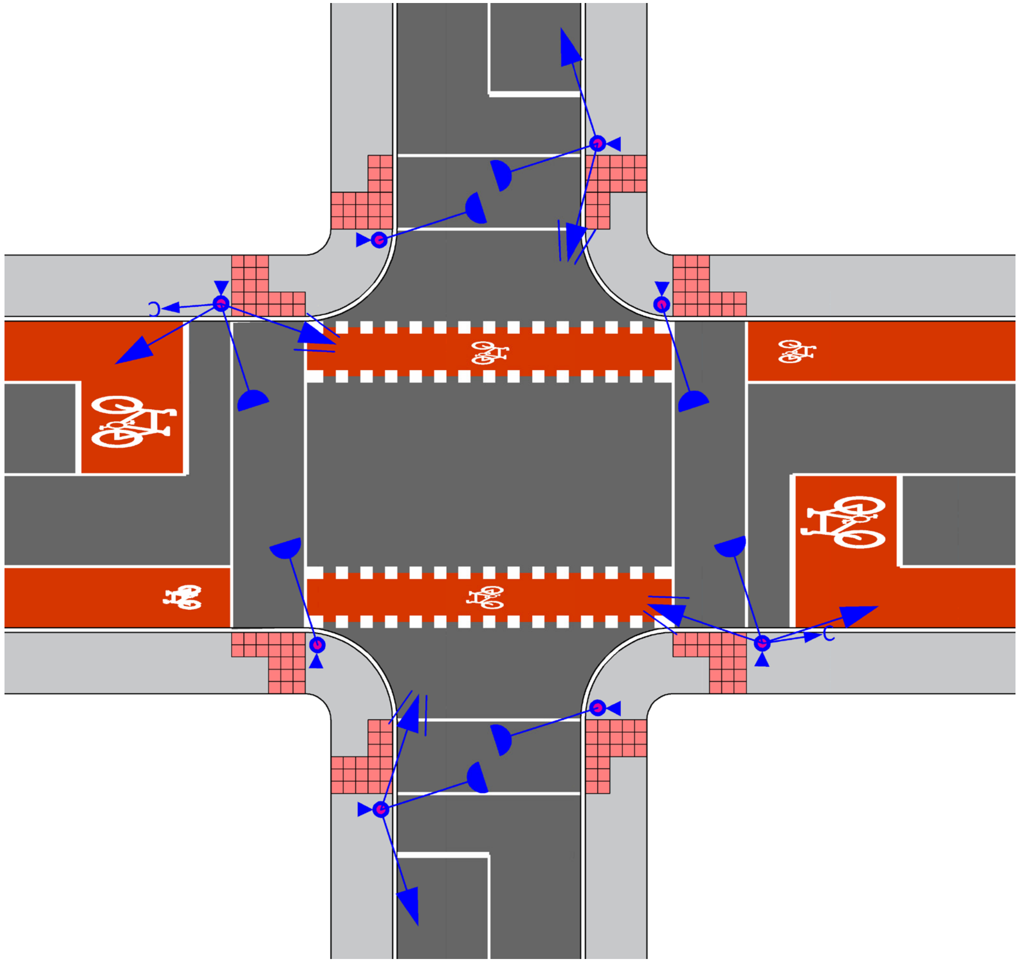

Figure 4.96: Typical layout of Advanced Stop Lines.

ASLs have previously been used extensively in Ireland and abroad and can be of benefit to experienced cyclists – although the benefits only accrue to cyclists who arrive at the junction when the traffic signals are on red. However, ASLs alone do not remove conflict with motor vehicles and are therefore unlikely to be an attractive proposition for a range of cycle users.

In line with the principles of this manual to provide safe, high-quality cycle facilities for people of all ages and abilities, new ASLs should therefore only be considered in exceptional circumstances and only on junction approaches where the traffic conditions are suitable for a mixed cycling environment as per the criteria specified in Table 2.1. They should also only be provided on single lane approaches. ASLs over multi-lane approaches are not recommended.

Where ASLs are being used, a cycle lane should be provided to enable cyclists to enter the reservoir in accordance with Chapter 7 of the Traffic Signs Manual.

It is also recommended that cyclists are given an early start in the signal stage. Refer to Section 4.4.5 for further information.

4.4.4.6 Streaming lanes (legacy junctions only) (TL509)

Streaming lanes are cycle lanes located between two traffic lanes, typically between a left turning lane and a straight-ahead lane. They have been used previously to reinforce priority for straight ahead cyclists over traffic entering the turning lane. However streaming lanes can place cyclists in a precarious position between two live traffic streams which may give rise to actual or perceived safety risks therefore:

Streaming lanes are no longer recommended for use in new scheme designs.

Where streaming lanes currently exist, interim measures may be considered to improve the safety of cyclists pending a permanent solution, such as installing bollards along the streaming lane as shown in Figure 4.97, leaving a 10m gap for turning traffic.

An alternative option could be to remove the streaming lane and rearrange the lanes markings so that all cyclists are brought up to the junction on the inside of the traffic lanes. To provide an appropriate provision for right-turning cyclists, a two-stage right-turn layout or a separate cycle phase could be implemented.

Figure 4.97: Flexible bollards installed as an interim measure at a streaming lane on Newtownpark Avenue, Dublin.

4.4.5 Traffic Signal Operations and Components

4.4.5.1 General

Chapter 9 of the Traffic Signs Manual (TSM), provides details of the requirements for traffic signals for use both at new installations or when replacing equipment at existing locations. The layout, symbols and the circumstances in which each signal may be used are specified. Chapter 9 should be read in conjunction with other relevant chapters of the Traffic Signs Manual.

The following sections presents some guidance on cycle provisions at signal-controlled junctions based on TSM requirements however designers should always refer to TSM for the most up-to-date guidance.

4.4.5.2 Signal heads

Cycle-only phases at signal-controlled junctions are controlled by three-aspect cycle signals RTS 007, which have red, amber and green cycle symbols. Two sizes of signals to RTS 007 are permitted as detailed in Table 4.21 below.

Table 4.21: Permitted types of three-aspect cycle signals RTS 007.

Signal Type	Nominal Aspect Diameter	Distance from ground to lowest aspect
High Level Cycle Signals	200mm	2.1m to 3.05m
Low Level Cycle Signals	80 - 110mm	1.5m to 1.7m

Low level cycle signals can be attached to full height traffic signal poles or may be installed as standalone signals on shorter poles, like the examples shown in Figure 4.98.

At signal-controlled junctions where cyclists are mixed with general traffic and share the same phases, cyclists are controlled by the signal heads controlling general traffic e.g. RTS 001, RTS 002 etc.

Figure 4.98: Examples of low level cycle signals attached to full height signal pole (left) and as standalone signal arrangement (right).

4.4.5.2.1 Alternative low level cycle signal for optional use at zebra crossings of cycle tracks

Zebra crossings of cycle tracks, such as at island bus stops or protected junctions with zebra crossings, will typically be controlled via the use of road markings and signage or belisha beacons where necessary. In some circumstances where it is considered necessary to provide additional control measures at zebra crossings of cycle tracks, the use of cycle signals may be considered.

A new single aspect low level cycle signal, see Figure 4.99, has been developed as an alternative cycle signal for optional use at zebra crossings of cycle tracks. The signal will be called on demand by pedestrians that need assistance via a push button unit. In the default setting, a flashing amber signal will be given to cyclists to warn them to proceed with caution if no pedestrians are present. When the signal is activated, cyclists will be given a red signal and pedestrians will get an audible signal to cross the cycle track.

Figure 4.99: New single aspect low level cycle signal for optional use at zebra crossings of cycle tracks.

4.4.5.3 Cycle detection

Detection for cyclists needs careful consideration. Well positioned detector equipment with suitable sensitivity settings should generally be included at signal-controlled junctions to enable cyclists to be detected. Above ground (infra-red or radar) or below ground (inductive loops) detection may be employed.

Above ground detector configuration needs to be carefully considered in the design of the signalised junction. For example, the pole used to hold the above ground detector units must be installed at the optimum location so that it functions correctly – typically it will need to be setback at a specific distance from the stop line and have sufficient forward visibility to capture oncoming cyclists (forward visibility should not be obstructed by trees or high sided vehicles in the adjacent lane of traffic). The above ground detection should be linked to a Fault Management System or routinely inspected and maintained.

Loop detectors need accurate positioning and calibrating to ensure they reliably detect cycle traffic. In a mixed traffic junction, loops for general traffic may not pick up cyclists, who tend to ride across the extremity of the loop, therefore the position of the loop in the lane relative to the path of the cycle traffic should be considered. Similar considerations will be needed for loop detectors within cycle lanes and Advanced Stop Lines (ASLs). The maintenance of loop detectors is important in order to ensure that the cycle provision through the junction is supported and that the relevant phase is demanded when a cyclists rolls over the detector. Faults should be reported, inspected and repaired by the relevant persons.

The use of on crossing detection should be considered where necessary to automatically extending crossing times at signal-controlled junctions and signalised crossings when needed.

Push Button Units

Push button units (PBUs) may also be used as a means of detecting cyclists at junctions. Were PBUs are used they must be located in such a way that they are accessible to all people cycling, including those using non-standard cycles such as cargo bikes or handcycles. Where cyclists approach a signalised crossing perpendicular to the carriageway, they should be able to safely access the PBU without their cycle vehicle encroaching onto the carriageway.

It is therefore recommended that PBUs should be located a minimum of 1.5m from the edge of the carriageway. This may mean that the PBU is located on a standalone pole in advance of the cycle signal head as shown in Figure 4.100.

In some instances, e.g. Toucan crossings, this manual recommends that PBUs face the carriageway so that they are accessible to cyclists remaining on carriageway at the crossing point. In such cases, designers must ensure that the PBU is located in such a way that it is accessible to all cyclists.

In terms of mounting height, PBUs should be located not more than 1.2m above ground level to ensure they are accessible to all including wheelchair users.

Figure 4.100: Push button unit for cyclists set back from carriageway and cycle signal

4.4.5.4 Signal timings

Cycle phases at junctions and crossings should have a minimum green duration of 7 seconds, but longer green times may be necessary where cycle flows are high. The use of on-crossing detection can also help by automatically extending crossing times when needed. The minimum duration of a cycle stage, green time plus intergreen time, should be sufficient to enable a cyclist to clear the junction when setting off from a stationary position. Local Authorities/Designers should specify these conditions in the Controller Operation Sheet for a signalised junction to ensure that early starts, extended crossing times such as special red substitutions, and longer minimum greens are catered for as required in the operation of a signal-controlled junction.

At junctions where no specific facilities for cyclists are provided, adjustments to signal timings for cyclists may nevertheless be beneficial, particularly at larger junctions, or where a junction arm has an uphill gradient. Timings should be validated on site and adjusted where necessary to ensure the available clearance time for cyclists is correct.

Cyclists' speeds and their ability to move off are greatly affected by gradients. Design parameters for cycles at traffic signals are shown in Table 4.22. These have been used to calculate the intergreen times in Table 4.23 taking into account cyclists' slower speed and allowing for gradients.

The path distance referred to in Table 4.23 is the difference in distance to the conflict point (B) from the phase losing right of way (A), and the traffic phase gaining right of way (C) as shown in Figure 4.101.

Table 4.22: Design parameters for cycles at traffic signals.

Parameter	Value	Notes
Acceleration	0.5m/s2	<3% uphill gradient
	0.4m/s2	≥3% uphill gradient
Design Speed	20 kph	<3% uphill gradient
	15 kph	≥3% uphill gradient
Length of cycle	2.8m	cycle design vehicle

Table 4.23: Minimum intergreen times to accommodate cycle traffic.

Path Distance	Fiat, downhill or less then 3% uphill gradient	≥3% uphill gradient
1-3m	5 seconds	5 seconds
4m	5 seconds	6 seconds
5-9m	6 seconds	6 seconds
10-14m	7 seconds	8 seconds
15m	8 seconds	8 seconds
16-18	8 seconds	9 seconds
19-21m	9 seconds	10 seconds
22-23m	9 seconds	11 seconds
24-27m	10 seconds	11 seconds
28-33m	11 seconds	13 seconds
34-36m	12 seconds	14 seconds

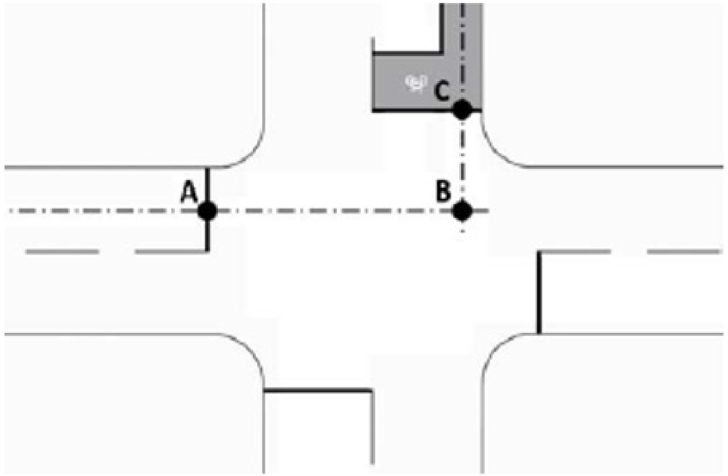

Figure 4.101: Path distance to conflict point.

Where cycle and pedestrian phases run together in a combined stage e.g. at parallel or toucan crossings, the minimum stage duration should be dictated by the pedestrian phase requirements as pedestrians typically travel at slower speeds. A minimum green time of 6 seconds should be provided in accordance with TSM.

The time required for the amber phase (which indicates that pedestrians should not start to cross) is dictated by pedestrian walking speeds. A walking speed of 1.2 m/s is conventionally used to calculate timings for pedestrian crossings. However some local authorities, for example Dublin City Council, have recently started to calculate timings based on a lower walking speed of 1.0 m/s to suit slower moving pedestrians. The move to reduce the walking speed calculation is based on research undertaken by The Irish Longitudinal Study on Ageing (TILDA 2015).

An all-red period before and after the pedestrian crossing phase shall be a minimum of 1 second but may be increased depending on traffic speed and crossing width.

4.4.5.5 Staging and Phasing

In line with the principles of a safe system approach, signal-controlled junctions should be staged appropriately to minimise the risk of conflict between cyclists and other road users. The optimum staging for each junction will be determined by the required junction operational parameters and local site conditions. Notwithstanding this, the following staging arrangements are recommended to minimise the risk of conflict between cyclists and other road users.

Minimising conflict with pedestrians

Generally, cycle phases should not run in conflict across pedestrian crossings i.e. cyclists should not cross pedestrian crossings during the pedestrian phase in a signal-controlled junction.

In exceptional circumstances, where specific conditions exist, a nested pelican arrangement like that used on the Grand Canal Cycle Route in Dublin may be considered. The specific conditions result from taking into consideration the cumulative impact of the competing interests and space constraints in the surrounding environment as presented below. Where the following conditions exist a nested pelican may be considered:

» Very constrained space i.e. old street network and a pinch point like a bridge.

» On a Public Tansport Corridor with a bus priority system in effect where there is a key focus to maintain bus time reliability.

» Competing demands for different movements/modes.

» The need to keep cycle lengths to a minimum to maintain linkages to other junctions on the Urban Traffic Control system.

In this type of arrangement, pedestrians get a short green stage first, followed by a longer stage where pedestrians and cyclists simultaneously receive a flashing amber signal. In the flashing amber stage pedestrians have legal priority and cyclists must yield accordingly. After the flashing amber stage, cyclists get a short separate green stage to ensure they can safely cross if pedestrian flows are high. The typical sequence is illustrated in Figure 4.102.

