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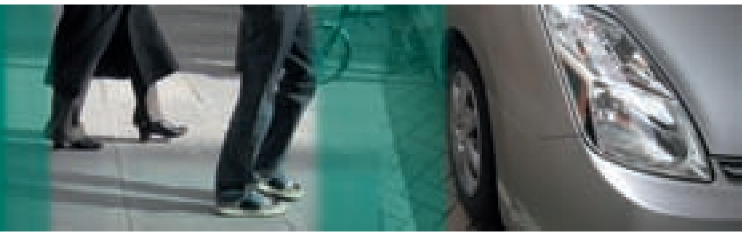

Local Transport Note 2/08

October 2008

Cycle Infrastructure Design

Department for Transport

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1 Introduction

1.1 Context

1.1.1 Encouraging more people to cycle is increasingly being seen as a vital part of any local authority plan to tackle congestion, improve air quality, promote physical activity and improve accessibility.

1.1.2 This design guide brings together and updates guidance previously available in a number of draft Local Transport Notes and other documents. Although its focus is the design of cycle infrastructure, parts of its advice are equally appropriate to improving conditions for pedestrians.

1.1.3 The guidance covers England, Wales and Scotland. Where the text refers to highway authorities (for England and Wales), the equivalent term in Scotland is road authorities.

1.2 Policy

1.2.1 Cycling is convenient and practical for many journeys. The Department for Transport recently increased the budget for Cycling England to £140 million over three years to work with local authorities, non-governmental organisations (NGOs) and others with an interest in demonstrating the impact of various cycling interventions and developing a better understanding of what works best.

1.2.2 Encouraging more people to take up cycling can help deliver a broad range of transport outcomes and wider environment and health goals. Local Area Agreements and Local Development Frameworks offer an opportunity to consider how increasing cycling can deliver on these goals. Developing a cycle route network plan that links key origins and destinations can help to prioritise local authority work programmes and identify opportunities to secure infrastructure enhancements from developers seeking planning permission. Many planning authorities adopt cycle parking standards for new development, and it can be helpful to developers if the standards include guidance on the quality of equipment required.

1.3 Underlying principles

1.3.1 Planning and designing high-quality infrastructure involves developing individual site-specific solutions, but there are some common requirements that need to be satisfied. The underpinning principle is that measures for pedestrians and cyclists should offer positive provision that reduces delay or diversion and improves safety. Table 1.1 shows when on-road or off-road provision is most suitable. When designing improvements to cycle infrastructure, the hierarchy of provision (Table 1.2) offers useful guidance on the steps to be considered. These hierarchies are not

Table 1.1 Type of cycle facility

Factor	On-road or off-road?
High traffic volume/speed routes	Off-road generally preferred, but see next item
Large number of side road junctions or property accesses along route	Makes on-road more attractive, as it reduces the potential for conflict at these locations
Busy pedestrian traffic along the route	On-road preferred, as it reduces the potential for conflict
High levels of on-street parking	Makes on-road less attractive, but needs careful consideration in view of the potential for increased conflict using off-road provision
High levels of HGV traffic	

meant to be rigidly applied, and solutions in the upper tiers of the hierarchy will not always be viable. However, designers should not dismiss them out of hand at the outset.

1.3.2 The road network is the most basic (and important) cycling facility available, and the preferred way of providing for cyclists is to create conditions on the carriageway where cyclists are content to use it, particularly in urban areas. There is seldom the opportunity to provide an off-carriageway route within the highway boundary that does not compromise pedestrian facilities or create potential hazards for cyclists, particularly at side roads. Measures that reduce the volume or speed of motor traffic benefit other road users by making the roads safer and more pleasant for them to use. New-build situations provide good opportunities for creating attractive high-quality infrastructure for cyclists, either in the form of quieter roads or direct cycle routes away from motor traffic.

1.3.3 An area cycle route network may be achieved through a combination of measures to manage the impact of motorised traffic as well as cycle-specific infrastructure. It is summarised in the hierarchy of provision (see Table 1.2). The hierarchy is not mutually exclusive – for example, reducing traffic speeds on links may enable junction geometry to be tightened to provide easier crossings for pedestrians; reducing the volume of traffic may release carriageway space to provide cycle lanes or tracks. Creating space for cyclists by taking existing footway space from pedestrians is generally the least acceptable course of action.

1.3.4 The *Manual for Streets* (DfT/CLG, 2007) adopts a hierarchy of users to assist in design, planning and development control decisions. This places pedestrians at the top (including the access requirements of people with disabilities), followed by cyclists, then public transport, with unaccompanied private-car users last. The aim is to ensure that the needs of the most vulnerable road users are fully considered in all highway schemes, but not necessarily to give priority to pedestrians and cyclists in every circumstance.

1.3.5 There are five core principles which summarise the desirable design requirements for pedestrians and cyclists. They have been derived from the requirements for pedestrians included in *Guidelines for Providing for Journeys on Foot* (IHT et al., 2000) (connectivity, conspicuity, convenience, comfort and conviviality) and requirements for cyclists included in *Cycle Friendly Infrastructure* (IHT, 1996) (coherence, directness, comfort, safety, and attractiveness). They are:

- ***Convenience:*** Networks should serve all the main destinations, and new facilities should offer an advantage in terms of directness and/or reduced delay compared with existing provision. Routes and key destinations should be properly signed, and

Table 1.2 Hierarchy of provision

Consider first ↓	Traffic volume reduction
	Traffic speed reduction
	Junction treatment, hazard site treatment, traffic management
	Reallocation of carriageway space
	Cycle tracks away from roads
Consider last	Conversion of footways/footpaths to shared use for pedestrians and cyclists

street names should be clearly visible. Route maps should be made available, and on-street maps can be helpful. Routes should be unimpeded by street furniture, pavement parking and other obstructions which can also be hazardous to visually impaired pedestrians. Delay for pedestrians and cyclists at signalled crossings should be minimised. Trip-end facilities should be clearly marked, conveniently located and appropriate for the likely length of stay. Designers should consider the future ease of maintenance, including access to vehicles for sweeping, trimming grass verges and surface and lighting repairs along off-road routes.

- ***Accessibility:*** Cycling networks should link trip origins and key destinations, including public transport access points. The routes should be continuous and coherent (type and colour of surfacing may be used to stress route continuity as appropriate). There should be provision for crossing busy roads and other barriers, and in some areas there should be a positive advantage over private motor traffic. Routes should be provided into and through areas normally inaccessible to motor vehicles, such as parks and vehicle restricted areas. Safe access for pedestrians and cyclists should be provided during road works. The needs of people with various types and degrees of disability should be taken into account through consultation and design.

- ***Safety:*** Not only must infrastructure be safe, but it should be perceived to be safe. Traffic volumes and speeds should be reduced where possible to create safer conditions for cycling and walking. Reducing traffic can sometimes enable the introduction of measures for pedestrians and cyclists that might not otherwise be viable. Opportunities for redistributing space within the highway should be explored, including moving kerb lines and street furniture, providing right-turn refuges for cyclists or separating conflicting movements by using traffic signals. The potential for conflict between pedestrians and cyclists should be minimised. Surface defects should not be allowed to develop to the extent that they become a hazard, and vegetation should be regularly cut back to preserve available width and sight lines. The risk of crime can be reduced through the removal of hiding places along the route, provision of lighting and the presence of passive surveillance from neighbouring premises or other users. Cycle parking should be sited where people using the facilities can feel safe. The needs of pedestrians, cyclists and equestrians should be considered where their routes cross busy roads, especially in rural areas.

- ***Comfort:*** Infrastructure should meet design standards for width, gradient and surface quality, and cater for all types of user, including children and disabled people. Pedestrians and cyclists benefit from even, well-maintained and regularly swept surfaces with gentle gradients. Dropped kerbs are particularly beneficial to users of wheelchairs, pushchairs and cycles, and tactile paving needs to be provided to assist visually impaired people. Dropped kerbs should ideally be flush with the road surface. Even a very small step can be uncomfortable and irritating for users, especially if there are several to be negotiated along a route.

- ***Attractiveness:*** Aesthetics, noise reduction and integration with surrounding areas are important. The environment should be attractive, interesting and free from litter and broken glass. The ability for people to window shop, walk or cycle two abreast, converse or stop to rest or look at a view makes for a more pleasant experience. Public spaces need to be well-designed, finished in attractive materials and be such that people want to stay. The surfaces, landscaping and street furniture should be well maintained and in keeping with the surrounding area. Issues of light pollution should be considered, in addition to personal security in rural and semi-rural routes.

1.3.6 These principles are useful when designing for the differing priorities assigned to various aspects of a route (for example, perceived safety versus directness) for users with different requirements resulting from their journey purpose, level of experience or ability. The design of the most appropriate infrastructure needs to take account of the type(s) of cyclist expected to use it.

1.3.7 Some cyclists are more able and willing to mix with motor traffic than others. In order to accommodate the sometimes conflicting needs of various user types and functions, it may be necessary to combine measures or to create dual networks offering different levels of provision, with one network offering greater segregation from motor traffic at the expense of directness and/or priority. Such dual networks may be considered analogous to a busy main road carrying through-traffic and a service road catering for access to homes and shops at lower speeds.

1.3.8 The different categories of cyclist include:

- fast commuter – confident in most on-road situations and will use a route with significant traffic volumes if it is more direct than a quieter route;
- utility cyclist – may seek some segregation at busy junctions and on links carrying high-speed traffic;
- inexperienced and/or leisure cyclist – may be willing to sacrifice directness, in terms of both distance and time, for a route with less traffic and more places to stop and rest;
- child – may require segregated, direct largely off-road routes from residential areas to schools, even where an on-road solution is available. Design needs to take account of personal security issues. Child cyclists should be anticipated in all residential areas and on most leisure cycling routes; and
- users of specialised equipment – includes users of trailers, trailer-cycles, tandems and tricycles, as well as disabled people using hand-cranked machines. This group requires wide facilities free of sharp bends and an absence of pinch-points or any other features that force cyclists to dismount. Cycle tracks and lanes where adult cyclists frequently accompany young children should be sufficiently wide to allow for cycling two abreast. This enables adults to ride alongside children when necessary.

1.3.9 Pedestrians and cyclists will use high-quality, well-maintained, traffic-free routes away from the carriageway if they are more direct than the equivalent on-road alternative and there are no personal security issues.

1.3.10 For most utility cyclists, convenience (in terms of journey time and distance) and an acceptable degree of traffic safety and personal security are most important. These are key factors when planning networks of routes. The journey purpose is important in defining the value attached to attractiveness. There are situations where walking or cycling for pleasure may be the only reason for the journey. These include rural leisure routes, parks, urban squares and tourist destinations. There are also multi-function environments, such as shopping arcades, market places and public transport interchanges, where people may wish to meet, relax or trade, but which also serve as through-routes for pedestrians and cyclists.

1.3.11 Where the speed and volume of traffic is high, it may be appropriate to consider an off-carriageway option for cyclists or, at least, wide cycle lanes that allow for increased separation between cyclists and other vehicles.

1.3.12 Table 1.3 is based on the *London Cycling Design Standards* (TfL, 2005). It gives an approximate indication of suitable types of provision for cyclists. It is only a guide, and what is eventually provided will depend on site conditions.