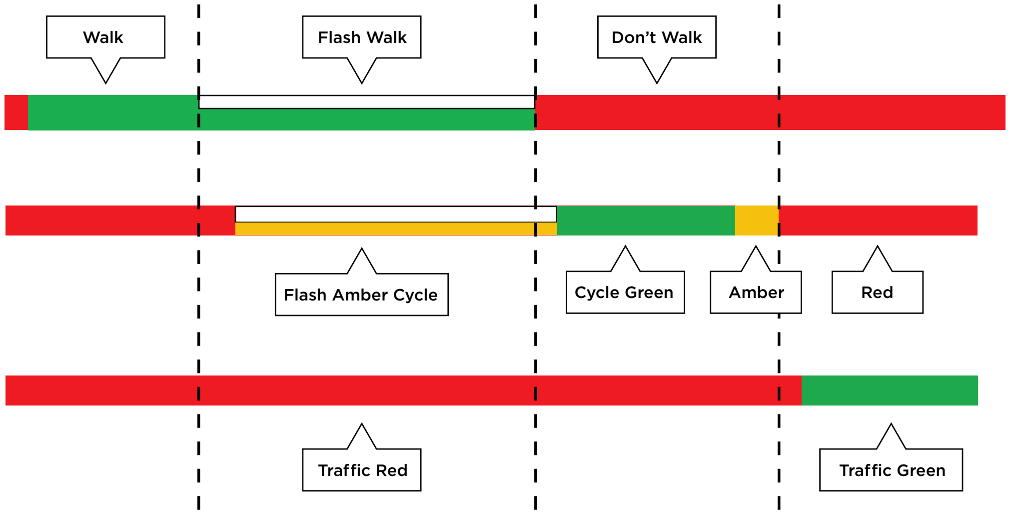

Figure 4.102: Typical sequence for a nested pelican arrangement.

Minimising conflict with turning motor traffic

One of the key considerations in the design of signalised junctions from a cycling perspective is the conflict between turning motor traffic and straight-ahead cyclists. The following are the recommended arrangements for dealing with this conflict for right-turning and left-turning motor traffic.

Right-turning motor traffic

Right-turning motor traffic and straight-ahead cyclists should, where practicable, always be separately staged in a junction under signal control to eliminate the conflict risk.

Left-turning motor traffic

Preferably, left-turning motor traffic and straight-ahead cyclists will also be separately staged to eliminate the conflict risk.

However, at signal-controlled junctions with lower volumes of left-turning motor traffic, to achieve optimum operational effectiveness including the efficient movement of cyclists, consideration can be given to permitting straight-ahead cyclists and left-turning motor traffic to proceed at the same time in a partial conflict arrangement. Partial conflicts are strongly discouraged if:

» The volume of left-turning traffic exceeds 150 PCU/Hour.

» A two-way cycle track crosses the junction.

» In rural locations with higher traffic speeds.

» There is a large volume of HGV's turning left e.g. at a business park or industrial estate.

Table 4.24 provides suggested thresholds where partial conflicts may be permitted based on the volume of left-turning motor traffic, if other conditions are suitable to consider the arrangement.

Table 4.24: Thresholds for partial conflict based on volume of left-turning motor traffic.

Volume of left-turning motor traffic (PCU/Hour)	Partial conflict permitted
0-100	Yes
101-150	Departure required
>150	No

Where partial conflicts between left-turning motor traffic and straight-ahead cyclists are being implemented, the following additional features are recommended:

» An early start (see section 4.4.5.6) for cyclist shall be provided;

» A flashing amber arrow signal (RTS 004) should be used in place of a full green aspect to warn left-turning motorists;

» Flashing amber LED studs may be included on the inside of the cycle crossing (see Figure 4.103);

» Set back stop lines for general traffic; and

» Supplementary yield markings and signage may be considered.

Figure 4.103: Example of flashing amber LED studs at a protected junction.

4.4.5.6 Early start

In an early start arrangement, a low level cycle signal can be used to give cyclists a green signal in advance of the main traffic phase where cycle traffic and motor traffic are not separately staged. This enables cyclists to establish themselves within the junction ahead of the release of general traffic, in order to reduce the risk of potential conflicts between cyclists and turning motor traffic.

The early start phase should be long enough to allow cyclists to travel beyond the left-turn conflict point before other vehicles reach that point. A duration of 4-5 seconds is recommended, with 3 seconds as absolute minimum. Designers may confirm the suitability of the early start duration through on site observations once installed, and adjust if necessary.

Early starts are recommend for use in conjunction with the following arrangements:

- Partial conflict arrangements;
- Two-stage right-turns; and
- Advanced stop lines (ASLs).

4.5 Crossings

4.5.1 Introduction

This section provides guidance on the provision of mid-block road crossing facilities for cyclists i.e. crossings that are at a remove from a road junction. For guidance on crossings facilities at junctions, refer to the relevant junction section in the manual.

Cycle crossings are important parts of a cycle network and should enable cycle users to safely, and efficiently, cross a carriageway where required, for example:

- to access key destinations e.g. schools, shops, transport interchanges and local services;
- at intersections between off-road cycle facilities (e.g. greenways) and carriageways; and
- at mid-block locations on routes with few other crossing opportunities.

There are five different types of cycle crossings as follows and the choice of crossing will depend upon a number of factors:

- Uncontrolled crossing;
- Cycle priority crossing;
- Zebra crossing (controlled);
- Signal-controlled crossing; and
- Grade separated crossing.

In general, crossing facilities will include provision for both pedestrians and cyclists to cross the road at the same location (either segregated or in a shared environment) however there may be circumstances where cycle-only crossings are required such as where cycle tracks diagonally cross a carriageway.

Where crossings cater for both modes, options for segregated or shared facilities are presented. As shared facilities are generally disliked by both modes, the preference is to provide segregated crossing facilities wherever possible. However, shared crossing facilities can be appropriate in some situations including:

- where a shared pedestrian and cycle facility, e.g. greenway, intersects with a road;
- at some grade separated facilities; and
- in exceptionally constrained circumstances (departure required).

Designers should refer to Section 4.1 for guidance on geometric requirements e.g. sight visibility requirements, when designing crossing facilities.

4.5.2 Crossing selection

The choice of crossing to be provided will depend on a number of factors including:

- Speed and volume of motor traffic on the road to be crossed;
- Type of cycle link approaching the crossing;
- Anticipated volumes of crossing pedestrians and cyclists; and
- Spatial constraints.

The Crossing suitability guide in Table 4.25 provides an indication of the suitability of each type of crossing depending on the speed and volume of motor traffic. It is recommended that designers use this as a starting point to see what types of crossings may be suitable for a given location depending on the traffic regime and then consider any additional factors as appropriate.

The following points should be noted when using the table:

i) In general, as traffic speeds and volumes increase, more complex/ expensive solutions will be required. However, it should be noted that traffic speeds and volumes are not fixed and if they were to be reduced, e.g. through traffic management/calming measures, a simpler crossing may be an option.

ii) More complex crossings are not solely reserved for roads with higher traffic speeds/volumes and may be considered on quieter roads.

iii) Uncontrolled and zebra crossings are not recommended where there is more than one traffic lane per direction to be crossed. In such circumstances, designers should consider if the number of lanes per direction can be reduced and if not, a signalised or grade separated solution would be recommended.

iv) Zebra crossings are not suitable if traffic speeds are greater than 50 km/h and signal controlled crossings are not recommended if traffic speeds exceed 60 km/h.

v) The provision of refuge islands is recommended for uncontrolled and zebra crossings in certain situations. Refuge islands can greatly improve the comfort and safety of cyclists by reducing the number of lanes to be crossed in a single movement and by encouraging slower traffic speeds at the crossing point. It is recommended that refuge islands should be 3m wide to cater for larger cycles. Refuge islands less than 2m in width should not be used.

vi) The provision of raised crossings is recommended for all crossing types. Raised crossings can improve the comfort of both pedestrians and cyclists, particularly where cycle links are raised on the approach to the crossing. They can also assist with managing traffic speeds at conflict points, and at uncontrolled crossings they can be used to implement a courtesy crossing type arrangement to afford greater priority to active travel modes.

vii) For guidance on rural crossings refer to TII Publication Rural Cycleway Design (Offline & Greenway), DN-GEO-03047.

Table 4.25 : Crossing Suitability Guide

Speed Limit	Traffic Flow (PCU/day)	Cycle Priority Crossing	Uncontrolled Crossing*	Zebra Crossing*	Signal-controlled crossing	Grade seperated crossing
≤30 km/h	<2000		**			
	Any		**			
40 km/h	Any		**			
50 km/h	<2000		**			
	2,000-4000		***			
	>4000			***		
60 km/h	Any					
80 km/h	Any					
>80 km/h	Any					

Provision should be suitable for most users
Provision may not be suitable for all users
Provision not recommended
Provision not suitable

* Provision not recommended where more than one traffic lane per direction is to be crossed.

** Consider providing a refuge island

*** Refuge island recommended

4.5.3 Uncontrolled crossing (TL601, TL602)

Where the speed and volume of motor traffic is low, cyclists and pedestrians can usually safely cross a two-way road via an uncontrolled crossing by waiting for a suitable gap in traffic. Refer to section 4.5.5 for guidance on thresholds.

The crossing can be segregated (generally preferred) or shared with pedestrians. It may be at-grade or placed on a raised table to provide a level grade crossings and help control motor traffic speeds.

Refuge islands can also be considered to improve the comfort and safety of cyclists by reducing the number of lanes to be crossed in a single movement and by encouraging slower traffic speeds at the crossing point. An example refuge is shown in Figure 4.104 below. It is recommended that refuge islands should be 3m wide to cater for larger cycles, with a 2m absolute minimum width requirement.

Traffic lane widths at refuge islands should be 3.25m maximum to minimise the risk of close overtaking of cyclists by motor traffic.

Figure 4.104: Segregated uncontrolled crossing with refuge island, Wicklow.

4.5.4 Cycle priority crossing (TL603)

In situations where a busy cycle route intersects with a lightly-trafficked, low speed carriageway, the cycle route may be given legal priority over motor traffic by the use of yield signage and markings. Cycle priority crossings are common features in some other jurisdictions with more developed cycle networks. See example in Figure 4.105 from the Netherlands.

Figure 4.105: Cycle priority crossing, Netherlands (Source: André Pettinga).

At a cycle priority crossing it is vital that drivers are clearly aware of the facility, and that motor traffic speeds approaching the crossing are not excessive. The visibility of the cycle track from the road is defined by a conventional visibility splay using X and Y dimensions (see figure 4.1.4).

The cycle track should have a red surface and the crossing should be raised above the carriageway level to assist cyclist comfort and for traffic calming purposes.

4.5.5 Zebra crossings

Zebra crossings are controlled crossings of the carriageway where motorists are required to yield to persons on the crossing. They are typically best suited to carriageways with lower volumes and speeds of motor traffic. See Table 4.24 for guidance on thresholds.

The Traffic Sign Manual prescribes the feature of a zebra crossing (RPC 001) which typically consists of flashing amber (belisha) beacons, alternate black and white stripes across the road, and other road markings as shown in Figure 4.106.

Designers should note that the NTA are currently (at time of publication) conducting a zebra crossing trial to use signage instead of belisha beacons at zebra crossings, similar to the approach used in many other countries. Any potential changes to zebra requirements will be communicated after the trial is completed.

As with other crossings, pedestrians and cyclists can be segregated or shared at a zebra crossing however for a zebra crossing there are some key differences between segregated and shared layouts. A segregated arrangement is called as a parallel zebra crossing and a shared layout is referred to as a combined zebra crossing. These are discussed in the following sections.

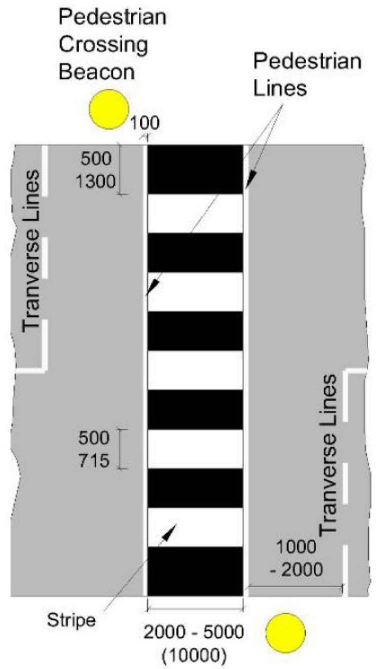

Figure 4.106: Zebra crossing layout (RPC 001), Chapter 7 of the Traffic Signs Manual.

4.5.5.1 Parallel zebra crossing (TL604)

In a parallel zebra crossing layout, pedestrians and cyclists have their own dedicated space to cross the carriageway. The pedestrian crossing space is delineated by the standard black and white stripes, and a separate cycle crossing is delineated parallel to this using red surfacing and elephant's footprint, as shown in Figure 4.107, with a 1m gap between the two crossings.

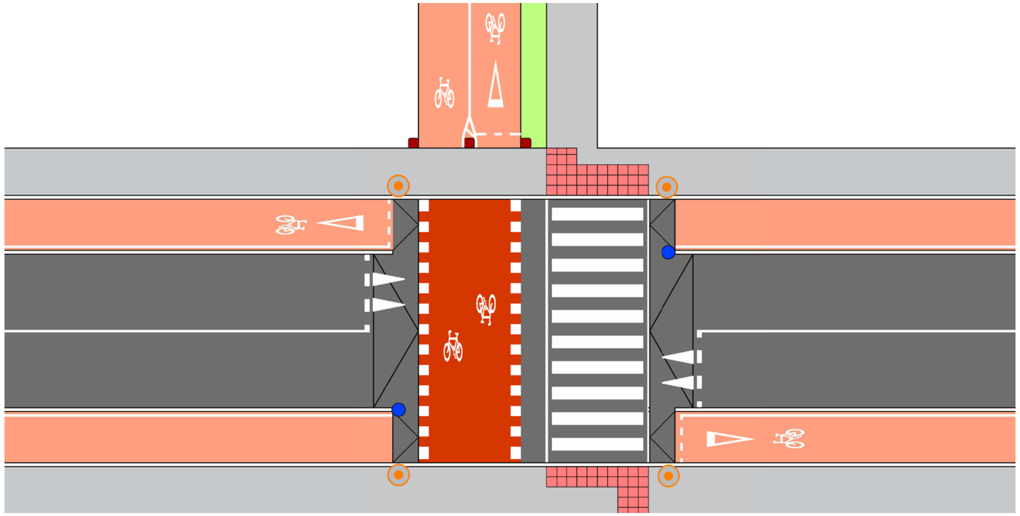

Figure 4.107: Typical layout of parallel cycle zebra crossing.

In this layout the belisha beacons, or zebra crossing signage, are located on the extremity of the crossing to encompass both the pedestrian and cycle crossings. Four belisha beacons are required, two either side of the crossing as shown in Figure 4.108.

The main advantage of a parallel zebra crossing, compared to a combined zebra crossing, is that segregation between pedestrians and cyclists can be maintained thus avoiding the need for shared space. The main disadvantage of the layout is that it typically requires more space to implement, although this may be less of an issue at mid-block locations. It also may be slightly more expensive to implement than a combined zebra crossing.

Figure 4.108: Parallel cycle zebra crossing with four belisha beacons, London (image: Google Street View).

4.5.5.2 Combined zebra crossing (TL605)

A combined zebra crossing is similar to a conventional zebra crossing layout, however in a combined zebra, elephant's footprints are placed either side of the zebra stripes and pedestrians and cyclists share the crossing. The crossing is typically wider (4m minimum) than a standard zebra crossing to accommodate both modes. Only two belisha beacons (or zebra crossing signs) are necessary as per standard TSM layout (Figure 4.109).

Figure 4.109: Combined zebra crossing, Carlow Town. (note - elephant's footprint markings not shown)

The main advantages of a combined zebra crossing, in comparison to a parallel zebra crossing, are that it requires a smaller footprint and is cheaper slightly to implement. However as the layout requires pedestrians and cyclists to share the same space which is generally less preferable, careful consideration should be given to where the layout is appropriate to use.

4.5.6 Signal-controlled crossings

On urban roads with higher speed limits (up to 60 km/h), higher traffic volumes and multi-lane carriageways, greater control is likely required to regulate road user movements and signal-controlled crossings may be necessary.

There are three main types of signal-controlled mid-block crossings which may be used as listed below and described in the following sections:

- Signalised Parallel crossing;
- Toucan crossing; and
- Cycle only crossing.

When designing signal-controlled crossings, designers should refer to the relevant guidance in the Traffic Signs Manual. Some guidance on traffic signal components and operations is also given in section 4.4.5 of this manual.

4.5.6.1 Signalised parallel crossing (TL606)

Signalised parallel crossings provide signal-controlled protection for pedestrians and cyclists whilst maintaining segregation between both modes. Like a parallel zebra crossing, pedestrians and cyclist have their own demarcated space on the crossing (See Figure 4.110).

They are recommended for situations where the crossing links cycle tracks on each side of the road so that separation from pedestrians is maintained, and at crossings where demand by both pedestrians and cyclists is high.