1.3.13 Conversion of existing footways to permit cycle use should only be considered when on-carriageway options have been rejected as unworkable. In particular, hearing- and sight-impaired pedestrians have problems sensing the presence of cyclists. In vehicle restricted areas where the whole street width is available, cyclists can usually mix safely with pedestrians, especially outside the main retail trading hours. The potential for conflict between cyclists and pedestrians is greatest where width is restricted, flows are heavy and their respective routes cross each other, such as where a cycle track passes a busy bus stop. The speed differential between cyclists and pedestrians can exacerbate this.

1.4 Networks links and connections

1.4.1 The National Cycle Network and signed local cycle route networks and can help to encourage walking and cycling. The National Cycle Network continues to attract more cyclists each year (Sustrans, 2008). Pedestrians and cyclists need direct access to commercial, retail, education and employment areas. Non-motorised users are particularly affected by indirect routes because of the additional physical effort required and the sometimes considerable increase in journey time. Having an advantage over private car users in terms of distance and/or journey time will also help to encourage cycle use or walking in preference to car use for short trips

Table 1.3 Approximate guide to type of provision

Traffic flow	85th percentile speeds			
	<20 mph	20–30 mph	30–40 mph	>40 mph
<1,500 vpd, or <150 vph				Cycle lanes or tracks
1,500–3,000 vpd, or 150–300 vph			Cycle lanes or tracks	Cycle lanes or tracks
3,000–8,000 vpd, or 300–800 vph	Cycle lanes may be appropriate	Cycle lanes may be appropriate	Cycle lanes or tracks	Cycle tracks
8,000–10,000 vpd , or 800–1,000 vph	Cycle lanes	Cycle lanes	Cycle lanes or tracks	Cycle tracks
>10,000 vpd	Cycle lanes or tracks	Cycle lanes or tracks	Cycle lanes or tracks	Cycle tracks

Notes:
1 vpd = number of motor vehicles in typical 24-hour weekday.
2 vph = number of motor vehicles in typical morning peak hour.
3 Where traffic speeds/flows are low, the designer should assume a default position of no signs/markings specifically for cyclists. However, there may be situations where it is appropriate to indicate the cycle route using cycle symbol markings to diagram 1057 with advisory route signs to diagram 967.
4 Cycle lanes used in the higher speed/flow situations should provide good separation between cyclists and motorists. Wide cycle lanes or buffer zones can help here.
5 Where cycle lanes or tracks are shown in the table, cycle lanes should be considered first. In general, cycle tracks should only be considered if cycle lanes cannot be made to work.
6 In congested areas cycle lanes can be useful even when traffic speeds/flows are low.

1.4.2 The network of routes for non-motorised users needs to be planned at a finer scale than the highway network, based around the principle of providing small connected blocks of development so that walk and cycle distances are minimised. However, it is important to avoid creating long, narrow routes that are not overlooked by adjacent properties, as these can give rise to anti-social behaviour. Meeting the needs of larger vehicles in residential streets should not be to the detriment of pedestrians, cyclists and public transport users. Signed cycle routes can offer "fine grain" networks with greater accessibility than for motor traffic by using quiet residential roads, contraflow schemes, paths alongside rivers and canals, disused railways, vehicle restricted areas and parks. Opening up paths for cycle use, such as when implementing a Rights of Way Improvement Plan, may benefit pedestrians too. The upgraded surface of the Thames River Path provides a good example – see Figure 1.1.

1.4.3 Cycle routes on back streets and off-road routes need to be clearly signed, and changes in direction should be kept to a minimum. However, a balanced approach to signing is required to avoid clutter. Designers should investigate options for modifying existing signs or mounting new signs on existing poles or other street furniture. Creating a smooth physical interface between different elements of a route by, for example, using dropped kerbs also helps to create a continuous, legible and coherent network that is easy to follow.

1.4.4 Consultation with local cyclists both before and after scheme implementation will tap into local knowledge to help to identify and prioritise the development of a cycle route network.

1.4.5 Detailed route design entails development of a series of site-specific solutions. It can be difficult to apply a standard solution to the kind of issues that arise when designing for pedestrians and cyclists. Cyclists and pedestrians may, for example, ignore formal crossing points. One way to consider the

Before

After

Figure 1.1 Route improved by removing a gate and providing a wider, sealed surface (Patrick Lingwood)

process of infrastructure design is through a behavioural approach. Essentially this involves observing how users interact and then formulating a solution that accommodates the main movements of each mode while minimising the potential for conflict. This may be preferable, less unsightly and more practicable than installing an arrangement that attempts to divert people from their desire lines through the use of guard railing, signs and road markings. Such an approach may require a move away from the idea of fully segregated areas for pedestrians, cyclists and motorists.

1.5 Typical cycle trip distances

1.5.1 Urban networks are primarily for local journeys. In common with other modes, many utility cycle journeys are under three miles (ECF, 1998), although, for commuter journeys, a trip distance of over five miles is not uncommon. Novice and occasional leisure cyclists will cycle longer distances where the cycle ride is the primary purpose of their journey. A round trip on a way-marked leisure route could easily involve distances of 20 to 30 miles. Experienced cyclists will often be prepared to cycle longer distances for whatever journey purpose.

1.6 Risk and liability

1.6.1 The *Manual for Streets* (DfT/CLG, 2007) acknowledges the reluctance of some authorities to implement innovative schemes or schemes that do not meet all safety criteria, for fear of litigation. However, the vast majority of claims against highway authorities relate to maintenance defects rather than deficiency in design. An authority should not be exposed to claims if there are robust design procedures in place where the resulting decisions are recorded in an audit trail. The *Manual for Streets* (DfT/CLG, 2007) suggests the following approach:

- set clear and concise scheme objectives;
- work up the design against these objectives; and
- review the design against these objectives through a quality audit.

1.6.2 A risk assessment may be undertaken as part of the design review process to determine the scale and likelihood of any perceived hazard, and it can be beneficial to involve user groups in this process. It is essential that the risk assessor fully understands the relative risks of various options. A common decision on cycle route provision involves choosing whether to take cyclists off the carriageway by providing a cycle track. Making such a decision is rarely as straightforward as it might seem at first. A cycle track frequently interrupted by side roads can have a significantly worse potential for accidents than the equivalent on-carriageway facility.

1.6.3 The assessor should determine if the proposal improves upon the existing situation and whether any risk is justified when compared with alternative solutions. For example, some practitioners dislike cycle contraflow schemes because they believe that they are inherently hazardous. However contraflow travel can be safer than with-flow travel as the contraflow route may mean cyclists can avoid a longer, heavily trafficked alternative route.

1.7 Cycle audit and review

1.7.1 A cycle audit is different from the risk assessment process described above, or safety audits that consider road safety issues in isolation. It is a check on the design of a highway scheme to ensure that it does not unduly affect cyclists. A cycle audit should not be necessary if a scheme is specifically aimed at improving conditions for cyclists, because the design process should address all the relevant issues. However, such a scheme could benefit from a pedestrian audit to help ensure that improvements for cyclists do not create difficulties for pedestrians. Many authorities conduct "non-motorised user" audits to ensure that new schemes encompass the needs of pedestrians, cyclists, equestrians and disabled people. A cycle audit should not be limited to aspects that affect cyclists negatively – it should also identify opportunities to improve conditions for cyclists.

1.7.2 Although campaign groups tend to focus on particular issues, they can be very helpful in providing specialist expertise and may even undertake audits.

1.7.3 Cycle audits may be undertaken at up to four stages of the design process:

- preparation of a design brief;
- preliminary design;
- detailed design;
- substantial completion.

1.7.4 Cycle review is a process of examining existing infrastructure to explore ways of improving conditions for cyclists. The review procedures offer a systematic way of identifying shortcomings and potential enhancements to transport networks.

1.7.5 The findings of a review can be useful when evaluating design options – a pedestrian/cycle review can be applied to part or all of a network to identify priority for action. It can also be used within the design process.

1.7.6 *Guidelines for Cycle Audit and Cycle Review* (IHT et al., 1998) was published by the Institution of Highways and Transportation. Many authorities have customised this guidance to fit within their particular planning, design and consultation processes.

1.7.7 When planning a new road scheme or other major works, high-quality cycle and pedestrian links should be considered from the outset, rather than being left until later. The non-motorised user audit procedures in the *Design Manual for Roads and Bridges* (HA, 1993 onwards) in Vol. 5, Section 2, HD42/05, provide a framework for incorporating pedestrians and cyclists into the design of major schemes.

2 General design parameters

2.1 Clear space required by cyclists

2.1.1 The space needed for a cyclist in which to feel safe and comfortable depends on:

- the cyclist's dynamic envelope, i.e. the space needed in motion;
- the clearance when passing fixed objects; and
- the distance from, and speed of other traffic.

These factors, and their impact on the design process, are critical to achieving a cycle friendly environment. As the speed differential between cyclists and motor traffic increases, greater separation is required. This principle also applies where cyclists share space with pedestrians. If the design allows for relatively high cycling speeds, larger separation distances are beneficial. At very low speeds and on uneven surfaces, cyclists require additional width to maintain balance.

Figure 2.1 Cyclist deviation from straight line

2.2 Dynamic envelope

2.2.1 At low speeds, cyclists are prone to wobble and deviate from a straight line. For most cyclists, a speed of 7 mph (11 km/h) or more is required to ride comfortably in a straight line without a conscious effort to maintain balance. Above 7 mph, the amount of deviation, i.e. the additional width needed when moving, is 0.2 metres. Below this, deviation increases – at 3 mph deviation is typically 0.8 metres (see Figure 2.1). Hazards such as uneven gully gratings may cause cyclists to deviate from their chosen line. Additional width for cyclists is recommended where such hazards exist.

2.2.2 For simplicity, the dynamic width (actual width plus deviation) of a cyclist on the road may be taken as 1 metre.

2.3 Critical distances to fixed objects

2.3.1 The following minimum clearances (Table 2.1) are recommended and should be increased where possible. They are measured between the wheel and the object.

Table 2.1 Minimum clearances

Object	Distance from wheel to object (metres)
Kerbs under 50 mm	0.25 m
Kerb over 50 mm	0.5 m
Sign posts, lamp columns, etc.	0.75 m
Continuous features, e.g. walls, railings, bridge parapets	1 m

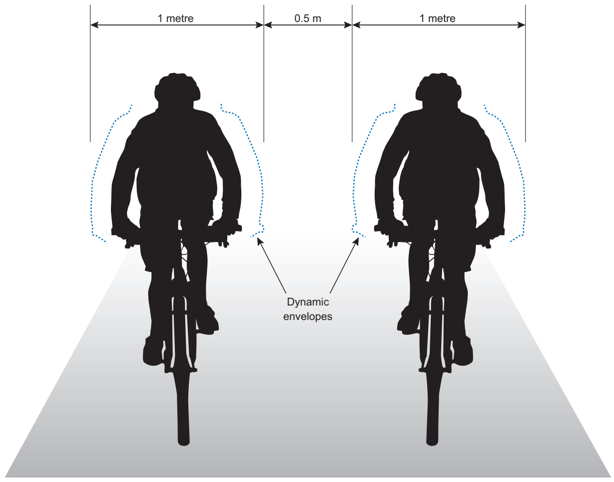

Figure 2.2 Width required by two cyclists

2.4 Cyclists passing other cyclists

2.4.1 Where cyclists need to pass each other, 0.5 metres separation should ideally be allowed between the dynamic envelope of each cyclist. This gives a desirable minimum width of 2.5 metres for two-way cycle tracks (see Figure 2.2).

2.5 Overtaking by motor vehicles

2.5.1 Cyclists often feel uncomfortable when cars overtake, particularly if they do so at high speed. Research from the Netherlands (CROW, 2003) shows that motorists driving at 20 mph will often pass cyclists leaving a clearance of only 0.85 metres. This distance increases to around 1.05 metres when passing at 30 mph.

2.5.2 These clearances are not necessarily sufficient for comfort and have been increased to establish the minimum suggested passing distances in Table 2.2. Even these clearances will be uncomfortable for some cyclists and should be exceeded where possible.

2.5.3 Table 2.3 sets out ideal minimum total widths (not necessarily lane widths) required for vehicles overtaking cyclists.

Table 2.2 Minimum passing distances

Measured from outside of cyclist's dynamic envelope	
20 mph	1.0 metres
30 mph	1.5 metres

Table 2.3 Total width required for overtaking

Vehicle type/speed	Total width required (metres)
Car passing at 20 mph	3.8 m
Car passing at 30 mph	4.3 m
Bus/HGV passing at 20 mph	4.6 m
Bus/HGV passing at 30 mph	5.05 m

2.5.4 The above advice applies to the general width along a route. For localised narrowings such as between kerbs and central islands or pedestrian refuges, see Section 5.7.

2.6 Dimensions of cycles

2.6.1 Highway designers consider the dimensions of motor vehicles and their swept paths to determine carriageway widths, junction dimensions and parking layouts. The sizes and swept paths of cycles are usually irrelevant in the design of on-road cycle routes, but there are occasions where they need to be considered. Examples include the approach to a cycle gap, or the interface between the carriageway and an off-road cycle route. Failure to provide the room a cyclist requires can make some routes inaccessible or difficult to use, particularly for disabled cyclists, tandem or trailer users and parents transporting young children by bicycle.

2.6.2 A typical bicycle is approximately 1800 mm long and 650 mm wide, but there is a great variety of types in use. Designers should anticipate the use of non-standard cycles, particularly in areas with high levels of utility cycling, on recreation routes and on routes serving schools and nurseries. Designing to accommodate tandems, tricycles and trailers opens up cycle routes to families with children and users of hand-cranked cycles. It also offers the opportunity to cater for wheelchairs and other mobility aids.

2.6.3 Most non-standard cycles are bigger than the conventional bicycle and have larger turning circles. They are therefore unable to be used on facilities designed to the minimum dimensions required to accommodate a standard bicycle. Most access controls for off-carriageway paths do not allow non-standard cycles through (see Section 8.14).

2.6.4 The minimum turning circle of a bicycle depends on the ability of the rider to balance at low speeds. Where children are carried in child seats, the centre of gravity is quite high, and the heavier the child, the more awkward it is to make a tight turn. Table 2.4 is intended as a guide to typical minimum turning circles achievable at low speeds but designers should try to work to larger radii. The minimum inner kerb radius in cycle route design should be 4 metres (unless a deliberately smaller radius is being used to control motor vehicle and/or cycle speeds).

2.6.5 Other factors also affect access for users of non-standard cycles. It is impossible for some users to lift their cycle to clear obstructions such as an access control.

2.6.6 Local authorities should consider the position and design of cycle parking for non-standard cycles. For example, this could include extra-long Sheffield stands positioned to prevent trailers blocking adjacent footways, particularly where trailers may be commonplace, such as in town centres, primary schools and leisure sites.

Table 2.4 Minimum turning circles (mm)

		Minimum turning circle	
	Overall length	Outer radius*	Inner radius**
Conventional bicycle	1800	1650	850
Bicycle and 850 wide trailer	2700	2650	1500
Bicycle and trailer cycle	2750	2050	700
Tandem	2400	3150	2250

* The outer radius governs the distance between walls required to execute a full turn.
** The inner radius indicates the size of an imaginary circular obstruction which the cyclist moves around.

3 Signing issues

3.1 Introduction

3.1.1 The design of all prescribed road signs (and markings – markings are technically signs) should be in accordance with DfT's working drawings, the advice given in Chapters 3, 5, and 7 of the *Traffic Signs Manual* (DfT, 2008 and 2003a and 2003b) and the requirements of the Traffic Signs Regulations and General Directions 2002 (TSRGD). For detailed guidance on the use of signs most relevant to cycling, and for examples of cycle-specific signing layouts, refer to Chapter 3 of the *Traffic Signs Manual*, Section 17 (DfT, 2008). The advice given here complements that guidance by expanding on some signing issues particular to the design of cycle infrastructure. Unless otherwise stated, all diagram numbers below refer to those given in TSRGD.

3.1.2 For non-prescribed signs (i.e. signs not included in TSRGD), authorisation is required before they can be used. The Department for Transport authorises non-prescribed signs in England. The relevant authority for Wales is Transport Wales (Welsh Assembly Government), and for Scotland it is the Transport Directorate (Scottish Government).

3.1.3 Many signs are optional rather than mandatory. It is useful to bear this in mind, as cycle infrastructure can be quite sign-intensive and, if not carefully designed, can create unnecessary visual intrusion. Over-use of coloured surfacing adds to this. Where appropriate, signs should be mounted on walls, existing posts or other street furniture to minimise the number of sign posts on the footway.

3.2 Coloured surfaces

3.2.1 Coloured surfaces are not prescribed by TSRGD and they have no legal meaning. There is no obligation to use them. They are included here because they can be useful for emphasising cycle lane markings and to help remind motorists that the surface is either primarily or exclusively for the use of cyclists. They can also help cyclists to follow a route or position themselves in the appropriate part of a carriageway. Coloured surfaces have little or no effect at night.

3.2.2 Coloured surfaces are relatively expensive to lay. If used to excess, they can be visually intrusive and lose their highlighting effect where needed most. For best effect they should be used sparingly. For example, rather than using colour for the whole length of a cycle lane, consideration could be given to reserving it for specific locations where it would be most beneficial, such as where the cycle lane passes side-road entrances. Coloured surfaces are especially useful for cycle lanes away from the kerb, such as a non-nearside cycle feeder lanes for an advanced stop line layout, or where a cycle lane runs along the offside of a dedicated left-turn lane.

3.2.3 Colour may be appropriate:

- in the lead-in lane and cycle reservoir at an advanced stop line arrangement;
- in non-nearside and right-turn cycle lanes;
- in contraflow cycle lanes;
- in cycle lanes beside parking bays;
- in cycle lanes alongside narrow all-purpose lanes;
- at junctions where certain manoeuvres are limited to cyclists;
- at locations where the lane highlights a potential risk, e.g. cycle lanes through pinch points;
- in two-way cycle lanes (although such lanes are not generally recommended as they can be confusing to motorists – see Section 7.9).

3.2.4 Selection of the appropriate colour is a matter for the relevant highway authority but, in the interests of consistency and simplifying maintenance, it is recommended that one colour is used for cycle infrastructure within a highway authority's area. Green and red surfaces are most commonly used.

Compared with road markings, the durability of such a surface can be poor, and it varies depending on the materials, colour and the method of application. This needs to be taken into account when deciding if coloured surfaces are necessary, because they add to the costs of maintenance.

3.3 The cycle symbol

3.3.1 The cycle symbol, diagram 1057, is probably the most commonly used marking in cycle infrastructure. It is generally used in conjunction with vertical signs and is particularly useful at junctions

3.3.2 The cycle symbol is also one of the most poorly replicated diagrams in practice. Some examples of cycle symbols which do not conform to DfT's working drawings are shown in the photographs used in this document. Apart from being unlawful, the results are almost invariably mediocre at best. Non-conforming markings should not be used.

3.4 The END marking and the END OF ROUTE sign

3.4.1 The END marking to diagram 1058 and the END OF ROUTE sign to diagram 965 can be used where a cycle lane, track or route terminates. However, in practice they are often provided unnecessarily, possibly because of an assumption that their use is mandatory – it is not.

3.4.2 In most cases, cycle lanes can simply stop. For short breaks, such as where a cycle lane is interrupted by a controlled crossing or a bus stop, indicating that the lane has ended is never appropriate. Indeed, it is likely that for the termination of cycle lanes in general, diagrams 1058 and 965 are rarely required.

3.4.3 When deciding whether to provide them, consideration should be given to the purpose they are meant to serve. They might be useful where a route terminates at a hazardous location, but, if the end of the lane/track/route is obvious, these diagrams would be redundant. If the cycle lane/track/route has to concede priority on ending, GIVE WAY signing is used instead.

3.4.4 TSRGD lays down a hierarchy for the use of these diagrams. The END marking can be used with or without the END OF ROUTE sign but, in either case, the cycle symbol to diagram 1057 must be used because the END marking cannot be used without it. The hierarchy in order of increasing signing is therefore:

1. the route ends with none of the above;
2. it ends with the cycle symbol to diagram 1057 and the END marking to diagram 1058;
3. it ends with diagram 1057 and diagram 1058, accompanied by the END OF ROUTE sign to diagram 965.

3.5 GIVE WAY signing

3.5.1 In a similar manner to END signing, TSRGD lays down a hierarchy for GIVE WAY signing for cyclists (this hierarchy also applies to GIVE WAY signing in general). At its simplest, the need to give way is indicated by the double broken line to diagram 1003 across the end of the route. This marking may be supplemented by the triangle marking to diagram 1023. If a vertical give way sign to diagram 602 is used, it must be in conjunction with markings to diagrams 1003 and 1023. The hierarchy in order of increasing signing is therefore:

1. a double broken line to diagram 1003;
2. diagram 1003 with a triangle marking to diagram 1023;
3. diagrams 1003 and 1023 with a vertical sign to diagram 602.

3.6 The CYCLISTS DISMOUNT sign

3.6.1 The CYCLISTS DISMOUNT sign to diagram 966 is another over-used sign. On a well designed cycle facility, it is very rarely appropriate. The sign is possibly the least favoured among cyclists – each time it is used, it represents a discontinuity in the journey, which is highly disruptive.

3.6.2 In general, the sign should only be used in relatively rare situations where it would be unsafe or impracticable for a cyclist to continue riding.

3.6.3 If it looks as if the sign might be needed, practitioners should first check to see whether the scheme design could not first be modified to make its use unnecessary. In general, the sign should not be used where a cycle track joins a carriageway directly.

3.6.4 Where the sign's use appears unavoidable, practitioners should be able to defend their decision and explain why it cannot be avoided by design.

4 Network management

4.1 Introduction

4.1.1 Schemes that reduce the impact of motor traffic can help deliver a pleasant environment for cyclists, pedestrians and disabled users, as well as meeting other policy objectives such as increasing walking and cycling as well as improving health and the environment. They can also reduce the need for cycle-specific infrastructure.

4.1.2 There are many ways of encouraging and facilitating cycle use, including:

- traffic management measures such as vehicle restricted areas or 20 mph zones;
- redistribution of carriageway space by, for example providing cycle (or bus) lanes, or by simply widening the nearside lane where possible;
- initiatives that encourage the use of public transport, such as Bike-and-Ride;
- cycle parking
- residential, workplace and school travel plans;
- programmes of cycle skills training;
- individualised travel marketing;
- self-calming roads where geometric design and the use of physical features such as build-outs, planters or seating encourages lower speeds; and
- Quiet Lanes, or area speed limits such as the blanket 40 mph limit on rural roads in the New Forest.