Signalised parallel crossings are preferred to Toucan crossings to reduce conflict between pedestrians and cyclists. Where pedestrians need to cross cycle tracks before or after the parallel crossing, the crossing point should be designed in line with the guidance on pedestrian crossings of cycle tracks in Section 4.2.14.

Figure 4.110: Signalised parallel crossing on Frascatti Road, Blackrock showing cycle crossing in foreground and adjacent pedestrian crossing.

4.5.6.2 Toucan crossing (TL607)

Toucan crossings are signal-controlled crossings where pedestrians and cyclists share the crossing with no separation between the two (Figure 4.111). In general, the preference is for segregation to be maintained between pedestrians and cyclists at signal-controlled crossings, e.g. a signalised parallel crossing, however there may be circumstances where a shared toucan crossing may be appropriate for example:

- where a shared active travel facility leads to the crossing;
- where on-road cycle lanes lead to the crossing;
- in exceptionally constrained locations where a segregated crossing is not feasible; and
- where volumes of pedestrians and/or cyclists using the crossing are low.

The crossing should be a minimum width of 4.0m to cater for both modes however this can be extended to 10m to accommodate larger numbers of pedestrians and/or cyclists.

Separate signal heads are required for pedestrians and cyclists. The required red signal time to vehicles is determined by the pedestrian phase requirements, which is typically longer than for cyclists. Separate detection for cyclists may reduce delay time to vehicles, as cyclists will be able to cross more quickly than pedestrians.

Staggered toucan crossings should be avoided as they can be difficult for some cyclists, particularly those using non-standard cycles, to use and they can give rise to additional conflict with pedestrians in a confined space.

Figure 4.111: Toucan crossing on Firhouse Road, Dublin 14.

4.5.6.3 Cycle-only crossings (TL608)

Signal-controlled crossings that cater for cyclists only may be required in certain situations for example where a cycle track diagonally crosses a carriageway at a mid-block location. In such circumstances, designers should follow the relevant requirements in this manual and the Traffic Signs Manual when developing solutions.

4.5.7 Provision for right-turning cyclists

At all mid-block crossing facilities, the provision for right-turning cyclists needs to be carefully considered. Right-turning cyclists must be able to safely access the crossing, call the crossing (if required) and wait in a safe location that doesn't block cyclists travelling straight ahead.

Typical provisions for right-turning cyclists are indicated in the typical crossing layouts in the appendix.

However, at crossings on busier cycle routes and/or where a significant volume of right-turning cyclists is anticipated, the provision of enhanced turning facilities, including sufficient stacking space, should be considered. (Note - stacking space is generally not required for zebra crossing layouts as motorists are expected to yield promptly to cyclists wishing to cross).

Each crossing will need to be assessed on an individual basis to determine how best to cater for right turning cyclists depending on anticipated volumes and site geometry.

One of the simplest ways of creating additional waiting/stacking space for right-turning cyclists is to use a wide buffer between the cycle track and carriageway. The buffer automatically creates space for right-turning cyclists to wait to cross as shown in Figure 4.112. The waiting area should be sufficiently wide and deep to cater for the anticipated volumes of turning cyclists.

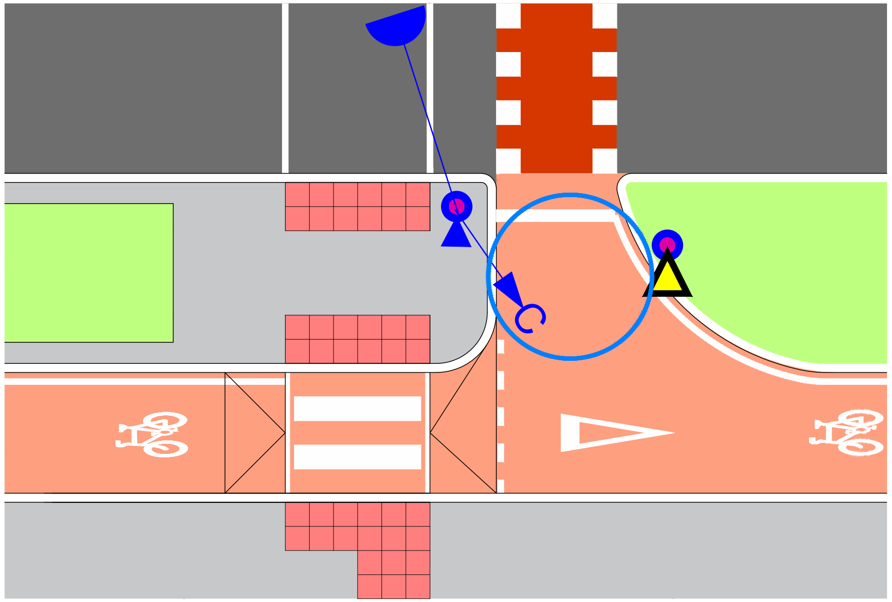

Figure 4.112: Example of wide buffer between a cycle track and carriageway that creates waiting/stacking space for right-turning cyclists (circled blue).

Where sufficient buffer cannot be provided, the two options below can be consider.

Option 1 – Widen the cycle track

Widen the cycle track at the crossing to create space for a dedicated waiting area adjacent to the footway kerb for right-turning cyclists. A push button unit facing the waiting cyclists will be required to allow cyclists to call the crossing. The unit should be positioned so that it is easily reachable by people using all types of cycles.

The waiting area should be located within the extents of the crossing e.g. within the relevant road markings.

The location of the traffic signals will need careful consideration to ensure visibility as per TSM requirements is achieved. Locating signals in an island adjacent to the carriageway or the use of cantilevered signals may need to be considered.

Figures 4.113 and 4.114 illustrate this types of arrangement for a signalised parallel crossing and toucan crossing respectively.

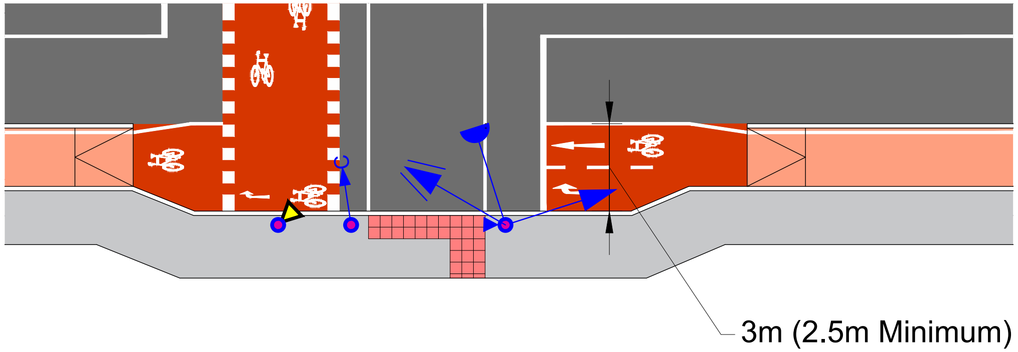

Figure 4.113: Example of cycle lane widening at a parallel crossing to create space waiting/stacking space for right-turning cyclists.

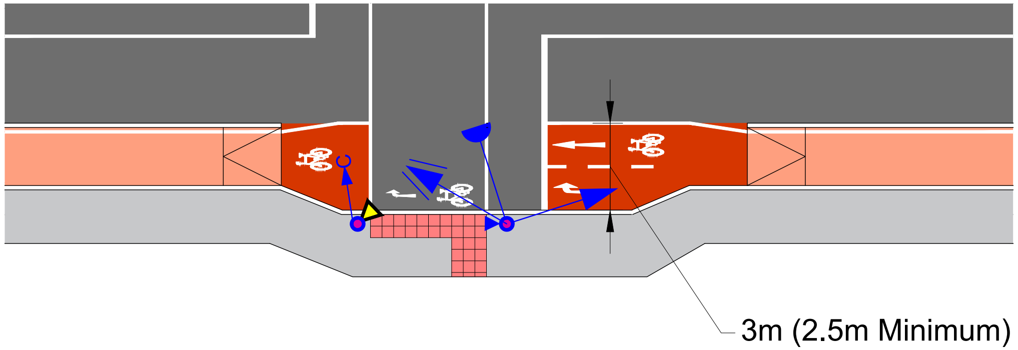

Figure 4.114: Example of cycle lane widening at toucan crossing to create space waiting/stacking space for right-turning cyclists.

Option 2 – Transition to shared space

In this arrangement, the cycle track/lane for straight ahead cyclists continues as normal and a ramped transition is provided to bring turning cyclists up to a shared area at the crossing (see Figure 4.115).

As shared spaces are disliked by both pedestrians and cyclists, transitioning to shared space should only be consider in constrained locations and where a shared crossing, e.g. toucan crossing, is being implemented.

The ramp should have a maximum gradient of 5% (1:20) and should be a minimum of 1.5m wide. Appropriate signage and tactile paving to warn users of the shared space will be required.

Figure 4.115: Example of a transition to shared space at a toucan crossing.

4.5.8 Grade separated crossings

Providing appropriate crossing facilities can be challenging across high speed roads, railways and watercourses, and a grade separated crossing via an overbridge or underbridge (underpass/tunnel) may need to be considered.

Grade separation is safe because it completely removes the conflict between cycle and motor traffic. While there may be slight diversion or additional gradient at some sites, cycle traffic also benefits from a continuous route with no delay due to having to yield to other traffic.

The main disadvantage of grade separated crossings are they tend to be more expensive and have a higher visual and environmental impact on the surrounding area due to the additional infrastructure and space requirements.

4.5.8.1 Width

The required width for grade separated facilities will be primarily influenced by whether pedestrians and cyclists have their own designated space or whether the facility is shared.

Segregated facilities

On busier urban routes with higher volumes of pedestrians and cyclists, the preference should be to maintain segregation between pedestrians and cyclists, similar to example shown in Figure 4.116.

The required width of the cycle track should be determined using the width calculator, including adjustments as required for vertical wall/parapets/kerbs etc. and designers should refer to DMURS to establish the required width for pedestrians.

5.5 m will typically be the minimum width required for segregated facilities (2m footway, 3m cycle track, 0.5m clearance on one side) although additional width may be required on busier routes and to provide the desired separation between pedestrian and cycle facilities on overbridges.

Figure 4.116: Segregated pedestrian and cycle bridge at Cambridge Railway Station, UK.

Figure 4.117: Shared pedestrian and cycle bridge on the Dodder Greenway, Templeogue.

Shared facilities

As grade separated structures are costly to implement, it may be more practical to provide a shared facility (see Figure 4.117) in some situations, for example on routes with lower volumes of pedestrians and cyclists, routes outside of urban centres or where space is particularly constrained. Designers should refer to the guidance on the width of shared facilities in Section 4.2.7. In all cases the recommended minimum width of a shared grade separated facility is 4 m.

Width of underpasses

At underpasses, widths greater than desirable minimums should be considered to increase the attractiveness of the facility and the amount of natural light in the structure.

4.5.8.2 Access ramps

Access ramps to bridges or underpasses will normally be used by both cyclists and pedestrians and gradients should be suitable for wheelchair users. Ramp gradients should comply with the guidance in section 4.1.6.2. Designers should also refer to the guidance in ‘Building for Everyone: A Universal Design Approach’ published by the National Disability Authority (NDA). Sharp corners on access ramps should be avoided to enable users to maintain momentum on the gradients and to maximise personal security and passive surveillance. Meandering horizontal alignments like the example in Figure 4.118 are preferable for cycling. Where meandering ramps are used, consideration should be given to providing alternative stepped access to cater for strong pedestrian desire lines.

Figure 4.118: Meandering access ramp to Dafne Schippers Bridge, Utrecht, Netherlands (Image: www.consultancy.uk).

4.5.8.3 Headroom

The desirable and absolute minimum headroom clearances for underbridges and enclosed footbridges are given in Table 4.26. Cyclists ideally require a minimum headroom of 2.4 m at underbridges however this should be increased to at least 2.7 m where an underbridge is longer than 23 m to allow more natural light and improve visibility.

When deciding whether a headroom below desirable minimum is acceptable, designers should consider the visibility and consequent risk of collisions on the approaches and exits. Reflective hazard warning signs should be fitted above the entrances if there is a risk that taller riders may catch their head.

At existing structures, lowering the minimum headroom to 2.2m may be acceptable but decisions will need to be taken on a case by case basis, based on relevant factors such as the forward visibility.

Table 4.26: Headroom clearances for underbridges and enclosed footbridges.

Facility	Underbridge < 23 m or enclosed footbridge		Underbridge ≥ 23 m	
	Desirable min.	Absolute min.	Desirable min.	Absolute min.
Cycle-only or shared facility	2.4m	2.2m	2.7m	2.4m
Pedestrian-only facility	2.3m	2.2m	2.6m	2.2m

4.5.8.4 Parapet Heights

Minimum parapet heights for new overbridges in various circumstances are given in Table 4.27. A parapet height of 1.4m is recommended on new overbridges, and elsewhere with a vertical drop, where the cycling surface is immediately adjacent to it. The parapet height should be increased to 1.8m if equestrians also use the bridge.

For structures over railways, designers must liaise with Iarnród Éireann to determine specific requirements and gain requisite approvals.

Table 4.27: Minimum parapet heights for overbridges.

Facility	Minimum Parapet Height (excluding plinth)
Cycle-only or shared use overbridge, except over railways	1.4m
Footpath directly adjacent to the parapet	1.2m
All pedestrian and cycle bridges over railways	1.8m
Bridges serving equestrian users	1.8m

Where an existing footbridge or vehicular overbridge is being proposed for inclusion on a cycle route and the existing parapet height is less than 1.4 m, an absolute minimum parapet height of 1.2m may be acceptable subject to a satisfactory risk assessment and suitable mitigation measures being implemented. Such mitigation measure may include (but are not limited to):

- Providing a 0.5 m minimum buffer adjacent to the parapet to deter cyclists riding adjacent to the parapet;
- Tonal contrast or surface texture with pedestrians placed next to the parapet; and
- Separation of pedestrians and cycle users by means of a delineator strip.

4.5.8.5 Drainage

Appropriate gradients and crossfalls in accordance with section 4.1 Geometric Requirements, should be provided at all grade separated structures to ensure adequate drainage of surface water.

At underbridges, particular consideration should be given to drainage requirements to ensure no surface water ponding on the cycle route.

4.5.8.6 Wheeling ramps

Wheeling ramps should not generally be necessary on new bridges and underpasses however they can be retrofitted to older stepped infrastructure as a low cost measure to enable cycles to be rolled up or down a flight of steps that would otherwise interrupt a cycle route. See Figure 4.119.

It should be noted that wheeling ramps will be of limited use to those with non-standard cycles and are inaccessible to many people, therefore an alternative accessible route should also be provided.

The design of the wheeling ramps should be such that pedestrians can still easily access a handrail on one side of the steps, and that the ramp section is placed far enough from the edge that cycles and panniers do not catch on any hand rails or railings.

The suggested profiles for steel and concrete wheeling ramps are illustrated in Figure 4.120.

Figure 4.119: Wheeling ramps retrofitted to concrete steps.

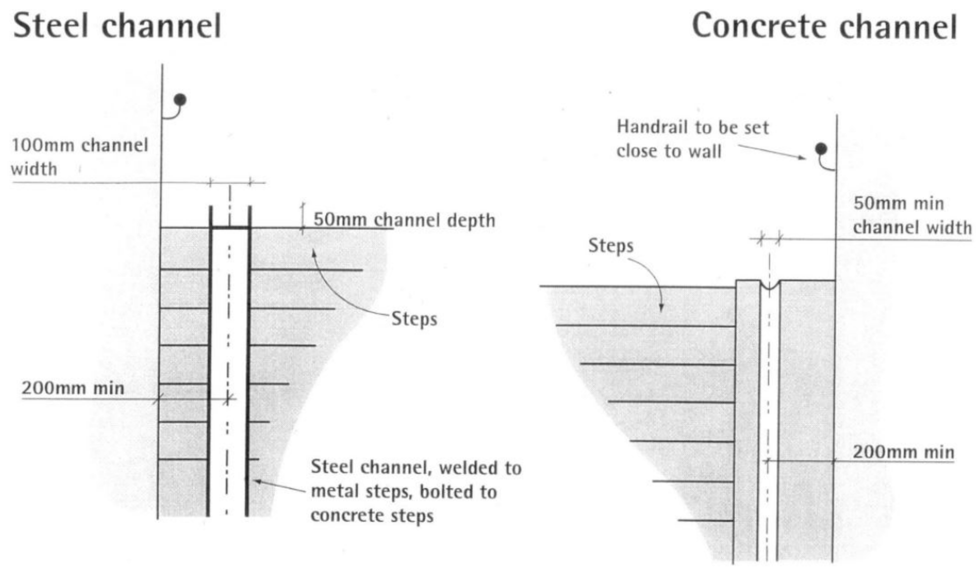

Figure 4.120: Suggested profiles of wheeling ramps (Source: Sustrans).