4.1.3 The following provides some examples of how network management can enhance conditions for cyclists.

4.2 Road closures and turning restrictions

4.2.1 It is sometimes necessary to restrict motor vehicle access on certain routes, particularly in residential areas. Where this is achieved by closing the end of a street, consideration should always be given to allowing cyclists to continue using the route by installing a cycle-gap in the closure. Such roads can provide ideal conditions for cyclists, offering them a quiet, high-quality route with more direct access to their destination. Detours along busy roads, gyratory systems or one-way systems are a deterrent to cycling, and can expose cyclists to additional hazards. Where possible cyclists should be provided with alternative routes to avoid them. Figures 4.1 and 4.2 show examples of traffic restrictions that exempt cyclists.

4.2.2 Cycle gaps in road closures should be at least 1.2 metres wide to accommodate tandems, trailers and mobility scooters.

4.2.3 Care needs to be taken to ensure that parked vehicles do not obstruct cycle gaps. Gaps in the centre of a closure are less likely to be blocked by parked vehicles.

Figure 4.1 A cycle route linking two cul-de-sacs (Patrick Lingwood)

Figure 4.2 Mid-link road closure with cycle access (Patrick Lingwood)

Figure 4.3 Rising bollards (Patrick Lingwood)

4.2.4 Cyclists should usually be exempt from prohibited turning movements or manoeuvres unless safety concerns dictate otherwise. An Order giving effect to the prohibition will need to exempt cyclists. The exemption is signed using the "Except cycles" plate (diagram 954.4) placed underneath the appropriate regulatory sign.

4.3 Parking control and vehicle restricted areas

4.3.1 Many towns and cities have central areas largely free of motor vehicles. These areas often form hubs for radial routes to shops, services and employment. Restricting vehicular access in these areas can sever routes for cyclists unless they are exempted from the restrictions.

4.3.2 The potential for shopping trips to be undertaken by cyclists should not be underestimated. It is sometimes suggested that limited carrying capacity is a barrier to cycling to the shops, but it is not that difficult to carry significant amounts of shopping in panniers and other bags mounted on the cycle. Most shopping trips tend to be locally based, and around half of all shopping trips in UK are under two miles (Bach, 1995), so distance is typically not a barrier to cycling for this purpose. Over 10 per cent of all shopping journeys to town centres in Germany are by bicycle (ECMT, 1996) compared with about 2 per cent in the UK.

4.3.3 The control of car parking through charges or limiting capacity or duration of stay can encourage cycling. Ensuring there is sufficient high quality cycle parking also helps. Parking control can also be used to support workplace travel plans or to protect residential areas from excessive traffic by reducing the availability of long-stay commuter parking. Removal of on-street parking spaces may enable space within the highway to be given over to pedestrians and cyclists.

4.3.4 It can be contentious to reintroduce cycling into vehicle restricted areas (VRAs) but, as these areas are often prime destinations where shops and services are located, good cycle access is desirable. Where new vehicular restrictions are to be introduced, serious consideration should always be given to retaining cycle access. Traffic conditions on unrestricted routes may be unattractive to cyclists, and the routes can be indirect. Maintaining formal cycle access needs to be considered against the likelihood of cyclists using the VRA regardless of any restrictions. Where cycling is permitted, most cyclists will usually dismount at the busiest times (DoT, 1993a).

4.3.5 There are many successful examples of VRAs where cycling is permitted. In Aylesbury, for example, access for buses and cycles has been retained (see Figure 4.3). If restrictions on cycling are considered necessary, they may only be required at certain times of day. Permitting cycling before 10 am and after 4 pm can meet the need of commuter cyclists while avoiding the busiest periods of pedestrian activity.

4.3.6 It is recommended that the authority makes a detailed assessment of how the vehicle restricted area will operate, to arrive at the best solution for all users. Some VRAs retain a defined carriageway (see Figure 4.4), while others use a shared surface (see

Figure 4.4 Street with one-way bus access and two-way cycling (Patrick Lingwood)

Figures 4.5 to 4.7). Pedestrian and cyclist flows, street widths, the availability and safety of alternative cycle routes and the demand for cycling in the area all need to be considered before allowing access by cyclists.

4.3.7 If proposals to allow cycling meet with opposition, one solution may be to introduce experimental traffic regulation orders (TROs) to permit cycling on a temporary basis to see if it is creating a problem. An experimental TRO can always restrict cycling to certain hours if it is a borderline case.

4.3.8 Pedestrians and cyclists often claim a preference for marked cycle routes within pedestrianised areas (Davies et al., 2003). However, in practice this can lead to higher cycle speeds and greater potential for conflict. Defining the cycle route may therefore not be the best solution in these cases.

Figure 4.5 A cycle route in an otherwise pedestrianised area (Patrick Lingwood)

Figure 4.6 Contrasting surface treatments used to suggest where cycling may be more appropriate (Patrick Lingwood)

4.3.9 Street furniture within vehicle restricted areas should not compromise visibility to the extent that it becomes hazardous for pedestrians and cyclists. Where the area acts as a through route for cyclists, marked cycle routes should keep cyclists away from doorways, benches, telephone kiosks and other features where pedestrians are likely to be moving across their path.

4.3.10 Careful urban design can help to create an attractive and functional environment in which cycle speeds are low and pedestrians clearly have priority. The positioning of features such as trees and benches and the use of surfacing materials can suggest a preferred route for cyclists without employing road signs while creating a legible environment for blind or partially sighted people.

4.4 Planning and new development

4.4.1 *Planning Policy Guidance Note 13* (PPG13) (DTLR, 2001) recognises cycling as a sustainable mode to be encouraged in new development, especially in urban areas. PPG13 covers England. For Wales, refer to *Planning Policy Wales* (2002) and *Technical Advice Note 18: Transport* (2007). For Scotland, refer to *Scottish Planning Policies Planning Advice Notes 75* (Scottish Executive Development Department, 2005).

Figure 4.7 This attractive route for pedestrians and cyclists is overlooked by new housing and offers a parallel alternative to a busy main road (Adrian Lord)

4.4.2 New developments or regeneration schemes (see Figure 4.7) offer opportunities to achieve a higher quality of design than is usually possible when making small-scale alterations to existing streets. In towns with a population of up to 200,000, the centre is usually no more than a 20-minute cycle ride from most of its residential areas. Around 60 per cent of car trips are typically under five miles and, given the right conditions, a significant proportion of motorists could transfer to cycling.

4.4.3 Low vehicle speeds and flows in residential and mixed-use developments can be achieved through careful design and neighbourhood planning. The location and grouping of buildings can create areas of high-quality public space overlooked by building occupants, and attractive to pedestrians and cyclists. The aim should be to create streets and squares that are attractive places in their own right, rather than their simply being corridors for movement.

4.4.4 New developments are usually designed to discourage through traffic, but, where possible, pedestrian and cyclist networks should maintain direct routes to encourage the use of these modes for local trips.

4.4.5 Security and crime prevention are often concerns, and encouraging street activity will usually be beneficial in this respect (ODPM, 2004) through enhanced passive surveillance. Passive surveillance is usually achieved by fronting buildings on to the route.

Figure 4.8 Cycle parking in the basement car park of a new development (Cycle-Works)

4.4.6 Streets overlooked by housing generally have good levels of personal security. To exploit the security advantages arising from human activity, pedestrian and cycle routes within new developments may best be planned to follow the road network. Where off-road pedestrian/cycle routes are necessary, they should be well lit, overlooked by properties and avoid features that create hiding places. Ideally, the routes should be short and wide.

4.4.7 Where industrial, commercial or retail developments generate high levels of traffic or frequent movements of heavy goods vehicles, it may be better to provide off-road routes for pedestrians and cyclists.

4.5 Cycle parking standards

4.5.1 Most local planning authorities in England have produced supplementary planning guidance with indicative maximum levels of car parking for different categories of development based on national guidance in PPG13 (ODPM, 2001). PPG13 recommends providing safe, secure public and residential cycle parking in new developments (see Figure 4.8). Residential cycle parking is also a requirement in the Code for Sustainable Homes.

4.5.2 Many local planning authorities have developed minimum cycle parking standards for new development, but such an approach needs to be applied with caution and flexibility. The appropriate type and amount of parking will depend on the anticipated level of cycle use, the type of development, floor area and anticipated number of employees/residents/visitors.

4.5.3 Current levels of cycle use may be determined by considering a range of sources:

- census data on journeys to work, which give an indication of the main mode of travel, but these are only updated every ten years;
- school and workplace travel plans, which usually incorporate surveys and ongoing monitoring by mode of travel;
- modal share data. Some authorities conduct occasional or regular household surveys to determine modal share for particular types of journey or general travel trends;
- traffic counts and cycle counts. These may also include counts of parked cycles;
- demographic data which show patterns of commuting, both in and out of areas, including typical catchment areas for employment or education.

4.5.4 Guidance on cycle parking infrastructure is included in Chapter 11.

5 Reducing vehicle speeds on cycle routes

5.1 Speed reduction

5.1.1 Many cyclists feel comfortable on roads with no cycle-specific infrastructure if traffic speeds are low enough. Lower speed not only reduces the likelihood of an accident, but it also reduces severity of injury in the event of one.

5.1.2 Table 5.1 provides examples of measures that encourage lower speeds, a few of which need to be designed with particular care if cyclists are not to be disadvantaged. Some of the measures are covered in more detail below. More information on speed reducing measures can be found in *Local Transport Note 1/07 Traffic Calming* (DfT, 2007) and measures in the Department's Traffic Advisory Leaflets on traffic

Table 5.1 Speed-reducing measures

Measures	Comments
Lower speed limits, 20 mph zones, Home Zones, Quiet Lanes	Encourage drivers to reduce their speed, thus making conditions more comfortable for other road users. Sometimes use shared surfaces (see below).
Reallocating road space to cyclists	Can be achieved by reducing the width of the all-purpose lane to create room for a cycle lane. Another option is simply to widen the nearside lane of a two-lane road to create more room for cyclists. However, care should be taken to ensure the extra width does not encourage higher vehicle speeds.
Shared surfaces (i.e. where kerbs are absent) with reduced signing and markings	Intended to remove any implied priority for motorists to improve conditions for other road users. Careful design is necessary, as they may create difficulties for some disabled people.
Low radius corners and narrower carriageways	Can reduce speeds and are often appropriate on residential access roads where flows are light.
On-street parking bays	Groups of parking bays at intervals on alternating sides of the road can create an indirect carriageway alignment to reduce speed.
Remarking the road to encourage lower speeds	Includes changing the road to make it appear narrower or removing the centre line marking. The latter needs to be carefully assessed, as it is not appropriate for all roads.
Textured surfaces	Block paving can reduce traffic speeds by between 2.5 and 4.5 mph and generally is acceptable for cycling. Cobbled surfaces are less suitable for cyclists, although their speed-reducing effect may be greater.
Physical traffic calming features such as speed humps or cushions, build-outs and other road narrowings	While any reduction in motor vehicle speeds is welcome, physical traffic calming measures can create problems for cyclists unless they are properly allowed for during design. Where practicable, cycle bypasses are recommended, as they are often the best way of avoiding these difficulties.

calming. See also the Traffic Calming Act 1992 and the Highways (Traffic Calming) Regulations 1999 (SI 1999, No. 1026).