4.6 Roundabouts

4.6.1 Introduction

Traditionally, roundabouts in Ireland have been designed to prioritise motor traffic and maximise capacity, featuring flared entries and exits with two or more traffic lanes, wide circulatory carriageways, and acute angles between approaching and circulating traffic.

The relatively smooth path for motor vehicles helps to increase traffic capacity but can result in high traffic speeds through the junction, particularly on large diameter roundabouts. As a result, many existing urban roundabouts are not conducive to safe pedestrian and cycling movements.

4.6.2 Roundabout Types

Normal single-lane roundabouts typically have an inscribed circle diameter (ICD) of between 28m and 40m. The central island is kerbed with a minimum diameter of at least 4m and the circulatory carriageway is up to 6m wide (between 1.0 and 1.2 times the maximum entry width). Multi-lane roundabouts have an ICD of up to 100m. Compact (also known as 'continental') roundabouts, provide tighter geometry with an ICD of typically 17m to 30m.

Mini-roundabouts have a flush or slightly raised central disc between 1m and 4m in diameter depending on the road space available. The central disc marking should be capable of withstanding overrunning by large vehicles. See Chapter 7 of the Traffic Signs Manual for the requirements and guidance for installing mini-roundabouts.

4.6.3 Design Principles

Roundabouts can work well for cyclists and pedestrians but only if designed to specifically address their needs and expectations. Safety, and not capacity, is the over-riding principle for good roundabout design. The following design principles should be considered when designing a cycle-friendly roundabout.

- Approaching traffic should be slowed (to near stopping speed) by narrowing the entry lane. This provides better gap acceptance, greater legibility for drivers and a safer cycling environment;
- Traffic speed on the roundabout should be controlled by means of a single narrow circulatory lane. Overrun areas can be utilised to provide a narrow lane while allowing larger vehicles to manoeuvre through the junction;
- Approach arms should be aligned towards the centre point of the central island and not deflected to the left;
- Traffic lanes should approach roundabouts at right angles rather than obliquely, and without any flares. This makes it easier for drivers to see cyclists and traffic on the roundabout, and it is easier for pedestrians to cross the mouth of the side road;
- The location and visibility of any pedestrian and cyclist crossing facilities must be carefully considered;
- Excessive visibility over the central island can result in high entry speeds, potentially leading to collisions. To mitigate this, suitably positioned landscaping or artwork within the central island can improve the conspicuity of the roundabout and encourage slower vehicular speeds. Typically, the height of proposed landscaping should be at or above the eye level of a driver (approximately 1.05m) and be passively safe; and
- Where multi-lane approaches or double or multiple gyratory lanes are necessary for capacity, the cycle traffic should be taken off the carriageway into a separate cycle facility.

Figure 4.121: Compact Roundabout, Railway Street, Navan, Co. Meath.

Cyclists can integrate with traffic at smaller diameter (compact) roundabouts and mini-roundabouts, where traffic volumes and speeds are (or can be made) low, and the traffic lane widths are narrow enough for cyclists to safely share the single lane entries, exits and circulatory carriageway in the ‘primary position’ (see Section 4.2.9).

Compact roundabouts (such as the example shown in Figure 4.121) will tend to have a lower traffic capacity than normal roundabouts. Depending on the traffic balance between arms, single lane roundabouts can accommodate up to 25,000 vehicles per day. Capacity can be assessed using traffic modelling software as traffic queue lengths may increase in the peak periods when this design is retrofitted at an existing site.

Off-carriageway cycle tracks are required at roundabouts where traffic volumes and/or speeds are higher. This necessitates the crossing of each arm of the roundabout by cyclists and pedestrians; crossings can be at-grade priority, signal-controlled, or fully grade-separated.

4.6.4 Improving Existing Roundabouts

Where traditionally designed normal roundabouts are located on cycle routes, designers can either look for an alternative route to avoid the roundabout using a more cycle-friendly parallel route or try to improve conditions for cycling at the roundabout which may entail any of the following options:

» If motor traffic flows and speeds are suitable (i.e., speeds >30km/h or traffic entering the roundabout is above 4,000 pcu/day), remodel the junction as a compact shared roundabout. Designers should include rapid build options that utilise cost-effective methods of construction as part of the Option Selection process;

» Provide protected space for cycling around the junction, with suitable crossings of each arm (as shown in Figure 4.122);

» Introduce signal control to the roundabout, with protected space or other suitable facilities for cycling;

» Replace the roundabout with a signal controlled or other form of junction, with appropriate cycle facilities; or

» Provide grade-separated cycle tracks around and/or across the junction.

Figure 4.122: Retro-fit scheme on Main Road, Tallaght which provided a compact, cycle-friendly roundabout with shared pedestrian-cyclist facilities.

4.6.5 Roundabouts with Protected Space for Cycling

Segregated cycling facilities are necessary where traffic volumes and speeds are too high for cycling with general traffic in the carriageway (see thresholds in Table 2.1). These roundabouts, which typically have an ICD of up to 40m, have tight geometry which reduces vehicle entry and exit speeds and provides safer crossings for cyclists.

Consideration should be given to providing one or two-way cycle tracks around the roundabout. While two-way tracks have the benefit of reducing the distance cyclists need to travel when making right turns, it can be more difficult, in safety terms, to provide priority for cyclists at entries and exits. At large roundabouts and gyratory systems, it is more likely that cyclists will look to take the shortest route to avoid the additional effort. One-way cycle tracks have the advantage that cycle traffic is moving in the same direction as other traffic on the roundabout, meaning that drivers are more likely to be aware of them.

4.6.5.1 Protected roundabout with cycle priority (TL 701)

A protected roundabout with cycle priority features a circular orbital cycle track, which maintains full segregation between all modes, and parallel zebra crossings to enable pedestrians and cyclists to cross the carriageway with priority. This roundabout design originated in the Netherlands and is being implemented in a growing number of countries worldwide. The first protected roundabout with cycle priority in Ireland was recently constructed in Fingal (see Figure 4.123).

This type of layout is suitable in urban areas only i.e. on roads/streets with speed limits up to 60 km/h, and is suitable for traffic capacities of up to 25,000 vehicles per day, based on experience from the Netherlands.

Ensuring slow motor vehicle speeds through the junction and on approach roads is critically important with this design to enable a safe system approach. As the majority of motor vehicles using the roundabout are likely to be private cars, the design must ensure that car speeds are kept particularly slow through the junction. Narrow approach roads and circulatory carriageways, overrun areas and raised crossings will be key elements in this regard.

Slow vehicle speeds also improve gap acceptance which enables traffic capacity to be maintained at levels comparable to traditional roundabout designs of similar scale.

Parallel zebra crossings have the advantage that they give immediate priority to cyclists and pedestrians with minimal delays to motor traffic unless the numbers crossing are high. The crossings must be raised and set back 5.0m (to base of ramp) from the circulatory carriageway to minimise deviation in the path of pedestrians and cyclists while also providing adequate stopping and stacking space for motor traffic entering and exiting the roundabout.

It is important that there is intervisibility between the carriageway, the cycle track, and the crossing location so that drivers, cyclists, and pedestrians are aware of each other's presence. The alignment of the cycle track on the approach to the crossing should be as close to perpendicular to the carriageway as possible to maximise the visibility envelope for drivers and cyclists. Channelising islands should be provided at the crossings to physically reduce entry and exit lanes and provide refuges for pedestrian and cyclist crossings.

Figure 4.123: Protected roundabout with cycle priority, Fingal, Dublin

4.6.5.2 Protected roundabout without cycle priority (TL 702)

Outside urban areas, i.e. greater than 60 km/h speed limits, it is not recommended that cyclists be given priority over motor traffic at roundabouts. In such situations a protected roundabout without cycle priority is recommended. A protected roundabout without cycle priority may also be suitable in urban locations where priority for motor vehicles at a roundabout is necessary or desirable.

The design features an orbital cycle track that closely follows the road kerb alignment around the corner, i.e. not a circular track, (see Figure 4.124) and turns through 90 degrees at the crossing point. This alignment helps to keep cycle speeds slow approaching the crossing as cyclists must yield to motor traffic. An advantage of this alignment is that it requires less space to implement compared to a protected roundabout with cycle priority.

Pedestrians and cyclists cross the carriageway at uncontrolled crossings with refuge islands. The crossings must be situated a minimum of 10m from the circulatory carriageway so that people waiting to cross can differentiate between vehicles exiting and continuing to circulate the roundabout. It is important in this situation that the cycle track alignment changes on the approach to the crossing to position cyclists perpendicular to the carriageway. This will slow cyclists on approach to the carriageway edge and ensure that they have good visibility of approaching traffic while waiting to cross.

As with other cycle friendly roundabout layouts, ensuring slow motor vehicle speeds, particularly the speed of private cars through the junction and on the approach roads is critically important.

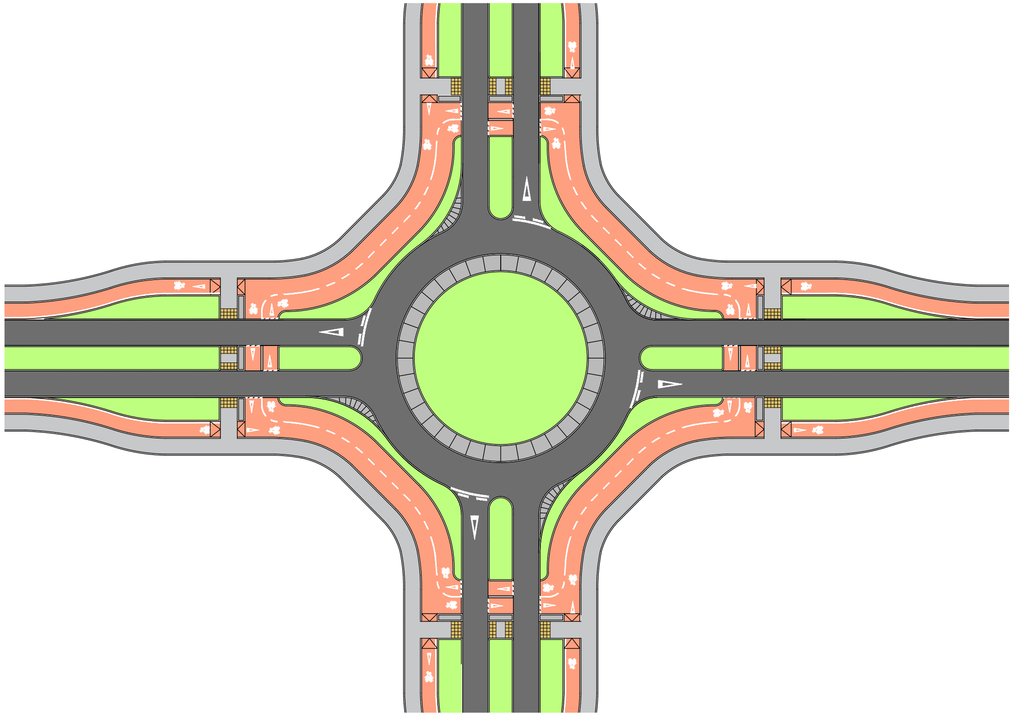

Figure 4.124 Protected roundabout without cycle priority.

4.6.5.3 Segregated roundabout with shared active travel facilities (TL703)

This type of layout is suitable in urban areas only i.e. on roads/streets with speed limits up to 60 km/h, and is suitable for traffic capacities of up to 25,000 vehicles per day.

The design includes shared areas (with pedestrian priority throughout) around the roundabout for pedestrians and cyclists and combined zebra crossings of the carriageway (see Figure 4.125). As shared facilities are disliked by both pedestrians and cyclists, other protected roundabout layouts (TL701, TL702) that maintain segregation between pedestrians and cyclists are preferred. This layout is also not appropriate for new development schemes with segregated cycle infrastructure. In such schemes, space should be made available for a protected roundabout layout also.

The layout can be an acceptable solution in circumstances where:

» space is limited;

» both pedestrian and cycle numbers are low (e.g. suburban areas);

» where shared active travel facilities are present on the approach road(s); or

» where there is a lot of wheeling activity on the footpath (e.g. around primary schools).

The design accommodates cycling both clockwise and anti-clockwise, using combined zebra crossings. This roundabout can be more space efficient than protected roundabout layouts with segregated pedestrian and cycle facilities.

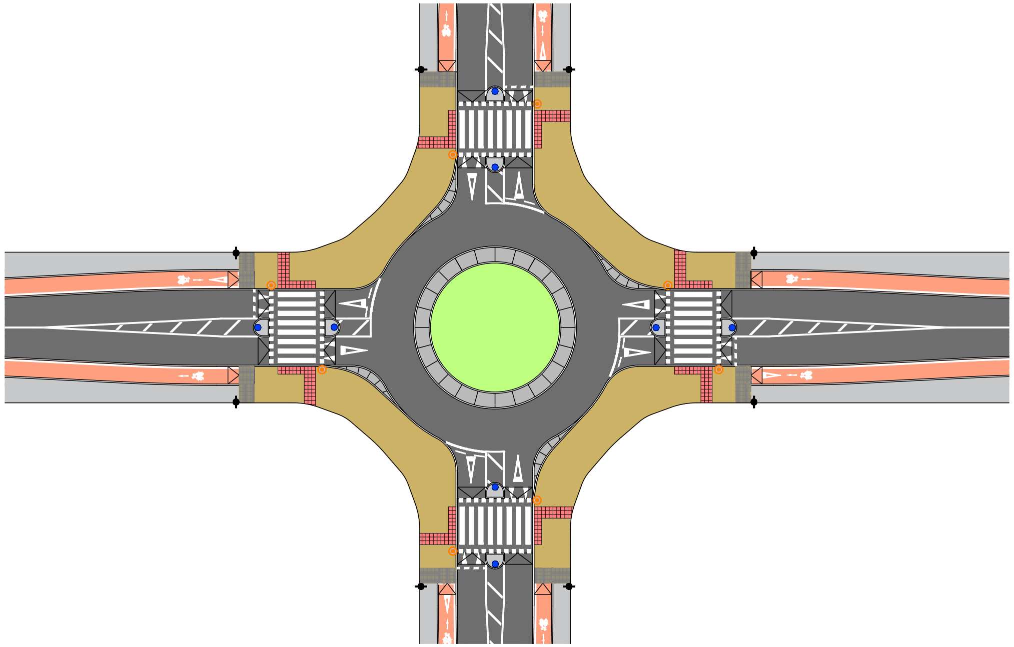

Figure 4.125: Segregated roundabout with shared active travel facilities

4.6.6 Signal-controlled roundabouts

Large, multi-lane, signal-controlled roundabouts are dangerous environments for cycling so where these roundabouts exist on cycle networks, suitable segregated crossings must be provided to enable safe passage of cyclists. The preferred solution in most cases will be to provide grade separated crossing facilities i.e. overbridge or underpass, particularly for new junctions. However, in retrofit situations, the provision of grade separated solutions may be prohibitively expensive and at-grade crossing solutions may need to be explored.

There are three options for providing at-grade crossings within signal-controlled roundabouts as follows:

Signal-controlled crossings (TL705)

The points at which cyclists and pedestrians cross roundabout entries and exits can be signal controlled to separate the conflicting movements, as shown in Figure 4.6.5. Signal-controlled crossings must be located a minimum of 20 metres from the circulatory carriageway across exit lanes and less than 20 metres from the circulatory carriageway across entry lanes.

Crossings of the roundabout arms can be integrated with the junction signal phases so that cyclists and pedestrians can cross while circulatory traffic is receiving a green signal. Detection equipment should be provided to enable cyclists to call a green signal as they approach the crossing.

Hold the left (TL706)

Cycle-only stages can be provided on signalised roundabouts using a 'hold the left' arrangement where left turning general traffic is held on a separate red signal while all circulating traffic (cycles and motor vehicles) and pedestrians are given a green signal. Motor traffic turning left to leave the roundabout is given a green aspect at the same time as traffic entering the roundabout.

Crossing to central island

In some locations, particularly at large diameter roundabouts, the provision of cycle facilities across or around the central island may provide a more direct route, as shown in Figure 4.126. Cyclists will often be able to travel to and from central islands without reducing junction capacity by crossing the roundabout entry while circulating traffic has a green signal and crossing the circulatory carriageway while entry traffic has a green signal.

Figure 4.126: Cycle track crossing to central island, M50 Junction 14, Dublin (image: Google earth)

4.6.7 Roundabouts for cycling in mixed traffic (TL704)

Shared Roundabouts (sometimes known as compact or Continental style roundabouts) are characterised by a physical central island clearly defined by a solid kerb. The diameter of the central island is 4m or larger. The arms are aligned in a radial pattern, with unflared single lane entries and exits, and a single lane circulatory carriageway that is no wider than 4m. Deflection is greater than with normal roundabouts with the design used to reduce speeds. An overrun area can be provided (on the central island or on the exit radius), if required, to increase lateral deflection and reduce the width of the circulatory lane while facilitating occasional larger vehicles. Figure 4.127 shows a typical layouts at shared roundabouts.

Figure 4.127 Shared roundabout, Stillorgan Road, Dublin (Image: Google Street view)

Cyclists can typically mix with general traffic at shared roundabouts with a throughput of up to 2,000 pcu/day and where the vehicular speeds on the approach roads is 30 km/h or less. At higher motor traffic flows and, protected space for cycling is required.

As the geometry of compact roundabouts encourages lower speeds, cyclists can use the carriageway to pass through the roundabout in the primary position. Motorists are unable to overtake cyclists on the entry and exit lanes and circulatory carriageway because of their reduced width.

Cycle symbols should be placed on the entries, exits and circulatory carriageway to alert motorists that they are in a shared street environment. Unsegregated cycle lanes should not be marked around the outside of the circulatory carriageway, even on compact and mini roundabouts since cycle lanes offer no physical protection and cyclists using them are in the 'secondary position' (see Section 4.2.9) where they are vulnerable to side-swipe ('left hook') collisions when motor vehicles are exiting the junction.

At compact roundabouts where pedestrian priority is to be provided, raised zebra crossings should be provided on all arms of the junction. This reduces vehicle speeds approaching the crossing and provides pedestrians with a raised crossing surface at footpath level.

5

Implementation & Maintenance

5.1 Introduction

The appropriate design and selection of construction materials and proper maintenance of cycle facilities should ensure that they will be used and fulfil the purpose for which they have been provided, and can help reduce ongoing maintenance costs.

Cyclists are more directly affected by hazardous surfaces so routine and winter maintenance of cycle tracks requires a different approach to that used on-carriageways. Under the 1993 Roads Act (Section 13, Part 2), Local Authorities have an obligation to maintain public roads. The maintenance of cycle ways and cycle tracks falls within this remit. This chapter considers maintenance of cycle facilities from the perspective of design and construction.

5.2 Construction Elements

Cycle tracks are composite structures that typically comprise of four layers. The principal components are illustrated in Figure 5.1, but other features to consider are transitions, edges and verges, ecology, drainage and ancillary works such as lighting, fencing, access controls and landscape features. There are many options for their general form of construction and constituent materials. The optimum choice will depend on the environment in which the track is being provided.

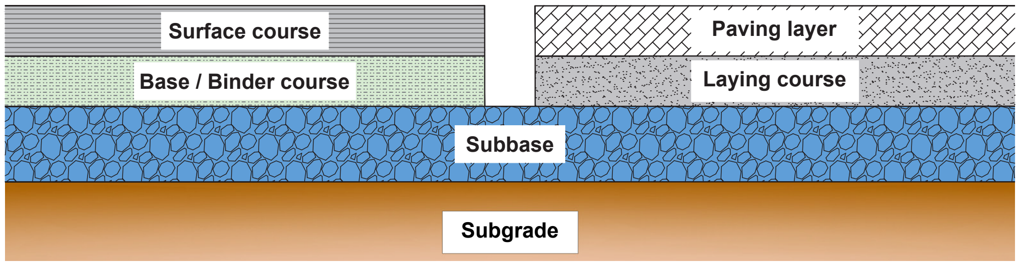

Figure 5.1: Typical constituent parts of an urban cycle track.

5.2.1 Sub-grade (formation)

The sub-grade is the existing ground or native material below a constructed pavement. The top of the subgrade is termed the formation. Sub-grade is usually present within the carriageway already and should be designed to provide stable conditions on which the track can be formed.

Off-carriageway this can be created by compacting the natural ground. Where the ground is contaminated or unstable, a capping material may be required. The stability can be increased by using geotextiles such as felt, polypropylenes or plastic grid systems.

Cyclists and pedestrians do not create a high loading requirement, but where vehicles and machinery will be used for construction and maintenance, the sub grade must be able to support these. All vegetation must be removed with the topsoil. Voids and subsidence can be caused by decomposing matter. In places of ecological or archaeological significance 'no-dig' construction may be required (Figure 5.2).

Figure 5.2: No dig construction technique around trees in Blackrock Park, Dun Laoghaire.

The minimum subgrade condition requirement is defined as a design California Bearing Ratio (CBR) of 2.5%. The determination of the design CBR for a particular subgrade material is detailed in Analytic Pavement and Foundation Design (DN-PAV-03021). Where subgrade design CBRs determined are less than 2.5%, subgrade treatment through cement stabilisation, geotextiles, or material replacement will be required. A capping layer may also be required where subgrade conditions are insufficient to carry construction traffic.

5.2.2 Traffic Loading

The estimated traffic loading to the pavement structure needs to be assessed within the pavement design process. Vehicles with a gross vehicle mass greater than or equal to 3.5 tonnes are considered to structurally degrade a pavement structure under repeated load repetitions. Vehicles with a gross mass less than this are not considered to structurally deteriorate a pavement structure and environmental impacts on pavement long term performance take precedence. For off-line and fully segregated cycleways it is estimated that the pavement will carry less than 0.2 million standard axles (msa). Where the expected traffic is higher designers should undertake a full pavement design according to DN-PAV-03021.

5.2.3 Pavement Type

Smooth surfaces improve accessibility and safety for a wider range of users, such as wheelchair users, mobility scooters and those using non-standard bicycles. Good quality machine laid surfaces will appeal to this wider group, and provide a comfortable and attractive surface for all to cycle on.

The selection of the most suitable pavement type is at the discretion of the designer based on the particular requirements and conditions at the location of the cycleway.

A number of pavement material types are available for consideration and inclusion within a cycleway pavement structure. These material types, relevant National Standards Authority of Ireland (NSAI), NTA Interim Technical Advice and TII Specification for Road Works publications and mixtures allowed for use within cycleway pavement structures are shown in Table 5.1.

The typical make-up of a cycle track is shown in Figure 5.3.

Table 5.1: Cycleway Pavement Materials and Mixtures.

Material Type	Publication	Mixtures
Bituminous Materials	NSAI Standard Recommendation S.R. 28 (2018) “Recommendation for the use and implementation of the I.S. EN 13108 series bituminous mixtures – material specifications” IS EN 13108-5 “Bituminous Mixtures – Material Specifications – Part 5: Stone Mastic Asphalt”. NTA Specification of Red Surface Course for Use on Off-Road Urban Cycleways – Interim Technical Advice, April 2023. Transport Infrastructure Ireland (TII) Publications DN-PAV-03024 and DN-PAV-03074	SMA 6 surf 65/100 (Red, Off-Road) AC 6 close surf 70/100 SMA 10 surf 70/100 AC 20 dense bin 70/100
Unbound Granular	CC-SPW-00800 Specification for Road Works Series 800 - Road Pavements - Unbound and Cement Bound Mixtures	UGM A UGM B
Earthworks	CC-SPW-00600 Earthworks	Capping 6F1 Capping 6F2

Designers are encouraged to consider using recycled materials in the makeup of pavements in line with that permitted in the guidelines.

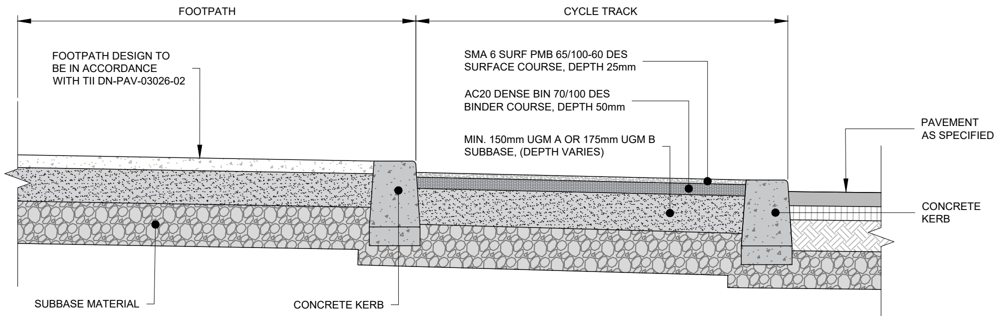

Figure 5.3: Typical make-up of off-road cycle track.

5.2.4 Coloured Surfacing

The use of coloured surfacing on cycle facilities can enhance the legibility and attractiveness of the facilities and help to increase driver awareness of the potential presence of cycle users. It will also increase pedestrian awareness of the cycle facility, which will be important at all points of pedestrian interaction, including junctions, crossings, bus stops and parking areas. Tonal contrast between areas allocated to pedestrians and cycle users will assist partially sighted pedestrians in navigating these spaces.

For this reason it is recommended that all dedicated cycle facilities, with the exception of remote greenways and shared active travel facilities, in urban areas in Ireland should be red in colour. Outside of urban centres or where the facilities are shared with pedestrians, the use of red surfacing is generally not recommended and if red surfacing is being proposed on such facilities, a departure must be sought and approved by the relevant approving authority. When deciding how to apply this recommendation, designers should carefully consider the following factors:

» **Legibility** – the more that a consistent surface colour is applied, the greater the level of understanding and appreciation will be for its purposes from all user groups.

» **Comfort and attractiveness** – clear and visually distinguishable cycle facilities will provide greater confidence to new and less confident cycle users that the network is fully joined-up and encourage them to use these facilities more.

» **Safety priorities** – where cost is a constraint, Local Authorities, with the agreement of the Approving Authority, may choose to focus the application of coloured surfacing to locations where the greatest safety risks lie, such as at junctions and on approach to crossings and areas of kerbside activity (parking, loading and bus stops).

» **Visual Impact** – in locations with cultural heritage value or high visual amenity characteristics the use of a red coloured surfacing may not be appropriate. Subject to Approving Authority agreement, alternative surface colour can be considered in such locations.

» **Maintenance** – like-for-like repairs to cycle link surfaces will be important for user comfort for the reasons set out above. The ability to repair and maintain coloured surfacing without creating gaps in the coloured surface will be important.

The NTA has developed an interim guidance note "Specification of Red Surface Course for Use on Off-Road Urban Cycleways" for a red SMA surface which will provide a high quality, long lasting, surface for cyclists. At time of publication, this specification is only permitted for use on off-road, segregated cycle facilities.

For cycle lanes at carriageway level through junctions, the red colour should be provided using High Friction Surfacing with approved PrTrait in Accordance with Road Pavements – Bituminous Materials (CC-SPW-00900). In high traffic flow locations this may need replacing every 5 years to maintain impact.

5.2.5 Laying Materials

To ensure a smooth ride quality, bituminous layers of cycle tracks/lanes must be machine laid. Narrow paving machines (see example in Figure 5.4) are available to lay the surface course although there are limitations on the width of available machines in the Irish market at present. It is therefore recommended that a minimum machine width of 1.1m is assumed.

The use of hand work should be limited to localised restricted areas only and must be subject to the agreement of the Approving Authority.

Figure 5.4: Narrow Paver for cycleways (source: Arkil).

5.2.6 Edges and Verges

Concrete kerbs or timber/concrete edgings often form a part of road construction standards. Edging reduces the frequency of the edges breaking away which in turn reduces maintenance requirements and provides a useful marker for where vegetation clearing should start. For this reason it is recommended that edging is included on urban cycle schemes.

The verges adjacent to off-road paths act as natural drainage, absorbing the run-off from the sealed surface. Vertical features such as hedges and walls reduce the useable width, so ideally a mown grass verge or low, slow growing plants should be provided for 1.0m immediately next to the path.

While fencing should be avoided if possible as it can negatively impact on the attractiveness of a cycle route, fencing may be required for stock control or to protect path users from steep drops, water or high-speed traffic immediately alongside the cycle path. Fences should generally be a maximum of 1.5m high which is sufficient for stock control while enabling most adult cyclists to see over the top.

5.2.7 Drainage

The standard of drainage associated with cycle routes must be effective given that cycle braking systems and tyres are not as effective in the wet and that standing water can conceal serious surface defects, amongst other risks.

Drainage gullies, channels and inspection covers can present hazards to cyclists and should be located away from travelling surface used by cyclists. This is particularly important on bends and sharp curves as wet ironmongery is may to cause cyclists to skid, slip or fall off.

Cycle friendly design solutions include:

» Offline positioning for inspection covers etc.;

» Side-entry gullies; and

» Continuous kerb drainage (Figure 5.6).

Ironmongery should be placed offline. Where this is not possible, it should be flush (typically +/-5mm) and recessed covers should be considered to avoid slippery metal surfaces. Gullies with slots running in the direction of travel wheels are also a serious hazard to cyclists (Figure 5.5). Gully slots must be at right angles to the direction of cycling or replaced with a different pattern. Cycle friendly drainage gullies are detailed in TII CC-SCD-05144 Cycle Friendly Gully Details.

Figure 5.5: Incorrect Gulley grate for cycle facilities. (Source: London Cycling Design Standards).

Figure 5.6: Continuous kerb drainage.

Paths should be constructed with crossfall or camber, with drainage falling to the inside on bends. The path itself should not be lower than the adjacent natural ground so that water has an escape route.

Cross falls and long falls are used to drain road and cycling surfaces. Drainage usually works adequately within the following gradient ranges:

Cross Fall:	1.0% to 2.5% (Max 5% over a 100m section)
Long Fall:	0.5% to 3.0% (Max. 5% over a 150m section)

Depending on the type of cycle link, the surface can either:

- » Drain to both sides. This might be used on cycleways and on certain segregated cycle tracks.
- » Drain to one side only. This is applicable to on-road cycle facilities and certain cycle tracks.

On adjacent cycle tracks, cross-fall away from the main carriageway is more comfortable for cyclists. However, this requires an independent gully or channel system. In such instances, the cycle track gully spacing's should match the main road gully locations to reduce pipework. A cross-fall towards the main carriageway may also be implemented if required however in such situations the cross-fall should not exceed 2.5% and superelevation may need to be considered on bends.

Paths through wetlands, adjacent to rivers or in cuttings prone to flooding, can be made more resilient by building them on a causeway. This approach requires an understanding of the potential impact on drainage and ecology. In some cases, a boardwalk may offer the better ecological solution. Simple ditches or swales alongside the path will help avoid surface water run-off from flooding into adjacent areas. UPVC filter drains set in a stone bed can help water to percolate more slowly but will require maintenance as they can become blocked by roots from vegetation. Regular inspection pits can help to isolate the location of blockages to ease maintenance. Pipe gradients should be between 1:15 and 1:50. Soakaways can be used to divert collected water back into the natural water table. Culverts can offer a more cost effective and less visually intrusive option to bridges where a cycle track crosses a small stream or drainage feature.

5.2.8 Sustainable Urban Drainage Systems

The provision of footpaths and cycle facilities can generate as much run-off as a standard carriageway. This must be taken into account in the design of the overall drainage network. Rather than increasing the capacity of the existing drainage network, designers should consider how Nature Based Solutions could accommodate the additional runoff. The Department of Housing, Local Government and Heritage have published an interim guidance note "Nature-based Solutions to the Management of Rainwater and Surface Water Runoff in Urban Areas" which should be referenced. Designers should also seek out individual Local Authorities Sustainable Drainage Systems (SUDs) Guides as requirements may differ between administrative areas.

Planting not only improves the attractiveness of a cycle route, but can also do much more in practical terms, particularly if incorporated into Sustainable Drainage Systems (SuDS), providing separation from traffic, shade and shelter, biodiversity, urban cooling, water collection and flooding reduction, and filtration of pollutants (Figure 5.7).

Figure 5.7: Sheffield Grey to Green Scheme (source: Nigel Dunnett.)