5.2 Cycle bypasses

5.2.1 Physical traffic calming measures can sometimes create problems for cyclists. In general, measures involving vertical deflection (e.g. humps or cushions) tend to reduce cyclist comfort, while horizontal deflection measures (e.g. build-outs or other road narrowings) are more likely to introduce cycling hazards.

5.2.2 Central reserves, refuges, traffic islands, and build-outs can create pinch points for cyclists which can bring them into conflict with motor vehicles. For example, drivers may attempt to overtake cyclists ahead of the narrowing to avoid being delayed (speed reducing features on the approach can help here). Drivers may also attempt to overtake a cyclist within the narrowed section.

5.2.3 As traffic calming measures are predominantly aimed at reducing motor vehicle speed, it is usually appropriate to provide a means for cyclists to circumvent them where practicable. In the particular case of features which narrow the road, a cycle bypass will not only reduce potential hazards for cyclists, but it also allows the designer to choose a more effective width in terms of speed reduction. Cycle bypasses are particularly beneficial at chicanes.

5.2.4 Cycle bypasses should be at least 1.2 metres wide and free from sudden changes in direction (minimum radius 4 metres recommended). This helps ensure they are accessible to cycle trailers and other non-standard cycle arrangements such as recumbents or tricycles. The exit alignment of a bypass should not require cyclists to merge abruptly with motor vehicles. If car parking near the bypass is likely to obstruct cyclists entering or leaving it, the arrangement should be designed to discourage or prevent it by, for example, introducing waiting restrictions or physical measures.

Figure 5.1 Cycle bypass ramped up to footway level (Patrick Lingwood)

5.2.5 Bypasses need to be regularly swept, as detritus can be a skid hazard and may cause punctures. The bypass should ideally be wide enough to accept a mechanical sweeper. If the bypass is at carriageway level, consideration should be given to moving surface-mounted gully gratings or replacing them with kerb face gratings.

5.2.6 Alternatively the bypass can be raised to the level of the adjacent footway using a gentle gradient at each end. Figure 5.1 shows such an arrangement alongside a pinch point. Its raised profile makes it less likely to become cluttered with unswept debris.

5.3 Removal of centre lines

5.3.1 Removing the centre line can reduce traffic speeds, but the technique is not suitable for all roads. Some authorities have chosen to remove the centre line and create a single, wide two-way general purpose traffic lane with advisory cycle lanes on either side (see Figure 5.2). When oncoming motor vehicles need to pass each other, they can momentarily encroach upon the cycle lanes.

Figure 5.2 Cycle lanes on road with no centre line (Tim Pheby)

5.3.2 Initial trials in Devizes, Wiltshire (Wiltshire County Council/TRL, 2003/4) suggest that removal of centre lines contributed to a reduction in traffic speeds. On roads where removal of the centre lines was accompanied by the introduction of cycle lanes, traffic speeds were found to have fallen further. Some highway authorities (such as Essex, 2003–05) have introduced presumptions against the general use of centre lines as part of their speed management strategy (Essex County Council, 2003/05).

5.3.3 The technique is suitable for roads wide enough to accommodate two 1.5-metre cycle lanes and a central general traffic lane of at least 3.5 metres (i.e. an overall carriageway width of at least 6.5 metres). It is best suited to locations where there are few heavy goods vehicles and general traffic flows are low. If carriageway width exceeds 6.5 metres, the additional space can be used to increase the width of the cycle lanes, but they need to be clearly indicated, otherwise motorists may confuse them with general purpose lanes

5.4 Overrun areas and textured surfacing

5.4.1 Overrun areas are used to delineate a tight road alignment to encourage lower speeds, while still allowing for the occasional passage of larger vehicles. They often have a textured surface to deter encroachment by smaller vehicles, and this can be hazardous for cyclists. Overrun areas should be avoided where it is likely that cyclists may be forced onto them because of prevailing or expected traffic conditions.

5.4.2 Stone setts are sometimes installed in short sections to act as traffic calming devices, or they may be used over some length as part of an urban improvement scheme. They can be uncomfortable or hazardous for cyclists and some disabled people. These problems may be mitigated by careful construction and maintenance. Concrete block or clay paviours are smoother than stone setts, and they have better skid resistance than paving slabs when wet, so they may be preferable where cyclists are expected. Blocks and setts require a high level of care during reinstatement, so the maintenance implications should be considered when planning a new paved area. Some textured surfaces include a path through the area for cyclists by incorporating strips of smoother paving along the line they might be expected to take – see Traffic Advisory Leaflet 12/93 on **Overrun Areas** (DoT, 1993b).

5.5 Road humps

5.5.1 The most common type of road hump (round-topped, 75 mm high) gives good speed reduction benefits and is more comfortable for cyclists than humps constructed to the maximum allowable height of 100 mm. Flat-topped road humps can be used as pedestrian crossings (formal or otherwise). Road hump requirements are contained in Statutory Instrument No. 1025, The Highways (Road Humps) Regulations 1999, for England and Wales.

5.5.2 Full-width humps can be uncomfortable for cyclists. Sloping the ends to road level is often done to facilitate drainage and can provide a way for cyclists to avoid the main profile. A cycle bypass allows the hump to be avoided altogether. Where cyclists have no choice but to cycle over humps, care should be taken to ensure that the transition from road to hump has no upstand. Some authorities specify a reduced ramp gradient adjacent to the kerb on cycle routes.

5.5.3 Sinusoidal ramps are more comfortable for cyclists (see Figure 5.3) and can be created by adding fillets to a round-topped hump to create a smooth transition profile. The fillet should be about 1 metre wide, i.e. it should extend 500 mm before and after each road/hump interface. Any difficulties in achieving the sinusoidal profile may be overcome by using pre-formed sections. These are particularly useful for approaches to flat-topped humps and speed tables. The profile of pre-cast products should be checked to ensure it conforms to the Regulations.

Figure 5.3 Flat-topped hump using pre-formed sinusoidal ramp face units (Tim Pheby)

Figure 5.4 Cycle lane alongside refuge (Adrian Lord)

5.5.4 Where they are provided, cycle bypasses can simplify drainage arrangements by allowing for the retention of kerbside channels.

5.6 Speed cushions

5.6.1 Speed cushions are subject to The Highways (Road Hump) Regulations 1999. They are sized so that wide-tracked vehicles such as buses, ambulances and HGVs can straddle them. Cyclists usually prefer speed cushions to humps because they can more easily avoid them. Speed cushion gaps that cyclists are intended to use should be unobstructed by parked vehicles. This may be addressed by introducing waiting restrictions, physical measures such as parking bays or build-outs, or short sections of mandatory cycle lane before and after the speed cushions.

5.6.2 A gap between kerb and cushion of between 0.75 metre and 1 metre will enable cyclists to pass conveniently. Larger gaps may encourage drivers to avoid the cushion. Cushions adjacent to kerbside drainage gullies can be hazardous to cyclists.

5.7 Pedestrian refuges, traffic islands and central hatching

5.7.1 These measures make it easier for pedestrians to cross the road, discourage overtaking, and in some cases, encourage lower speeds. However, refuges and islands in particular can create hazardous pinch points for cyclists. If they are introduced and it is not possible to provide a cycle bypass, the width available should either be sufficient to allow vehicles to overtake cyclists safely, or narrow enough to discourage overtaking altogether.

5.7.2 TAL 15/99 *Cyclists at Roadworks* (DETR, 1999a) advises that gaps of between 2.75 metres and 3.25 metres over any distance should be avoided, as car drivers may attempt to overtake even though there is insufficient room to do so safely. However, conditions at roadworks are not necessarily the same as those at localised pinch-points. While it remains true that widths within this range should be especially avoided, cyclists can benefit from still wider clearances between physical features. In view of this (and in the absence of a cycle bypass) a minimum gap of 4 metres is recommended unless additional features to significantly reduce motor vehicle speeds are incorporated. If the approach to the narrowed section is not direct (e.g. at chicanes) or significant numbers of HGVs or buses are expected, it is worth considering increasing this minimum further.

5.7.3 It should be noted that, on their own, gaps over 3.5 metres wide are not very effective in calming traffic. In order for sufficient width to be provided to help ensure cyclists are not put at a disadvantage, it may therefore be necessary to use measures other than road narrowing to control speeds.

5.7.4 If a cycle lane passes through a pinch-point, it is recommended that it is at least 1.5 metres wide and mandatory. Where there is insufficient room to provide a mandatory lane of this width, an advisory 1.5 metre cycle lane should be considered. Figure 5.4 shows localised widening with the addition of cycle lanes at a road junction with a right-turning lane. If there is not enough room to provide an advisory 1.5 m cycle lane, it may be best to avoid a cycle lane through the pinch-point altogether. There is evidence that overtaking motorists refer to the cycle lane marking rather than the cyclist when overtaking, and cars may pass too closely if the lane is narrower than 1.5 metres.

5.7.5 Central hatching has the effect of narrowing traffic lanes, thereby increasing separation between opposing traffic flows and discouraging overtaking. The arrangement can be detrimental to cyclists if overtaking nevertheless takes place, because motorists may be reluctant to enter the hatched area. Cycle lanes may help to keep vehicles away from the carriageway edge if central hatching is used (see Figure 5.5).

5.8 Chicanes and other build-out arrangements

5.8.1 Chicanes are usually constructed using two or more build-outs alternating between each side of the road. Lower vehicle speeds are realised through a combination of carriageway deflection, road narrowing and, in lower speed environments, reduced sight lines. Providing staggered parking bays can achieve a similar effect. A cycle bypass should be seriously considered if chicanes are proposed, otherwise cyclists may face conflict with oncoming vehicles in addition to those following them.

5.8.2 Other build-out arrangements can also create hazards for cyclists. On roads where vehicle speeds are over 20 mph, cyclists can still come into conflict with following motorists, and cycle bypasses should be considered.

Figure 5.5 Cycle lane continued at refuge (CTC Benchmarking

6 Bus and tram routes

6.1 Bus lanes

6.1.1 Bus lanes form an important part of cycle route networks. They are often placed on primary transport routes, providing cyclists with direct routes to town centres and other important destinations. Bus lanes are generally popular with cyclists (Reid and Guthrie, 2004). They are often preferred over off-road facilities as a result of the advantage of remaining in the carriageway and therefore having priority at side roads (Pedler and Davies, 2000). Cyclists in bus lanes are able to avoid queues, and they value the separation from general traffic that these lanes afford.

6.1.2 With-flow bus lanes are usually open to cyclists. If a highway authority wishes to prohibit cyclists from using a with-flow bus lane, sign authorisation is required.

6.2 Bus lane widths

6.2.1 The ease with which a bus can overtake a cyclist depends on the width of the bus lane, the width of the adjoining general purpose lane, and the volume and speed of traffic.

Figure 6.1 Narrow 3-metres wide bus lane (Sustrans)

Figure 6.2 Cycle lane discontinued at bus stop (Patrick Lingwood)

6.2.2 A bus lane width of 4.5 metres will enable buses to safely pass cyclists without having to leave the lane. Widths below 4 metres generally result in buses moving out of the lane when overtaking cyclists, but this may be difficult if the adjacent lane is congested (see Figure 6.1). Widths below 4 metres are not recommended for bus lanes physically bounded on both sides, unless they are over very short distances.