SuDS consist of a range of measures that emulate a natural drainage process to reduce the concentration of pollutants and reduce the rate and volume of urban run-off into natural water systems. Where possible, designs should seek to incorporate SuDS, particularly in areas where ponding is a current or potential issue.

Incorporating nature based solutions into retrofit cycle schemes is challenging as the space available within existing streets is limited, however there are usually pockets of space that are not being fully utilized that could be repurposed. An example in Figure 5.8 is from Dun Laoghaire Rathdown County Council where an existing median island was removed and a rain garden created in the space that was made available.

Figure 5.8: Rock Road Active Travel Scheme rain garden, Dun Laogahire Rathdown County Council.


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5.3 Maintenance

Potholes, debris, fallen leaves, overhanging branches, poor drainage or snow and ice can all increase the likelihood of a collision or fall and put people off cycling altogether. Maintenance is important to keep cycling infrastructure safe and in good condition.

Considering the following principles will ensure the functionality and safety of cycling facilities and help minimise ongoing maintenance costs:

- **Minimisation of Whole Life Cost (WLC):** It is important to promote and incorporate the WLC philosophy at the early stages of the design of new cycle schemes, that considers the expected remediation and maintenance costs, particularly in relation to pavements and surfaces;
- **Provision of a Safe and Comfortable Facility for all Users:** Promoting the design and construction of schemes that are as safe as is reasonably practicable, utilising the Best Available Technology (BAT), where possible;
- **Enhanced Durability and Service Life:** The design team's focus should be to minimise construction waste, by means of Resource and Waste Management Plans and to design a scheme that is robust and durable using materials with low carbon footprints and that are easily sourced and preferably from local suppliers;
- **Implementation of Circular Economy Principles:** It is important to minimise resource consumption during all stages of cycle scheme development.
- **Improved Aesthetics or Environmental Impact:** To design and promote schemes that balance aesthetics and the visual amenity of a place and that are sympathetic to the receiving environment and furthermore seek to enhance the existing heritage.

5.3.1 Design for Maintenance

Design decisions have a large impact on the level of maintenance required through the life of an Active Travel project or network. Maintenance considerations should be an integral part of the design process. For example:

- **Surface and Road Marking Type:** When evaluating the selection of surface materials and road markings, the design team should place a strong emphasis on specification, quality control, the quality of workmanship, the design life and the maintenance burden imposed by the selection;
- **Drainage:** The application of positive drainage will significantly reduce the damage caused by surface water run-off if designed and maintained correctly;
- **Planting:** Sympathetic and appropriate planning should be designed to incorporate slow-growing vegetation where overgrowth can be addressed at frequent intervals that are not excessive.
- **Trees:** The design and construction of a new route should address trees that are likely to cause problems in the future. This could include removal or where appropriate, the installation of root barriers.
- **Ancillary features such as signage and artwork:** Consideration should be given to how they will be maintained and whether it is appropriate to provide them at all where there are concerns of potential for anti-social behaviour, which could lead to reoccurring damage of such features.
- **Maintenance Access:** The requirements for maintenance access should be considered during the planning and design stage. It is important at the design stage to evaluate road and footpath loading/ end use and to design robust paving. The design of any access points should take this, as well as the turning requirements of maintenance vehicles into consideration. Or alternatively, restrict vehicle access to paved areas via control measures (for example removable bollards, complete with lockable integrated sockets, imposing weight restrictions, imposing bye-laws, etc.).

5.3.2 Maintenance Type

There are four different types of maintenance as follows:

» **Routine Maintenance:** this can include regular scheduled actions such as routine maintenance inspection checks to log baseline conditions, street cleaning, traffic sign cleaning, grass cutting and landscape maintenance;

» **Reactive Maintenance:** this can include responding to inspections (e.g. end of life treatment requirements following reports of poor performance indicators), complaints or emergencies;

» **Regulatory Maintenance:** this can include inspecting and regulating the activities of others; and

» **Seasonal Maintenance:** spring, summer, autumn, winter.

It is recommended that Local Authorities develop a Maintenance Delivery Plan (MDP), see example in Table 5.2, for their active travel networks which outlines how the network will maintain its functionality and safety for cyclists. An effective maintenance programme will identify faults in advance of their becoming a safety hazard and more costly to repair. The MDP should include a definitive inspection schedule. Consideration should be given to having the inspections carried out by cycle as this will more accurately identify the maintenance issues from a cycling perspective.

Table 5.2: Typical Maintenance Delivery Plan for cycle routes.

Item	Activity	Notes	Frequency	Time of Year
Cycle Track Surface	Winter maintenance	Consider importance as utility route.	As Necessary	Winter
	Inspection	Staff undertaking maintenance works can also carry out site inspections.	Every time site visited. Minimum of 4 visits per year.	Early spring, mid summer, early and late autumn (before and after leaf fall).
	Repairs to potholes etc.	Reactive maintenance in response to calls from public, plus programmed inspections.	As Necessary	N/A
	Sweeping to clear leaf litter and debris.	Combine with other activities if possible.	Site Specific	N/A
	Cut back encroaching vegetation on verges.		Once a year	November, and when sweeping takes place.
	Programmed maintenance, such as resurfacing.	The need for remedial work will depend on the condition of the cycle track. Unbound surfaces may require more frequent maintenance.	As Necessary	N/A
Drainage	Clear gullies and drainage channels etc.		Twice a year	April, November
Vegetation	Verges – mow, flail or strim.	To include forward and junction visibility splays.	N/A	July and September
	Grassed amenity areas.	Include with verge maintenance.	N/A	
	Cut back trees and herbaceous shrubs.	If necessary, allow for annual inspection of trees depending on number, type and condition.	As Necessary	Between 1 September and 28 February as per Section 40 or the Wildlife Act 1976.
Signs	Repair/replace/clean as necessary.	Maintenance will largely depend on levels of local vandalism.	N/A	N/A
Structures, including culverts.	Inspections.	Carried out by suitably qualified staff.	Visual inspection every 2 years and detailed structural inspection every 6 years	N/A
Street Furniture	Maintain or repair.		N/A	N/A
Lighting	Repair faulty lights.	Monitor on a regular basis to identify faults.	As Necessary	N/A

5.3.3 Winter Maintenance

Snow and ice are a serious problem for many cyclists and if cyclists are to continue cycling during the winter months, it is crucial that they can expect cleared cycle tracks when they go back and forth for their everyday trips. In addition, cyclists should never be tempted to use busy carriageways instead of cycle tracks during poor weather conditions. Consequently keeping cycle lanes clear of snow and ice should form part of regular and ongoing winter maintenance programmes. Local Authorities must therefore consider how key cycle routes, especially primary and secondary routes in urban areas, can be integrated into the existing Winter Service Planning programmes.

5.3.4 Inspections

The scheduled inspections noted in Table 5.2 should record the following:

» **Design flaws** – lips, poor transitions and poor quality reinstatements;

» **Surface defects** – longitudinal and transverse cracks, holes or general surface break-up;

» **Debris** – grit, glass and leaves;

» **Height restrictions** – where trees or signage reduce the clear height below 2.4m;

» **Width reductions** – encroaching vegetation, poorly placed signage and road works;

» **Signs and Lines** – signs are damage or removed, or line markings have deteriorated and become less visible;

» **Ironmongery** – gullies are sunken or proud, or lids have become loose; and

» **Drainage** – evidence of ponding on the cycle facility or blocked drains causing flooding and splashing on the carriageway.

Local Authorities should consider joint inspections with cyclists who are familiar with the routes and who can point out flaws that may not be immediately obvious, relevant or urgent to the inspector.

5.3.5 Fault Reporting

Faults and defects can also be detected by road users, especially cyclists and bus drivers, in advance of a scheduled inspection. A reporting mechanism should be put in place in each Local Authority to enable cyclists to report defects as soon as they arise. All defects (location, when reported, when it will be fixed) should be logged centrally. Ideally logging systems should be geo-referenced (map based) to help users accurately locate the defect when making a report. The results of all examinations and reports should be logged and prioritised as appropriate.

Defects such as potholes, uneven surfaces and defects pose a much greater risk to cyclists than they do to other road users. The same is true of broken glass, debris, wet leaves, standing water or ponding. These should be urgently attended to within the maintenance programme.

The nature and potential hazard of the reported defects from inspections and users should be prioritised by the degree of risk and the potential cost of non-feasance.

5.4 Public Lighting

5.4.1 Introduction

Public lighting improves the safety, comfort and security of all road users, including cyclists. Unlike motorised vehicles, cycle headlamps may not illuminate the route. Their design purpose is primarily to alert other road users to the presence of the cyclist. Cyclists are usually dependent on ambient or public lighting to see where they are going.

Unlit commuter cycle routes, away from road corridors, are particularly off putting for many existing or potential cyclists and can result in cyclists not using the route during hours of darkness. It is therefore an essential requirement for urban commuting during winter months that cycle routes are lit. Outside of built-up areas, recreational routes will not normally require lighting unless there are specific road safety concerns, e.g. at junctions or crossings, or if the route has a strong commuter or transport function.

5.4.2 Design Objectives

Well-designed public lighting increases the attractiveness of the route and gives the cyclist a greater sense of security. It can also increase the accessibility and utility of the route.

Street lighting helps cyclists to see potential hazards such as street furniture, gullies, broken glass etc., but also to see other road users.

Street lighting should meet the following basic requirements:

» illuminate the route ahead;

» illuminate the road surfaces;

» illuminate junctions, access points and conflict points; and

» illuminate obstacles and other users along the route.

Street lighting needs to be maintained in order to ensure these objectives are met. Regular inspections during hours of darkness should be carried out to identify and replace faulty lanterns, and a fault management system should be available to the public.

5.4.3 Key Issues to be Considered

5.4.3.1 Location of Lighting Columns

Care should be taken to avoid creating an obstruction for cyclists or pedestrians when positioning lighting columns at the edge of the roadway. A minimum clearance of 0.5m (desirable minimum 1.0m) between the lighting column and cycle track is recommended.

If there is no verge outside the footpath to locate the lighting column, the column should be located to the back of the footpath and adjusted if necessary to deliver the lighting levels attributed to the carriageway.

Public lighting columns should be relocated at an early stage in a retrofit project to allow for a smooth finish of pavements around the lighting column.

Care should be taken not to locate lighting columns close to trees that may obstruct the light.

5.4.3.2 Additional Cycleway Lighting

In addition to normal street lighting, specific cycleway lighting may be required:

» where a cycle track is located more than 2.0m from the carriageway;

» where there are sudden bends or corners on an unlit cycle track; or

» where a cycle track diverges from the carriageway and follows an independent route.

Crossings must be well-lit to highlight pedestrians and cyclists both approaching and using the crossing if the general carriageway lighting is insufficient. Additional lighting at both sides of the crossing may be required to achieve this. The cycle approach and waiting area (at least the area covered by the tactile paving surface) and the carriageway crossing area should be illuminated to a uniform level.

5.4.3 3 Environmental Impacts

The introduction of lighting along cycleways has the potential to impact on the habitat that it passes through, for example it has the potential of impacting on bats feeding behaviour. It is therefore imperative that the lighting design is considered early in the project development so that its environmental impact can be properly assessed and considered in any screening process being undertaken.

Where normal lighting is not appropriate, designers should consider alternatives such as low level lighting or smart lighting that controls when an area is lit. Removing lighting completely from a primary commuter route is not desirable and will necessitate the identification, and provision, of an alternative safe cycle route.

On the Portmarnock to Baldoyle Greenway, Fingal County Council used low level directional lighting to light the cycleway and adjacent footway primarily to reduce the environmental impact of the scheme, as shown in Figure 5.9. Where low level lighting is used, designers must give particular attention to making the lighting vandal proof as it will be easily accessible.

Figure 5.9: Lighting on the Portmarnock to Baldoyle Greenway, Dublin.

On the Dodder Greenway, South Dublin County Council undertook a needs based assessment in line with EUROBATS Publication, **Guidelines for Consideration of Bats in Lighting Projects,** to design a system that minimised impact on bats while still maintaining lighting for the public when needed.

The solution was the use of Smart Lighting system (Figure 5.10) that controls when the lights are on. The lights are on constantly until a set time (7pm in Winter) after which the system switches to motion sensors which turns on a bank of up to 5 lights as someone is detected approaching a sector.

Designers should consult with lighting and appropriate environmental specialists in the development of lighting plans for environmentally sensitive locations.

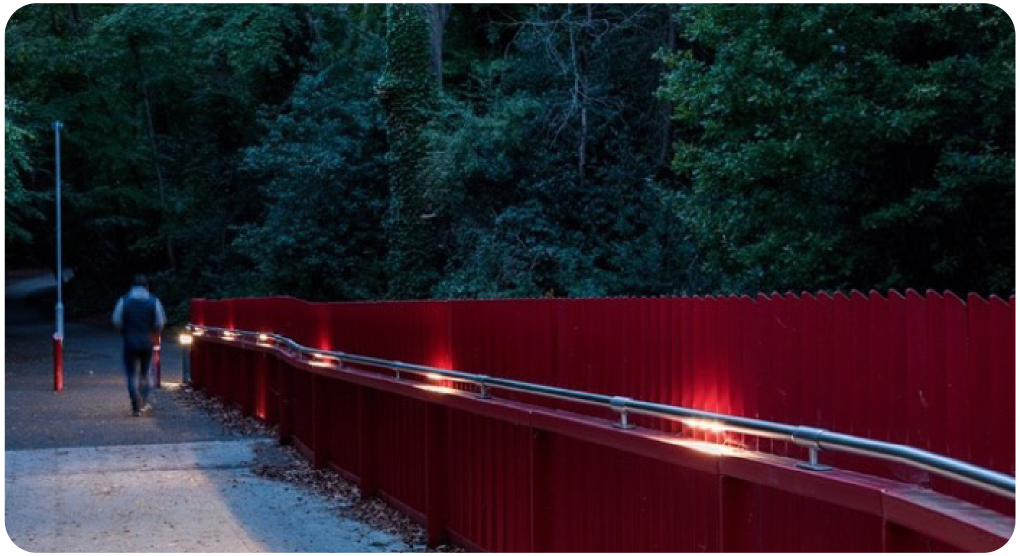

Figure 5.10: Lighting on the Dodder Greenway, Dublin, with detector visible at end of bridge.

5.4.4 Design Guidelines

Public lighting should always be considered as part of the Road Design and Road Safety Audit processes. The design, installation and maintenance of public lighting measures should be carried outin accordance with the Codes of Practice and guidelines listed below. Any proposed deviations should be subject to consultation with, and agreement by, the relevant Local Authority Public Lighting Department.

- I.S. EN 13201-2:2015; Road Lighting Performance requirements.
- BS 5489-1:2020; Design of Road Lighting, Part 1 Lighting of roads and public amenity areas – Code of Practice.
- PLG23; Lighting for Cycle Infrastructure; Institute of Lighting Professionals.
- DN-LHT-03038; Design of Road Lighting for the National Road Network; TII.
- Design Manual for Urban Roads and Street.

5.5 Signage & Wayfinding

5.5.1 Introduction

Legible and coherent design can help minimise the need for signs. However, some signs are required to help enforce traffic laws, and directional signs are needed to ensure people can understand and follow the route. Signs must be designed and positioned carefully to ensure the signs themselves do not create confusion or undue street clutter.

5.5.2 Regulatory signs

Designers should always refer to the latest version of the Traffic Signs Manual (TSM) which provides design advice and information for the use of regulatory signs. The Regulations, which are made under Section 95 of the Road Traffic Act 1961, define the regulatory signs and road markings to be used and the significance to be attached to them.

Regulatory signs and markings inform road users about on-road restrictions such as speed limits, turning bans, car parking regulations and prohibition of access for certain classes of vehicle. The on-street signs are also important because they enable the authorities to enforce the desired behaviors. Designers must be aware that deviations from the prescribed information in the TSM will impact the ability to enforce restrictions.

The regulatory signs (and accompanying road markings) form part of the cycle route network infrastructure, helping to create the conditions in which safe cycling can take place. Where it is safe to do so, consideration can be given to making cyclists exempt from prohibited movements by adding a supplementary plate with the wording “EXCEPT BICYCLES” (TSM P050).

5.5.3 Road markings

Advice on the use of road markings is given in Chapter 7 of the Traffic Signs Manual. They are used to indicate prohibitions, delineate carriageway space or crossing points, and provide information to assist with wayfinding such as direction arrows. Half-size versions of give way markings and centre line markings are prescribed for use along cycle tracks.