6.3 Bus gates and bus-only roads

6.3.1 Access to routes mainly limited to use by buses is sometimes controlled by bus gates. These gates typically comprise rising bollards, traffic signals, or a combination of the two. Where bus-activated signals are used, in the absence of a cycle bypass it will be necessary to provide a means for cyclists to activate the signals. This may be achieved through the use of a push-button unit for cyclists to operate. The installation of such equipment requires authorisation.

6.4 Bus and tram stops

6.4.1 Cycle lanes cannot be taken through a marked bus stop area – the cycle lane is simply discontinued over the length of the bus stop markings (see Figure 6.2).

6.4.2 Where the stop is located within a bus (or all-purpose) lane less than 3.5 metres wide, cyclists will need to leave the lane to pass a stopped bus. The flow and speed of general traffic will determine whether this proves hazardous. Where there is enough room, localised widening of the lane at the bus stop may be feasible.

6.4.3 Figure 6.3 shows a widened nearside lane, with a cycle lane passing on the offside of the stop and the parked vehicles downstream. Note the gap between the parking bays and the cycle lane to reduce the hazard of opening doors.

6.4.4 Bus boarders are sometimes used where buses have difficulty rejoining traffic after stopping (they also make passenger access easier). Bus boarders extend the footway into the carriageway over the length of the stop and discourage parking, but they can create pinch-points for cyclists. A wide nearside lane can mitigate this to some extent.

Figure 6.3 Cycle lane continued on the offside of bus stop and parking bays (Alex Sully

6.4.5 Where traffic speeds are high or there are large volumes of HGVs, it may be appropriate to create a bus-boarding island and take the cycle lane behind the island. Figure 6.4 shows such an arrangement at a bus/tram stop, and its particular advantage here is that it avoids the need for cyclists to cross, or pass close to, the nearside rail on the main carriageway. However, in this example the cycle bypass separates the bus shelter from the boarding area, and this may not be appropriate at busy stops where conflict with boarding and alighting passengers is more likely.

6.4.6 The cycle bypass can be ramped up to footway level to allow for easier pedestrian access to the bus boarder, although this may create a tendency for passengers to stand in the cycle track. The arrangement shown keeps the cycle bypass at carriageway level and uses dropped kerbs to facilitate pedestrian movement across it.

Figure 6.4 Cycle bypass at a bus and tram boarding island. The cycle bypass separates the bus shelter from the boarding area, and this may not be appropriate at busy stops where conflict with boarding and alighting passengers is more likely (Steve Essex)

7 Cycle lanes

7.1 Introduction

7.1.1 Cycle lanes can benefit cyclists, but poorly designed lanes can make conditions worse for them. There is no legal obligation for cyclists to use cycle lanes (or any other type of cycle infrastructure provision).The potential benefits of cycle lanes are that they can:

- create a comfort zone, especially for less experienced cyclists nervous about mixing with motor traffic;
- assist cyclists in difficult or congested situations;
- allow cyclists to bypass features intended to slow or exclude motorised traffic;
- help guide cyclists through complex junctions and provide route continuity to help with navigation;
- help control the speed of motor traffic by narrowing the all-purpose traffic lane; and
- help to raise driver awareness of cyclists.

7.1.2 Guidance on the correct signing and marking arrangements for cycle lanes is given in Chapters 3 and 5 of the *Traffic Signs Manual* (DfT, 2008 and 2003a).

7.1.3 Increasing the width of the nearside lane on a multi-lane road allows drivers to provide greater clearance when overtaking cyclists. The increased width can make a cycle lane unnecessary. The absence of a cycle lane may make it easier for cyclists to avoid drainage gratings and other surface hazards (in the presence of motor vehicles, cyclists sometimes feel reluctant to leave a marked lane).

7.1.4 Cycle lanes are not always suitable and may encourage cyclists to adopt inappropriate positioning if the lanes are poorly designed. Designers need to decide whether a cycle lane is going to help or not. If so, its alignment should ideally reflect guidance and training on safe techniques (Franklin, 2007) for manoeuvres undertaken by cyclists. For example, a non-nearside lane may be useful where there is a need for cyclists to position themselves away from the kerb in a multi-lane road. In general, a cycle lane located between two all-purpose traffic lanes should have a minimum width of 2 metres. Coloured surface treatment will help increase the conspicuity of such lanes.

7.1.5 On high streets with many side roads, bus stops, kerbside parking and accesses, there can be many cross-movements for cyclists to contend with. There may be little benefit in providing cycle lanes in situations like this (see Figure 7.1).

7.1.6 Where there is a significant gradient, a cycle lane can be beneficial in the uphill direction – the speed differential between cyclists and motorists tends to be larger, while cyclists may wander a little as their speed is reduced. A cycle lane in the downhill direction can make conditions worse for cyclists. As a cyclist's speed increases, the speed differential with motor traffic speeds reduces or disappears, and the cyclist needs to take up a more prominent position further from the nearside kerb. This helps ensure that drivers waiting to join from a side road can better see them and helps drivers behind to judge when it is safe to overtake. A single cycle lane of the recommended width going uphill is far preferable to sub-standard cycle lanes in both directions (see Figure 7.2).

Figure 7.1 Cycle lanes are not always appropriate in complex street environments. (Patrick Lingwood)

Figure 7.2 Cycle lane on uphill side of steep hill, (Patrick Lingwood)

7.2 Mandatory cycle lanes

7.2.1 Mandatory cycle lanes are bounded by a solid white line (diagram 1049) and other traffic is excluded from them during their times of operation by a traffic regulation order (TRO). If necessary, an experimental TRO will enable a scheme to be trialled before a decision is taken over establishing a permanent order.

7.2.2 Cycle lanes normally continue across side roads. At these locations, mandatory cycle lanes should be replaced by short sections of advisory lane to enable motor vehicles to cross them.

7.2.3 Where the lane operates only during certain periods, the times should be clearly displayed using the sign to diagram 961. Yellow lines (see Figure 7.3) and kerb no-loading marks (supported by upright signs indicating the restrictions) are not strictly necessary, unless waiting or loading is prohibited during non-operational periods. However, if present, they discourage motorists from stopping in the lane and make it easier for enforcement officers to deal with any such encroachment.

Figure 7.3 Mandatory cycle lane (Patrick Lingwood)

7.3 Advisory cycle lanes

7.3.1 Advisory cycle lanes marked on the carriageway (diagrams 1004 and 1057) signify that other vehicles should not enter unless it is safe to do so. Advisory lanes are not recommended where they are likely to be blocked by parked vehicles. They can work in circumstances where kerbside parking is restricted during peak times but available at other times.

7.3.2 An advisory lane passing the mouth of a side road may help to raise driver awareness of the likely presence of cyclists. This is especially beneficial in locations with generous carriageway width and where the side roads join the main alignment at a shallow angle (see Figure 7.4). The use of a coloured surface and a cycle symbol help to emphasise the lane at the junction and may also help prevent encroachment by vehicles waiting at side road exits.

7.3.3 Advisory cycle lanes can also be useful to indicate routes through a large or complex junction.

Figure 7.4 Coloured advisory cycle lane crossing side road junction (Steve Essex)

7.4 Cycle lane widths

7.4.1 A cycle lane offers cyclists some separation from motor traffic. Under the National Cycle Training Standards, cyclists are trained to ride in a safe position in the carriageway which is usually at least 1 metre from the kerb edge to avoid gulley grates and debris, and to ensure that they are within the sightlines of drivers waiting at side roads.

7.4.2 Cycle lanes should be 2 metres wide on busy roads, or where traffic is travelling in excess of 40 mph. A minimum width of 1.5 metres may be generally acceptable on roads with a 30 mph limit. For cycle feeder lanes to advanced stop line arrangements, a minimum width of 1.2m may be acceptable. Cycle lanes less than 1.2 metres wide cannot easily accommodate tricycles or child-carrying cycle trailers wholly within the lane.

7.4.3 Cyclists can overtake each other within a 2-metre wide lane and easily remain within it when looking back to check for traffic, or when avoiding kerbside drainage grates, etc. Drivers do not always realise that cyclists need to move away from the kerb to avoid surface hazards and may expect cyclists to stay in lane regardless of its width. A narrow cycle lane may therefore give motorists (misplaced) confidence to provide less clearance while overtaking than they would in the absence of a cycle lane. At localised carriageway width restrictions, designers can continue a full-width advisory cycle lane alongside a sub-standard all-purpose lane, or the cycle lane can simply be discontinued. A narrow cycle lane should not be used here.

Figure 7.5 Cycle lane with buffer zone alongside parking bays, Glasgow (Tony Russell)

7.5 Other design considerations

7.5.1 No lane markings are allowed within the controlled area of a pedestrian crossing, i.e. between the start of the approach zig-zags and the end of the departure ones. The cycle lane marking should simply stop where it meets the zig-zags and re-start afterwards without any start taper. See the Zebra, Pelican and Puffin Crossing Regulations and General Directions 1997 (SI 1997, No. 2400).

7.5.2 Cycle lanes can be marked on the offside of a line of parallel parking bays (see Figure 7.5). A buffer zone between the bays and the cycle lane of between 0.5 and 1 metre is generally recommended. The angle between the cycle lane and the kerb on the approach to the parking bays should be 1 in 10.

7.6 Contraflow cycle lanes

7.6.1 Contraflow cycling provides permeability for cyclists when the movement of other traffic is restricted by one-way systems. Where one-way systems are introduced, consideration should always be given to maintaining two-way working for cycles through contraflow working, if it can be safely accommodated. The advice in this section is also appropriate for authorities thinking of reintroducing two-way cycling in existing one-way streets. TAL 6/98 *Contraflow Cycling* (DETR, 1998a) gives additional advice on the technique.

7.6.2 Contraflow schemes can function satisfactorily in a variety of conditions, including very narrow streets, streets with high pedestrian flows and streets with high levels of kerbside parking or loading activity. Cycling in contraflow can be safer as well as more convenient than cycling along an alternative route, which is likely to involve longer distances and may be more hazardous.

7.6.3 The advice in this section can also be applied to false one-way streets. A false one-way street is a two-way street with entry to the street prohibited at one end. Two-way working is possible by turning around in the street, but in practice they often operate as one-way streets.

7.6.4 Mandatory contraflow cycle lanes are **often** accompanied by waiting (and sometimes loading) restrictions to prevent them from being obstructed (see Figure 7.6). These restrictions should be included in the traffic regulation order (TRO) used to create the mandatory lane. Where parking takes place to the nearside of a mandatory cycle lane and motor vehicles have to cross the lane to park, the TRO will need to allow for this.

7.6.5 Advisory contraflow cycle lanes (see Figure 7.7) and unmarked cycle contraflows require authorisation, because the requisite signs are non-prescribed. See Traffic Advisory Leaflet 6/98 (DTLR, 1998a) for guidance on obtaining signs authorisation, but note that the procedure has been slightly modified by paragraph 3.1.2 in this LTN. Advisory lanes may be considered where the 85th percentile speed is less than 25 mph or traffic flows are below 1,000 vehicles a day. Advisory lanes may be a suitable option where oncoming vehicles need to encroach into the lane to pass obstructions, or need to cross it to park. Advisory lanes also allow for occasional loading and unloading taking place within the lane.

7.6.6 Where the 85th percentile speed is less than 25 mph and traffic flows are below 1,000 vehicles a day, or where the street forms part of a 20 mph zone, it may be possible to dispense with any marked cycle lane. As with advisory contraflow lanes, such an approach requires non-prescribed signs to be authorised.

Figure 7.6 Mandatory contraflow cycle lane (Coventry City Council)

Figure 7.7 Advisory contraflow cycle lane (Patrick Lingwood)

Figure 7.8 Refuge and segregated entry to cycle cont contraflow lane (Tony Russell CTC)

7.6.7 Cycle entry (and exit) points segregated from the opposing flow are recommended, but they are not essential. In some cases, segregation may not be possible. TAL 6/98 (DETR, 1998a) gives some examples of signing layouts. Where segregation is provided, the “No entry” requirement for motorists is signed as usual (see Figure 7.8). If this is not possible, motor vehicles are prohibited using the sign to diagram 619. The supplementary “Except cycles” plate (diagram 954.4) is not necessary here (and it cannot be used with a “No entry” sign).

7.6.8 Where contraflow lane markings are meant to be largely absent, a short section of lane with coloured surfacing at each end of the road will help alert drivers and pedestrians to the possibility of encountering cyclists travelling in contraflow.

7.7 Parking and cycle contraflows

7.7.1 Parallel parking bays do not pose any more of a hazard for cyclists in contraflow than they do elsewhere. Indeed, drivers waiting to pull out of the bays usually face oncoming cyclists, and, if a cyclist should collide with a carelessly opened vehicle door, contact will generally be with its panel rather than its edge. As such, it may be acceptable to reduce or omit the buffer zone sometimes provided between parking bays and cyclists.

7.7.2 Echelon parking always needs careful consideration, regardless of whether the road is one-way or not. Echelon bays should ideally be angled so that drivers reverse into them. This means that they exit facing forwards and so avoid the need to reverse into the main flow to leave. It also means that, in contraflow cycling schemes, drivers again leave the bays facing approaching contraflow cyclists.

Figure 7.9 Contraflow bus lane, Isle of Wight (Patrick Lingwood)

7.8 Cycling and contraflow bus lanes

7.8.1 Cyclists are often permitted to use contraflow bus lanes. Where this is so, the recommended width of bus lane is 4.25 metres, with a preferred minimum of 4 metres. However, for short stretches, or where flows are low, narrower lanes may be acceptable. Figure 7.9 shows a 3-metre wide example. This is the minimum recommended width for contraflow bus lanes. Further advice on bus contraflow lanes is given in Chapters 3 and 5 of the *Traffic Signs Manual* (DfT, 2008 and 2003a) and Local Transport Note 1/97 *Keeping Buses Moving* (DETR, 1997c).

7.9 Two-way cycle lanes

7.9.1 Two-way cycle lanes are not generally recommended, because they can be confusing to motorists (see next paragraph). However, they can overcome design issues that may be difficult to resolve otherwise. For example, if two cycle routes meet a major road close to each other and on the same side of the road, a two-way cycle lane can be used to link the routes, thus avoiding the need for cyclists to cross the carriageway.

7.9.2 Two-way cycle lanes should generally be separated from other traffic lanes by means such as a kerb. If segregation is not adequately provided, the arrangement may be confusing to motorists, especially at night. Any two-way cycle facility needs to be very carefully designed, mainly because of the increased potential for conflict where these routes cross the mouths of side roads. A driver waiting to leave a side road may not be expecting to encounter cyclists approaching from two directions.

7.9.3 Other issues to consider include:

- the possible need for cycle gaps in the segregating feature, so that cyclists can get to and from cycle lanes in the main carriageway;
- additional signs and traffic calming may be required;
- drivers turning out of a side road may inadvertently enter the two-way cycle lane if it is not clearly marked or protected by a bollard;
- arrangements for pedestrians become more complex near two-way cycle lanes, and pedestrians may not realise they need to look both ways before crossing;
- physical segregation of the lane prohibits activities such as parking or loading on one side of the carriageway – this may lead to problems on the other side.

8 Off-road cycle routes

8.1 Introduction

8.1.1 Off-road cycle routes almost invariably accommodate pedestrians too. They vary considerably in scope, from a shared-use track alongside an urban road to countryside leisure routes such as those on converted former railway lines. Overall design will depend on how each route is used. All routes should be safe and comfortable, but other design priorities will vary depending on the main purpose a route is intended to serve. For example, routes used for commuting need to be fairly direct, while on leisure routes directness may be less important than providing an attractive environment where the route itself may be one of the main attractors.

8.1.2 In general, off-road cycle routes in urban areas tend to be the least desired option, and it is usually better to cater for urban cyclists on-road if this is practicable. Off-road routes are often created by converting existing footways/footpaths and, if such routes are not carefully designed, pedestrians may view them as a reduction in quality of provision. It is important to consult with cyclists and pedestrian groups on the design of such facilities. This can help reduce the likelihood of objections to the conversion of pedestrian facilities. More information on the establishment of shared use schemes is available in Local Transport Note 2/86 *Shared Use by Cyclists and Pedestrians* (DoT, 1986).

8.1.3 In addition, urban off-road routes may be frequently interrupted by side roads. Track crossings of side roads can be difficult to get right, and they may become points of conflict between cyclists and motorists. This aspect is covered in more detail in Section 10.3.

8.1.4 Off-road leisure routes tend to be more attractive options because they do not usually suffer from the same problems. Long, cross-country routes, for example, are unlikely to be frequently interrupted. In addition, many off-road leisure routes have been created as additions to existing walking and cycling networks, and thus represent an improvement for all users.

8.1.5 New off road routes should be audited after installation to ensure the design is working well. Feedback from users can help this process.

8.2 Design speed

8.2.1 On commuter routes, cyclists usually want to be able to travel at speeds of between 12 mph and 20 mph, preferably without having to lose momentum. Frequent road crossings, tight corner radii, the presence of other users and restricted width or forward visibility all affect the speed with which cyclists can travel and the effort required. Cyclists tend not to favour cycle routes that frequently require them to adjust their speed or stop.

8.2.2 A design speed of 20 mph is preferred for off-road routes intended predominantly for utility cycling. This provides a margin of safety for most cyclists. The average speed of cyclists on a level surface is around 12 mph.

8.2.3 Where cyclists share a route with pedestrians, a lower design speed may be required. Routes with design speeds significantly below 20 mph are unlikely to be attractive to regular commuter cyclists, and it may be necessary to ensure there is an alternative on-carriageway route for this user category.

8.3 Visibility criteria

8.3.1 For cyclists using the carriageway, the forward visibility required to assess hazards and obstacles ahead is governed by the road geometry, which is likely to be more than adequate for cyclists' needs. For off-road routes, forward visibility needs to be considered in more detail.

8.3.2 Two visibility parameters determine whether cyclists can ride comfortably at their own desired speed and react safely to hazards. They are the sight distance in motion (SDM) and the stopping sight distance (SSD).

8.3.3 SDM could also be regarded as the comfort visibility zone when cycling. It is the distance that a cyclist needs to see ahead in order to make riding feel safe and comfortable. Research (CROW, 1993) has determined this to be equal to the distance covered in 8 to 10 seconds, i.e. between 50 metres and 80 metres at typical cycling speeds. SSD is the distance that a cyclist needs to see ahead to recognise a hazard, react to it and come to a halt. It is always shorter than the SDM.

8.3.4 The ability of a cyclist to interact safely with other cyclists and pedestrians will depend on the sightlines available. These in turn affect the ability to maintain momentum, anticipate the actions of others and, if necessary, stop in time. It is also important for personal security that cyclists can assess the situation ahead.

8.4 Geometric design

8.4.1 SDM values on off-road routes may be difficult to achieve, but failure to satisfy SDM requirements will not affect safety. However, providing adequate SDM sightlines is desirable, as they enhance comfort and obviate the need to consider SSDs.

8.4.2 The SSD depends on the rider's initial speed, perception/reaction time and the braking ability of the cycle. Table 8.1 gives suggested values for SSDs, which are similar to those given in the *Manual for Streets* (DfT/CLG, 2007). However, TA 90/05 in the *Design Manual for Roads and Bridges* Vol. 6 (Highways Agency, 2005b) recommends a higher minimum SSD of 30 metres at 30 km/h (19 mph). Whichever figure designers use, it should be noted that it relates to minimum SSDs, and any increase over these values will enhance comfort and hence the attractiveness of the route.

8.4.3 Another geometric factor that affects the speed at which cyclists can travel comfortably is the curvature of the cycle track. Whether considering sight distance or curvature, designers should allow for site-specific factors such as gradient or surface quality when applying them. For example, it is

Table 8.1 Off-road route design parameters

Type of off-road cycle route	Design speed	Min. stopping sight distance	Min. radius of curve
Commuter route	20 mph	25 metres	25 metres
Local access route	12 mph	15 metres	15 metres

estimated that minimum stopping distances should be increased by around 50 per cent for unsurfaced tracks (California DOT, 2001).

8.4.4 Physical constraints often make it impossible to meet the desired geometric criteria. If these cannot be achieved, mitigating measures may be necessary, such as where a cycle track approaches a subway entrance at a right angle (see paragraph 8.15.3). However, in many cases, cyclists can be expected to slow down for their own safety.

8.4.5 Regardless of geometry, it is important that cycling speeds do not cause inconvenience or danger to pedestrians. Generous sightlines on less busy routes can help pedestrians and cyclists to avoid each other, but at some conflict points measures such as staggered barriers may be required to reduce cycling speeds.

8.5 Width requirements

8.5.1 The minimum widths given in this section relate to what is physically required for the convenient passage of a small number of users. They do not take into account the need for increased width to accommodate larger user flows. Wherever it is possible, widths larger than the minimum should be used. Practitioners should not regard minimum widths as design targets. When cyclists are climbing steep gradients, they will need additional width to maintain balance. Similarly, when descending steep gradients, they can quickly gain speed, thus additional track width or separation will reduce the potential for conflict with pedestrians.

8.5.2 The minimum recommended width for urban footways on local roads is 2 metres. This is sufficient to allow a person walking alongside a pushchair to pass another pram or wheelchair user comfortably. A minimum width of 1.5 metres is recommended for a one-way cycle track. The minimum recommended width for a two-way cycle track is 3 metres. If these widths cannot be realised, the facility may become difficult for some people to use. Narrow stretches should be kept to short lengths, with passing places interspersed along the route. Passing places should be within sight of adjacent ones. The distance between passing places should not exceed 50 metres.

8.5.3 Where there is no segregation between pedestrians and cyclists, a route width of 3 metres should generally be regarded as the minimum acceptable, although in areas with few cyclists or pedestrians a narrower route might suffice. In all cases where a cycle track or footway is bounded by a vertical feature such as a wall, railings or kerb, an additional allowance should be made, as the very edge of the path cannot be used. Table 8.2 provides the recommended width additions for various vertical features, and Figure 8.1 illustrates how these figures might be applied to 2-metre cycle track alongside a 1.5-metre footpath.

Table 8.2 Additional width required for footways and cycle tracks

Type of edge constraint	Additional width required
Flush or near flush surface	Nil
Low upstand up to 150 mm	Add 200 mm
Vertical feature from 150 mm to 1.2 metres*	Add 250 mm
Vertical feature above 1.2 metres	Add 500 mm
* Including bridge parapets etc. over 1.2 metres for short distances	

8.6 Crossfall, camber and drainage

8.6.1 Crossfall should be between 1 and 2.5 per cent to ensure adequate drainage. Excessive crossfall can be uncomfortable for disabled people and hazardous in icy conditions. On straight sections, the track should ideally fall to either side from the centre. If used, raised white lines (diagram 1049.1) to segregate users may require regular gaps to allow surface water to drain away.