Markings such as direction arrows can assist with providing a coherent route for cyclists, particularly at transition points and to mark the route through complex junctions, and are less obtrusive than upright signs. Road markings should always be well-laid, clear and regularly maintained to ensure they remain legible.

5.5.4 Warning Signs

Warning signs are described in Chapter 6 of the Traffic Signs Manual. Where cycle routes cross or pass along busy roads, Cyclist warning signs, Sign W 143, may be erected to warn drivers of the presence of cyclists. The sign should not simply be used in lieu of designing safe cycle routes and crossings.

5.5.5 Direction signs

Direction signs provide users with information about direction and distances to key destinations along networks of cycle routes, either local routes or longer distance routes. Signs for cycle traffic are more necessary in quiet streets and traffic free routes than where the cycle route follows a main road, where direction signs for general traffic are already provided. Designers should look to provide signage only where necessary and they should be located at the back of footways, or in verges, where they are clearly visible to cyclists but are not causing an obstruction to pedestrians (Figure 5.11).

Direction signs can have the added benefit of promoting cycle routes and raising awareness of their location. A consistent approach to design and branding can assist with legibility of cycle networks. Poor design or missing signs will affect users trust in the cycle network.

Cycle direction signs can be placed at the junction itself, usually opposite the minor arm at a T-junction. Where cycle tracks pass through complex signal controlled, or grade separated junctions, direction signs may be needed to guide people through the junction at every point where there is a choice of routes available.

Repeater and confirmatory signs should only be used where they are essential. In general, if it adds to the clarity of the route without adding clutter, it should be considered.

Details on the design of Cycle Network Signs can be found in Chapter 4 of the Traffic Signs Manual.

Figure 5.11: Active Travel Directional Signing in Dun Laoghaire.

5.5.6 Sign Positioning

Signs should be mounted using as few posts as practicable to avoid signage clutter, and preferably on a single post. Where possible signs should be placed on existing street furniture (where it is suitably located) to reduce the need for additional posts. Cycle signs may be incorporated into general road traffic signs to help reduce street clutter.

Every effort should be made to ensure that sign poles do not impede the free movement or vision of mobility impaired people, the elderly, people with pushchairs, small children, or wheelchair users. Signs poles should ideally be located at the back of the footpath (with a cranked pole if necessary) or within verges with an offset of 0.5m from the edge of the cycle track.

5.5.7 Wayfinding strategies

An effective wayfinding strategy will result in users feeling like they are being guided along a route and removes the need for cyclists to stop to consult maps or phones. The provision of useful wayfinding can have a positive impact on pedestrian or cyclist experiences. An effective wayfinding system will:

- Keep pedestrians/cyclists informed;
- Connect users to key locations;
- Be consistent; and
- Capture information simply.

Locations that require additional information to allow users to make the right decisions are called decision points. Extra wayfinding information at these key decision points and the surrounding environment will enable users to travel more effectively.

Visual clues from the urban environment, surrounding architecture, landmarks, public spaces, parks and geographical features play an important role in enabling users to navigate and influence the decisions made on journeys.

The decision points can be categorised into 3 subcategories:

- **Primary Decision Point** - principally located at large crossings, multiple footway systems, and often where there are multiple route options;
- **Secondary Decision Point** - The secondary decision point is principally located along a defined routes where there is often more than one option to continue along the route; and
- **Tertiary Decision Point** - The tertiary decision point is principally located along a route where users need minor guidance.

The level of wayfinding provision should be in line with the decision point category, with the most information provided at the primary locations reducing to basic information, or sign, at Tertiary Locations.

Dun Laoghaire Rathdown County Council created a bespoke wayfinding scheme for their Active School Travel Routes projects, which incorporates 3 distinct corridors and requires cyclists to meander through different streets which could be complex if wayfinding was not provided. The 3 corridors with their associated logo are as follows:

Sea to Mountains

Mountains to Metals

Park to Park

These logos are used as road marking and on wooden bollards along the 3 routes to guide pedestrians and cyclists as is shown in Figure 5.12. The wooden bollards also include braille and QR Code.

Figure 5.12: Active School Travel Route Guidance in Dun Laoghaire.

5.5.8 Signing roadworks and temporary diversions

Roadworks can introduce hazards for cyclists including uneven surfaces, slippery metal plates, narrow traffic lanes and conflicts with construction vehicles. Markings and traffic cones or wands can be used to create protected space for cycling through roadworks whilst temporary signs can be used to highlight the issues. Warning signs for use at roadworks should be used in accordance with Table 8.3.1.1 of the Traffic Signs Manual. A summary of the key signs relating to cyclists are provided in Table 5.3.

Table 5.3: Cyclists warning signs for use on Roadworks.

Sign No.	Sign Face	Description
WK084		Cyclists Keep Left: this sign should be used to direct cyclists to the left.
WK085		Cyclists Keep Right: this sign should be used to direct cyclists to the right.
WK086		Cyclists: is available for use where it is considered necessary to warn traffic of the likely presence of a significant number of cyclists. A supplementary plate P 002 Length may be used where the length of the lane width restriction is greater than 250m.
WK087		Slippery for Cyclists: may be provided where roadworks may, due to a slippery surface, cause problems for cyclists.

Roadworks often result in narrower traffic lanes which can be located directly adjacent to physical vertical features such as fencing/ barriers. Where possible, a safe route should be provided through the creation of a temporary off-road cycle track, separated from the works area by a suitable barrier. Where cyclists are to be accommodated on the road, lane widths should be adequate to accommodate cyclists as well as vehicular traffic. Detailed guidance on providing for vulnerable road users including pedestrians and cyclists is provided in Chapter 8 of the Traffic Signs Manual, the Temporary Traffic Management Design Guidance and the **Temporary Traffic Management Operations Guidance**. Guidance on appropriate lane widths from the Temporary Traffic Management Design Guidance is provided in Table 5.4.

Table 5.4: Construction Lane Widths when Cyclists Present.

Lane width (m)	Comment and recommendation
<3.3	Can be used but should be supplemented with a WK 086 cyclists present sign. If existing lane width is less than 3.3m, then no signage is required. Signage is only required if lane is being reduced.
3.3 to 3.5	Can be used.
3.5 to 4.0	To be avoided.
>4.0	Can be used.

If practical a 4m lane will facilitate vehicles to overtake a cyclist and therefore reduce driver frustration. Lane widths of 3.5m to 4.0m should not be used as drivers of larger vehicles may attempt to overtake without adequate clearance.

5.5.9 Information totems

Information totems provide a platform to display on-street maps (see example in Figure 5.13). They can be provided alongside cycle hire docking stations, cycle parking stands or located at strategic points where a route choice must be made.

Maps are beneficial in telling the reader where they are in relation to their destination and isochrones can be used to provide an estimate of cycling times. The orientation of the map should be the same direction as the viewer is facing and street names should be included on the map. Sketches and photos of significant buildings or landmarks can be useful to assist with orientation.

Figure 5.13: Cycling network map of Houten, The Netherlands. (Source: Bicycle Dutch).

In addition to maps it is also beneficial to place awareness signs along routes which may be shared with other road users so as behaviours can be influenced, such as the “Ring your Bell” sign on the urban greenway in Figure 5.14. Other variations include signage advising users to “Keep Left, Pass on the Right”.

Figure 5.14: Information bollard on the Passage Greenway, Cork.

5.5.10 Irish Language Signage Requirements

The Official Languages Act sets out the statutory requirements regarding the use of the Irish language by public bodies. These requirements apply to signage and information panels located on routes in Ireland which are developed or funded by public bodies. These statutory requirements must be considered as part of the sign planning process. The following is an excerpt of the main requirements:

- Place names on information signs must be in both Irish and English except in Gaeltacht areas, where the names of places should be in Irish only.
- Where the spelling of a place name is similar in both languages, only the Irish form of the name should be shown.
- All Irish text should be in italic print, in lower case lettering, with initial letters in capitals.
- Irish script should be inclined to the right at an angle of 15 degrees to the vertical. All English text should be in upper case roman letters.

Note that the content of information panels must be presented in Irish and English, including in Gaeltacht areas. To identify the correct spelling of a place-name in Irish, consult **logainm.ie**.

The use of icons as an alternative to text is recommended as this facilitates understanding across multiple languages.

6

Cycle Parking

6.1 Introduction

The availability of cycle parking facilities at either end of a trip will heavily influence the decision to travel by bicycle. The absence of secure parking will deter some people, or make cycling impossible. Cyclists that experience repeated cycle theft will sometimes stop cycling altogether.

Cycle parking is integral to the cycle network and can be introduced relatively quickly. Cycle parking is also important for integration with public transport for multi-modal journeys. As with other cycle infrastructure, cycle parking and access to it should be safe, direct, comfortable, coherent, and attractive. A proportion of cycle parking should be accessible to all with some provision for larger cycles as well as standard bicycles.

6.2 Design Principles

The five core principles of designing cycling infrastructure also apply to cycle parking:

1. **Safe** – cycle parking should be secure for the cycle and users should feel safe from the risk of personal crime;
2. **Direct** – cycle parking should be near to the cycle route and/or as close as possible to the final destination;
3. **Coherent** – cycle parking should be well-connected to routes and buildings, well-signed and easy to find;
4. **Attractive** – cycle parking areas should be of good quality design and well-maintained; and
5. **Comfortable** – cycle parking should be easy to use and accessible to all.

The following factors should be considered when locating cycle parking:

- Safe access away from adjacent live traffic lanes;
- Lighting for personal security and convenience after dark;
- Weather protection for commuters and overnight parking;
- Away from main pedestrian thoroughfares and emergency access points so as not to cause an obstruction;
- Potential to integrate with existing street furniture and place-making;
- Level access, or if this cannot be achieved, perpendicular to the slope to avoid cycles rolling down the slope; and
- Located in obvious, clean, maintained and overlooked areas to deter vandalism/theft, and to make users feel safe and welcome.

Parking duration will also have an influence on which of the five criteria is of uppermost importance to users. For short stays, users will be most concerned with convenience of access while having a safe place to secure their cycle. Cycle parking located close to shop fronts or overlooked by offices will provide some passive surveillance. Small clusters of stands close to main attractors are preferable to one central hub, although in shopping centres, a central facility on the ground floor of a car park or near the main pedestrian entrance may be the optimum location. Proximity is essential for disabled cyclists who may be unable to walk far.

For long stay parking, either overnight or where bikes are regularly parked for much of the day, some users will be willing to trade a degree of convenience for additional protection or services such as CCTV coverage, shelter from weather and secure access (i.e. not open to the passing public).

Residential parking is mainly occupied overnight and therefore restricted access (locked compounds, individual lockers) is usually the primary theft deterrent. This is also the case for some town and city centre railway stations where cycles are used by commuters for onward travel from the station and then left overnight on the return trip.

There is a limit to how far people will be prepared, or able, to walk to their final destination, so even in longer stay locations the secure parking should still be close to the main entrances and local cycle route network.

6.3 Universal Access

A proportion of the cycle parking (typically 1 space per 20 spaces or 5%) should be provided for larger non-standard cycles so that they can be used by disabled people with adapted cycles (Figure 6.1) and other people using tandems, child trailers, cargo bikes and tricycles. Spaces for larger cycles should be provided in the most accessible locations, for example near to the accessible car parking spaces.

Figure 6.1: Dedicated cycle parking for persons with a disability, Trinity College Dublin.

All public cycle parking equipment should be easy to use, without the need to lift cycles other than to guide the wheels into parking equipment. Doors and locking mechanisms within secure compounds should be easy to operate when the cyclist is holding a bicycle with one hand. Space is required in front and alongside parking stands to enable cycles to be steered into the cycle parking and then securely locked in place.

The cycle parking should not inconvenience others. A tapping rail (Figure 6.2) across the bottom half of the stand (end stand in a row of stands), retro-reflective material and colour contrast will help blind and partially sighted users to detect stands that are in areas that people walk through. The rail may also be helpful for securing larger cycles to the end racks.

Figure 6.2: Tapping rail on Sheffield stand

6.4 Locating On-Street Short Stay Parking

The following should be taken into consideration when determining the location of on-street cycle parking.

Convenience: Short stay parking for shopping and access to other services should be primarily located on-street close to the attractions as the duration of stay will be short and people will usually move their cycle around the centre with them.

Security: A good location will help to deter thieves. Public cycle parking should be placed where there is good natural surveillance from passers-by, or where the cycle parking is overlooked by windows of adjacent buildings (Figure 6.3). The view of the cycle parking should not be obscured by trees or street furniture that would enable thieves to work undisturbed. On-street cycle parking should be in areas with street-lighting. Additional lighting may be required within shelters. Where the cycle parking is within a building the areas should be evenly lit with no dark shadow areas. Light coloured walls, ceilings and floors can help to improve the effectiveness of the lighting.

Safety: The cycle parking must not block key pedestrian desire lines including access to other street furniture such as bus shelters and benches. Stands should not be placed where they might reduce available footway width for pedestrians beyond the recommended minimum for pedestrian flows at the busiest times.

Cycle parking stands may be placed on the carriageway, or on build-outs between parking bays (Figures 6.4 & 6.5). Around eight parked cycles can be fitted in the same space taken up by one car parking space.

Figure 6.3: Parklet created in public car park to accommodate cycle parking.

It is important that there is sufficient space around the stands for users to be able to stop safely away from other traffic and manoeuvre the cycles into position. Care should be taken to minimise the risk of vehicles striking cycle stands or parked cycles. The stands will usually need to be protected through the construction of build-out extensions into existing carriageway space (Figure 6.4), although some designs include a protective feature as in Figure 6.5.

The cycle parking may also be integrated into the design of Parklets (see Figure 6.3) such as those introduced to provide outdoor seating as part of Covid measures.

Figure 6.4: Cycle parking in the carriageway, Meath Street, Dublin.

Figure 6.5: Temporary cycle parking in car parking bay.

6.5 Types of Equipment and Layout

The most common types of equipment used for cycle parking are:

- Stands or hoops – where the cycle is leaned against a metal structure and locked (this may include hi/low arrangements where alternate sides are ramped to avoid handlebars clashing);
- Two-tier racks – where the cycle is locked in a tray and supported either at ground level or shoulder height;
- Cycle Lockers – where individual cycles are secured in a metal box;
- Cycle hangers – where several cycles are secured in a metal box; and
- Semi-vertical or vertical racks - where cycles are lifted into a vertical position (note - these are not recommended as public cycle parking stands).

All of these may be placed within a secure building or compound. The design of hoops may include longer, lower stands designed to accommodate the various larger cycles as shown in Figures 6.6 and 6.7.

Figure 6.6: Cycle hoops for cargo bicycles, St Stephens Green, Dublin.


Figure 6.7: Space for non-standard cycles at the Drury Street Cycle Parking Facility, Dublin.

6.5.1 Sheffield stand or hoop

The most common form of cycle parking is a tubular metal hoop that must be securely anchored into the ground at two points, commonly referred to as a "Sheffield Stand". In addition to the basic rectangular hoop, many other shapes are available in particular:

» An 'M' shape stand that makes theft more difficult by reducing the ability for the locked bike to be moved. The 'M' shaped stand also offers better support to small-wheeled bikes and children's bikes.

» An 'A' shape where the cross-piece offers additional resistance to 'twisting' that is sometimes used to release cycles when the stand has been cut by thieves and can also be helpful to secure smaller and non-standard cycles.

The advantages of a tubular stand are security, relative cost-effectiveness, and stability for locked bikes. Two-point locking enables both wheels and the frame to be secured to the stand, increasing the amount of time required to steal a bike and thus decreasing the chances of a quick, opportunistic theft. Two-point locking also reduces the risk of single components being stolen, e.g. a wheel, as both wheels, and the frame, can be secured more easily.

Layout of Sheffield stands

Sheffield stands require at least 0.6m clearance to walls/kerbs because the bicycle protrudes beyond the stand. A clear space of 1.0m in front of the stand enable the bicycle to be wheeled into position. A distance of at least 1.0m between parallel stands enables users to park bicycles fitted with panniers, or child seats, that may be slightly wider than an unladen bicycle. Where the site is sloping, it is better to place the stands across the slope so that the parked bicycle is horizontal.

Where space permits, the end stand in a row might also be suitable for larger cycles and could be signed as 'disabled parking'. Where provision is required for three-wheeled cycles, lateral spaces between stands should be increased to at least 2.0m.

Table 6.1 gives recommended and minimum dimensions (for parking bicycles) where Sheffield stands are placed in a parallel or "toast rack" arrangement, and aisle widths where there are large numbers of stands within a cycle park or compound.

Table 6.1 Layout dimensions for simple cycle stands.

	Recommended	Minimum
Bay length (length of cycle parked on a stand)	2.0m	2.0m
Bay length (tandems, trailers and accessible cycles)	3.0m	2.5m
Access aisle width (for bicycles only, pushed into position by user on foot)	2.0m	1.5m
Access aisle width (bicycles ridden to stand, larger cycles use the end bay only)	3.0m	1.8m
Access aisle width (all cycles ridden to stand, large cycles use internal bays)	4.0m	3.0m
Spacing between stands	1.0m	0.8m
Gap between stand and wall (part of bay width)	600mm	600mm

Common Use

All types of location from individual on-street parking stands through to larger external and internal cycle parking areas.

6.5.2 Two-tier stands

Two-tier racks as shown in Figure 6.8 offer around a third more cycle parking capacity within the same footprint. Two-tier cycle racks are suitable only for two-wheeled bicycles so alternatives for larger bicycles should also be provided. Some users will find it difficult to lift their bike from the floor onto the tray of the upper tier, although the mechanisms to lift and slide the stands into position are spring loaded or gas-assisted. The stands can be noisy in operation, which may be of concern in residential areas.

Layout of two-tier stands

A clear space of about 2.0m - 2.5m (varies with design of the stand pivot) is needed in front of the stand to enable the cycle to be lined up and placed in the stand. Most designs allow for stands to be placed either at 90 degrees or 45 degrees to the aisle, so a minimum aisle width of 2.0m to 2.5m is acceptable. Two-tier stands require a ceiling height of at least 2.7m, so may not fit in all older buildings or basement parking.

Common use

Railway stations, commercial developments, workplace, educational establishments and larger residential blocks.

Figure 6.8: Two-tier cycle stands at University College Dublin.

6.5.3 Cycle Lockers

Cycle lockers are a secure metal box into which an individual bicycle is placed and locked (Figure 6.9). The lock may be integral to the design or provided by the user. Some lockers are vertical, where the front wheel is lifted onto a hook within the locker to save space. Some users will find it difficult to lift the front of the cycle. Lockers are usually only designed to accommodate standard bicycles.

Figure 6.9: Bike lockers, Newbridge Train Station.

Layout of lockers

A clear space of 2.0m in front of the locker is needed for the bicycle to be turned and lined up to be placed inside.

Common use

Railway stations, public buildings, hospitals, workplace parking.

6.5.4 Cycle Hangars or Bunkers

Cycle hangars are usually provided on-street within residential areas to provide parking for local residents where there is no space within older dwellings. Space within the hangar is leased by the Local Authority and access to the hangar is limited to the registered key holders. In addition to the locked door of the hangar, residents also lock their bicycle to the stands within.

A hangar is broadly similar in size to a standard parking space (dimensions vary by manufacturer) but the footprint is larger than a vehicle and may overhang the adjacent footway or carriageway, see Figure 6.10.

Figure 6.10: Bike Bunker, Portobello, Dublin.

Layout of hangars

A cycle hangar that can accommodate 6-10 cycles will have an approximate footprint of 2.5m x 5.0m similar to a single car parking space. Users will need safe access either from the footway (or carriageway on very quiet streets). Where the hangar is located within the carriageway it is important to assess the risks to users associated with passing vehicles when using the locker and potential damage to the hangar from vehicle strikes.

Common Use

Streets with terraced housing or houses in multiple occupation in older high-density residential areas.

6.5.5 Summary of Parking Layout Dimensions

The critical dimensions for the layout of cycle parking are as follows (see Figure 6.11 also for illustration):

- 3.0m width for two-way cycle track access outside and inside cycle parking facility.
- 2.0m minimum aisle width for access on foot within parking area.
- 2.5m aisle width for two-tier racks arranged perpendicular to the aisle.
- 1.0m between sheffield stand centres.
- 0.6m from end of a Sheffield stand to any wall.
- 0.75 x 2.0m footprint for individual horizontal cycle lockers.
- 2.0m clear space in front of stands, lockers etc. to enable cycle to be positioned.
- 2.7m ceiling height for two-tier racks.
- Max. gradient 5% on access tracks/paths (excluding ramps within a cycle parking facility)

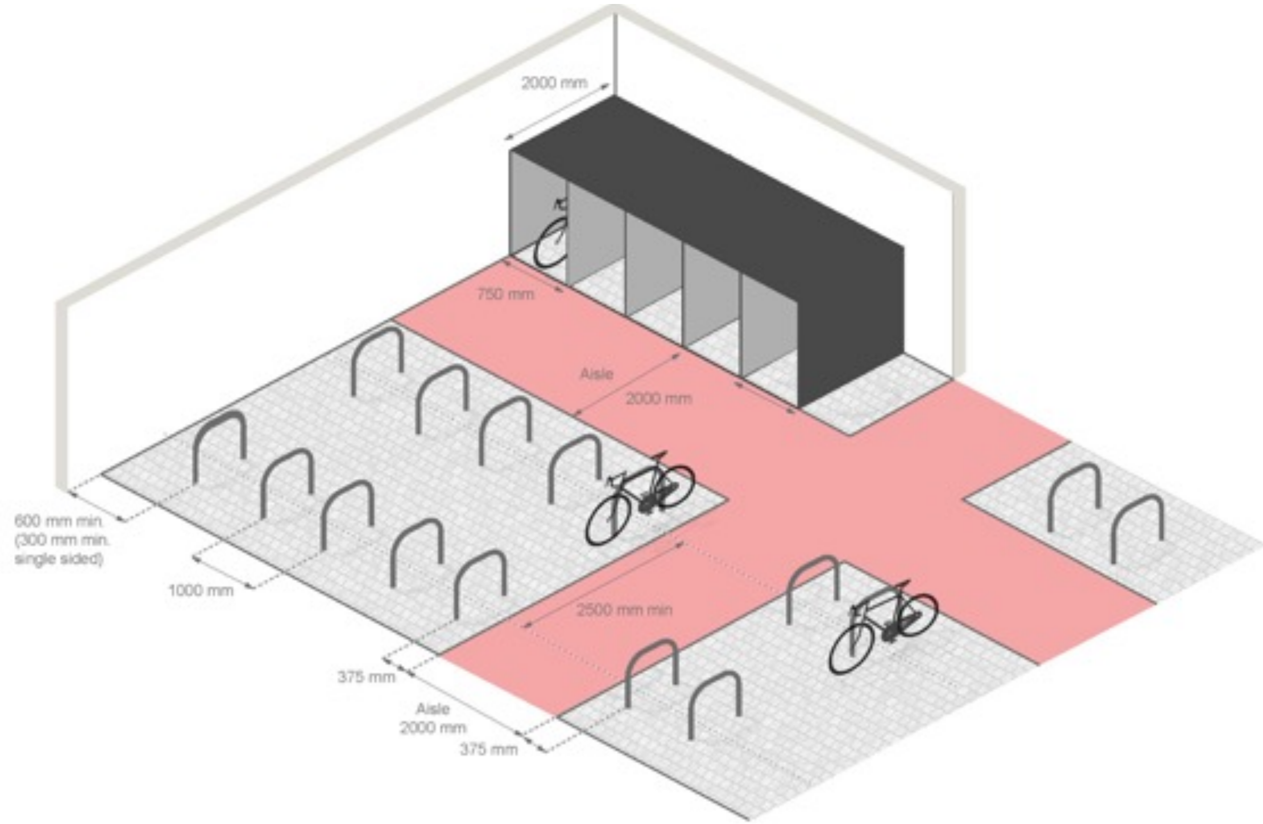

Figure 6.11: Cycle parking dimensions.

6.6 Additional Security Considerations

The following additional security measures for cycle parking should be considered.

Equipment Specification

The design and installation of the bicycle parking equipment should not feature fixings that could easily be removed with simple hand tools. Tamper proof nuts and bolts should be fitted. The depth of construction and security of fittings should be sufficient to prevent stands being loosened and lifted out of the ground. Security features such as locking bars and hasps should offer resistance to cutting and twisting.

Lighting

On-street and outdoor cycle parking should be illuminated to the same standard as the surrounding highway. This may require additional lighting to remove any shadows cast by the cycle shelter itself. Where the cycle parking is inside a building the use of light coloured walls and floor can help to enhance the effectiveness of the lighting.

CCTV

CCTV monitoring can help to deter thieves and recordings may help with recovery of stolen bicycles and prosecution. It is unlikely to stop theft unless it is being actively monitored and security staff can immediately intervene.

Shelters and Compounds

The cycle parking equipment can be placed within a locked shelter or compound (Figure 6.12) that adds an extra layer of security. This is commonly used within railway stations, school, residential and workplace situations where users must register for a key or access fob/code/smartcard. In residential settings the compound is often located in a basement car park. The facility is normally managed by the building owner/operator.

Figure 6.12: Secure access compound at St James Hospital, Dublin.

6.7 Cycle Hubs

Many journeys are short, particularly in urban areas, and can be made by walking or cycling alone. For longer journeys, combining cycling with public transport provides important links to more distant destinations.

Compared with walking, cycling increases the 20-minute travel time catchment area to public transport stops by a factor of around 16, thereby greatly extending the reach of public transport. Improving cycle access to interchanges therefore creates a major opportunity to generate new non-car trips or shift trips from car to sustainable modes. Cycling provides reliable journey times between the home and destination, little affected by peak time traffic congestion, and free or low cost parking.

Various types of combined trips might occur:

- Park (car) and Cycle to destination
- Cycle and Ride (on train/tram/bus)
- Ride and Cycle to destination

Cycle hubs are common in other countries at railway stations but may also be provided within town centres or co-located within large car parking facilities. The hubs offer a range of services to users which may include:

- Tools available for public use (Figure 6.13).
- Air pumps for public use.
- Cycle repairs.
- Cycle sales.
- Cycle hire.
- Cycle freight business.
- Changing rooms and showers.
- Maps and Travel information.
- Live departure boards.
- Ticket sales.
- Another business such as a newsagents, gymnasium or cycle themed café.
- Parcel collection point.

Figure 6.13: Cycle repair stand and pump at Drury Street Cycle Parking Facility, Dublin.

Cycle parking has potential to fulfil a role as an intermodal option at rural and suburban bus stops where, in less densely settled locations, the bus routes may be further from people’s homes or places of work. High-quality interurban bus routes, or limited stop express routes, may draw users from a further catchment than the traditional 5 or 10-minute walking distance hinterland normally assumed for bus services.

6.8 Changing Rooms, Showers and Storage Lockers

While people who commute short distances to a workplace are usually able to do so without wearing cycling clothing, those riding longer distances will appreciate changing rooms and lockers, preferably with facilities to dry clothing. These facilities are also used by people who run to work or for exercise.

These facilities may be provided at a workplace or form part of the services at a dedicated cycle parking hub.

6.9 Larger cycles and E-bike parking

E-bikes and adapted cycles are significantly more expensive than most bicycles and may be targeted by thieves. The batteries on some cycles can be easily removed. Providing parking areas in lockers or secure compounds will minimise the risk of theft. Because of the weight of e-bikes, horizontal lockers are preferable to vertical lockers.

Cycle parking facilities may include provision of electrical points for charging the cycles. The typical range for a fully charged bicycle is 60 – 80km so for most journeys the cycle does not need charging and provision for charging is a low priority. Operators should also consider potential fire risks and mitigation if charging facilities are provided.

6.10 Quantity

Regular counts of parked cycles at on-street locations and at public facilities such as stations will give an indication of any excess demand or spare capacity. Spare capacity is required so that users can be confident of finding a space. If a location is regularly almost full (circa 95% occupancy of capacity) the provision should be increased.

Counts should be undertaken in good weather at a range of times during the day. Where cycles are parked in locations that are not within the designated parking areas (railings, other street furniture) this may indicate that the existing parking provision is:

» Insufficient to meet demand;

» Not secure enough to provide confidence to users; or

» Not as convenient for the intended destination as the area of fly parking.

Ways to help plan the quantity and location of cycle parking investments may include:

» Data about existing travel patterns and planned new development can help to identify areas of potential demand for cycle parking as part of the overall network planning process;

» Engagement with businesses and organisations to understand how customer and visitor patterns vary across the day, week or year;

» Engagement with local cycling representative groups to understand existing problem locations – either where absence of parking is an issue, or where there are ongoing security concerns. Liaison with An Garda Síochána may also be helpful regarding the latter;

» Engagement with local pedestrian and accessibility groups to understand where informal parking presents an obstruction or hazard;

» Reviewing existing trip generators and the ability to access them easily by cycle – locations more easily accessible by cycle may justify an increased level of provision of cycle parking; and

- Introducing temporary cycle parking stands as a trial measure and monitoring use.

6.11 Managing Abandoned Cycles

Cycles that have been vandalised, subject to attempted theft or simply abandoned may be left locked to cycle parking or other street furniture for many months. This reduces the available capacity and can give the impression that a location is unsafe.

A bicycle may be identified as abandoned if it meets one or more of the following criteria:

- It is secured in a dangerous way (i.e. blocking access);
- It is secured to a cycle rack and considered unroadworthy;
- When it is reported by a member of the public and assessed as unroadworthy or in a dangerous position; and
- When it is noted as not having moved for a reasonable period of time – several weeks.

A bicycle that is defined as unroadworthy will have sustained one or more of the following:

- Flat front/rear/both tyres:
- Missing wheel(s);
- Missing seat;
- Buckled front/rear/both wheels;
- Bent forks;
- Seized/damaged brakes;
- Rusted chain/gears;and
- Missing chain.

Once a bicycle is identified as potentially abandoned, the Local Authority, or parking operator, can secure a notice to the bike and warn that if the bicycle is not removed within 14 days it will be removed as abandoned.

If there is anything about the bicycle that identifies the owner, an attempt to contact the owner should be made, and advise them that their bicycle is to be removed as abandoned.

Bicycle that are removed should be stored for a short period, after which it will be recycled as scrap metal or donated to a bicycle recycling scheme.

6.12 Temporary Cycle Parking

Temporary cycle parking, sometimes referred to as pop-up cycle parking, can be a cost-effective solution when cycle parking is required on a temporary, short term, or medium-term basis. Applications for temporary provision can include festivals (Figure 6.14), markets, concerts, fairs, exhibitions and sports events. Short term applications could include catering for an increase in cycle parking demand or simply where permanent cycle parking provision is either yet to be decided.

For longer periods, such as the loss of existing cycle parking due to construction or refurbishment works, a medium-term solution would be required. Each of these different scenarios require a solution that will accommodate both the quantity and duration for which the temporary cycle parking is required.

Figure 6.14: Event Parking at Bloom Festival, Dublin.

Figure 6.15: Event Parking using Scaffold Pole Structure (Bloom Festival, Dublin).

There are essentially three different types of temporary cycle parking which can be categorised as follows:

- Cycle Stands and Racks;
- Linked Pedestrian Barriers; and
- Scaffold Pole Structure (Figure 6.15).

If bicycles can only be locked securely at one point, it is advised this system is only used where security staff can observe the cycle parking, or a secure compound can be created.

Key Considerations for Temporary Cycle Parking are as follows:

- Make it clear that the cycle parking is temporary and not permanent;
- If the parking is only available at certain times (to match an event) make this clear to prevent cyclists from leaving their bikes parked outside these times;
- Always promote the cycling parking where appropriate for example provide the information to the event organiser to promote as a recommended travel option;
- Inform cyclists that they must use their own locks; and
- The location of the cycle parking is key and should be agreed with key stakeholders including the event organisers, local authorities and police agencies.

Appendix

Typical layouts for cycle infrastructure

This appendix contains the typical layouts for cycle infrastructure referred to throughout the manual. The layouts should be read in conjunction with the relevant text within the manual. Each layout also contains important notes which need to be considered when designing the relevant infrastructure.

At the bottom of the typical layout drawings, a 'back' button is provided. Clicking this button will bring you back to where the layout is discussed in the manual.

The legend opposite indicates the colours used for recurring elements throughout the layouts. Legends for key features, road markings etc. are shown on individual layouts as necessary.

LEGEND:

	Footpath
	Cycletrack
	Cycle Lane
	Shared Greenway
	Carriageway
	Verge

National Transport Authority,
Dún Scéine, Harcourt Lane,
Dublin 2, D02 WT20.