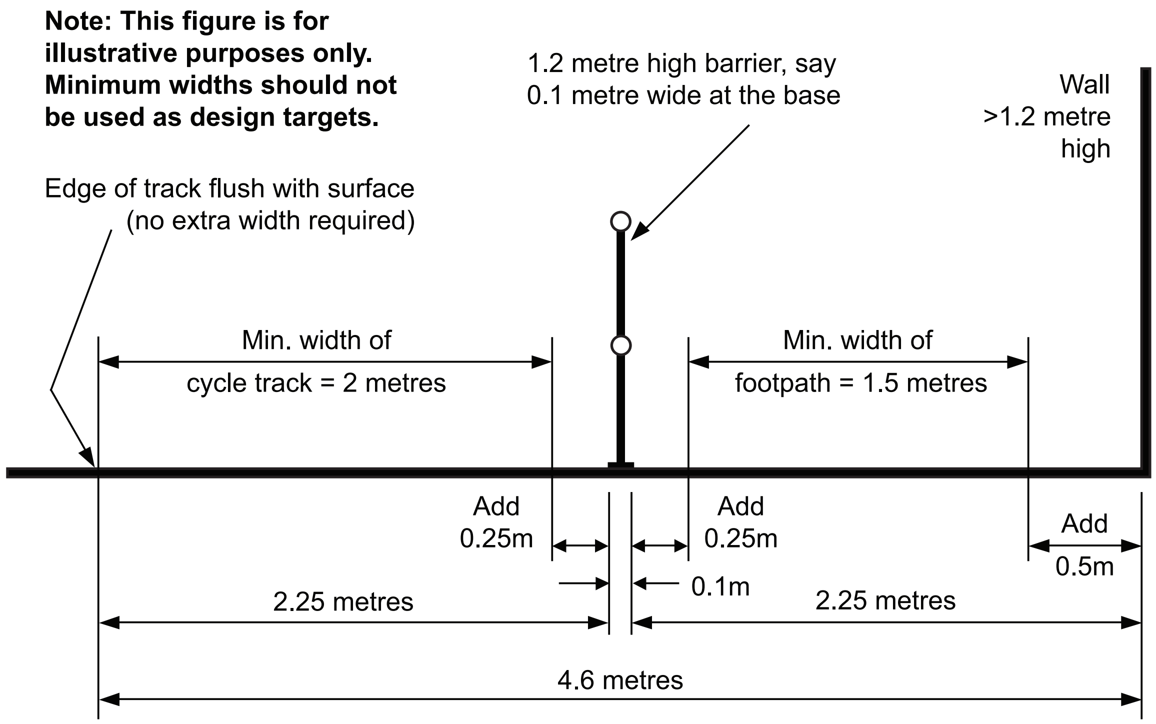

Figure 8.1 Widths for cycle tracks and footpaths

8.6.2 A cycle track should always fall from its outer edge to the inside on bends. If the track falls to the outside of a bend (negative camber), there is an increased risk of skidding. Super elevation, where the crossfall at a bend is increased to permit higher speeds, is unnecessary. Crossfall should be no more than is required for drainage purposes.

8.6.3 On unbound surfaces, it is important that the cycle track is constructed so that surface water is shed to the sides. Water running along the surface can cause erosion and ruts that require frequent maintenance.

8.6.4 Drainage gullies on a sealed surface cycle track should be set flush with it. Grating slots should be at right angles to the cyclist's line of travel to avoid the risk of them catching cycle wheels. The position of gullies should be noted during the design process, as they may need to be moved or realigned where footways are converted to shared use.

8.7 Gradients

8.7.1 Cyclists often go out of their way to avoid climbing a hill, especially where the gradient is steep. The may also try to avoid losing height once it has been gained. For new routes in a hilly area, therefore, an indirect alignment may be preferable to one involving steep gradients. Where space permits, steep gradients can be mitigated by providing ramps in a zig-zag arrangement up the hill. Where this approach is adopted, it is essential that the turning points are kept as level as possible using the minimum crossfall necessary to shed water. It is especially important to avoid adverse camber at these locations.

8.7.2 In general, a maximum gradient of 3 per cent is recommended, but this can rise to 5 per cent over a distance of up to 100 metres. Where steeper slopes are unavoidable, the limiting gradient is 7 per cent over a distance of up to 30 metres. Steeper gradients are not recommended, except over short distances. On the approach to priority junctions, the gradient would ideally not exceed 3 per cent. Where cyclists have to stop, such as at junctions, a short locally levelled section will be of benefit.

8.7.3 It is worth bearing in mind that recommendations on cycle route gradients relate to comfort not safety. While it is always preferable to minimise gradients to reduce the effort required, designers should not adhere too rigidly to the recommended maxima if doing so rules out the option of providing the cycle route in the first place. A very steep route may be better than none at all. In some hilly areas, it is not uncommon to find cycle routes on roads with gradients of between 10% and 15%.

8.7.4 The above advice on gradients relates to cycle routes in general. For ramps to subways or foot/cycle bridges, the gradient should normally be at 5% (see paragraph 10.8.1). Any less increases walking/cycling distances, while steeper gradients may cause difficulties for some users.

8.8 Surfaces

8.8.1 The type and quality of surface affects the comfort and attractiveness of a route and the whole-life costs of the project. An initially high capital cost for a good-quality specification may minimise maintenance and repair costs over the long term. Some of the most common treatments are considered in Table 8.3.

8.8.2 Cycle tracks do not suffer the same degree of wear as motor vehicle routes, but minor surface defects and debris that would be of little consequence for motorised traffic can be uncomfortable to cyclists and may present a hazard.

8.8.3 Designers need to choose a suitable surface for the route. This will depend on its purpose, its expected level of use, construction methods available, the available budget for construction and maintenance, and aesthetic and environmental considerations (UK Roads Board, 2003).

8.8.4 The construction specification will depend on the strength of the sub grade, drainage, frost susceptibility, the design life and whether access is also required by motorised traffic or horses.

8.8.5 Within urban areas subject to high cycle flows, the preferred surface is a bound construction similar to that of footways, with additional thickness provided in areas subject to motor vehicle over-run. In rural areas, unbound surfaces may be more appropriate. Guidance on the suitability of a range of surface types for pedestrians, cyclists and equestrians may be found in DMRB Vol. 5, Section 2, Part 4 TA 91/05 (HA, 2005a).

8.8.6 Machine-laid cycle tracks are preferred. Hand-laid surfaces may be acceptable for pedestrian use, but they are often uncomfortable for cyclists.

8.8.7 Where equestrians share well-used rural off-road routes with cyclists and walkers, it may be desirable to provide a parallel track for horses. This is because bound surfaces are generally unsuitable for horses, except over short lengths, and, where the cycle track surface is unbound, it can be damaged by their hooves.

8.8.8 Unbound surfaces are generally unsuitable for use on commuter routes because they are less durable, dusty when dry and can throw up dirt when wet. Surfaces can be sealed with tar spray and chippings on a suitable base, and this may also be a solution where equestrian damage to unsealed surfaces is a problem. The chipping surface offers a degree of grip for horses. Type 1 granular material is generally used as a base course for rural cycle tracks and paths. Recycled surfacing material such as planings arising from highway maintenance activities can be used and may offer environmental benefits and cost savings from reduced haulage and disposal costs.

8.8.9 Additional strength or wearing resistance can be achieved through the use of fibre-reinforced surfacing techniques. Since these are usually machine-laid, the construction thickness will need to be increased to carry the weight of the machinery involved. Where these surfaces are used, it is important their presence is recorded so that maintenance activities, and in particular excavation, are carried out in a manner that avoids damage to them.

Table 8.3 Typical cycle track construction

Surface	Comment
Asphalt or bituminous	Preferred surface, suitable for high-flow routes, can be surface dressed, lower long-term maintenance costs.
Concrete laid in situ	High installation cost but durable. Not very comfortable to ride on, and a textured surface may be required for adequate skid resistance. In rural locations a concrete surface may be useful for localised areas such as cattle crossings.
Concrete block or clay paviours	Expensive, but durable.
Surface dressed base course	More suitable in rural environments. Preferred to unbound surfacing, allows for colour variation through choice of chippings. Fibre-reinforced surfaces add strength.
Unbound	Not generally recommended except on very quiet routes. Can be dusty when dry and result in unpleasant spray when wet. Prone to erosion by poor drainage. Can have higher long-term maintenance costs, and is prone to damage by horses and farm vehicles.

8.9 Dropped kerbs

8.9.1 The transition from cycle track to carriageway is an important detail for cyclists' safety and comfort. An upstand crossed at a narrow angle or when combined with loose debris in the channel can be hazardous and is also a disadvantage to people with prams or wheelchair users on shared use facilities. The transition between surfaces should ideally be flush (see Figures 8.2 and 8.3).

8.9.2 Sometimes it is possible to omit kerbs altogether, providing a continuous surface (see Figure 8.2). Where edge restraint is required, square-edged kerbs or channel blocks may be used.

8.9.3 Gully gratings should be relocated clear of the crossing point. If this is not possible, the grating should be orientated so that the grating slots are roughly at right angles to the direction of cyclists' flow to avoid the danger of a wheel becoming caught. A dropped kerb at the carriageway edge should be wide enough to accommodate cyclists turning at a reasonable speed and without them needing to pull out towards the centre of the carriageway to join or leave the cycle track. A 4-metre minimum radius should be assumed when assessing entry angles.

8.10 Bus stops

8.10.1 Where shared use routes pass bus stops, there is increased potential for conflict between pedestrians and cyclists, especially where room is limited. Passengers alighting from buses are unlikely to consider that cyclists may be passing.

8.10.2 It is common practice for cyclists to be placed closest to the carriageway when a footway is converted to a segregated shared use cycle track. This enables pedestrians to walk at the back of the footway and reduces the likelihood of cyclists colliding with vehicles at driveway entrances. At bus stops, this arrangement is not ideal, as it is more likely to bring cyclists into conflict with bus users. Where space permits, conflict may be reduced by swapping the footway and cycle track positions so that cyclists pass behind the bus shelter and any waiting passengers (see Figure 8.4).

Figure 8.2 Smooth transition from carriageway to cycle track, Bingley. Note that the cycle symbol does not conform to diagram 1057 (see paragraph 3.3.2). (Tim Pheby)

Figure 8.3 Flush surfaces at dropped kerb (Alex Sully, ERCDT)

Figure 8.4 Cycle track changing sides at bus stop (Tim Pheby)

8.11 Street furniture

8.11.1 Where a footway or footpath is being converted for cycle use, obstacles within the track such as sign poles, lighting columns, pillar boxes, bus stops and telephone kiosks may need to be moved. If barriers or bollards are required to restrict motor vehicle access to the route, they should be highlighted through the use of reflective material or high-visibility paint, especially in areas where there is no street lighting. A cycle audit during the hours of darkness as well as in daylight may help to identify potential hazards.

8.11.2 When cyclists lean into a bend, they may extend over the inner edge of a cycle track. Poles, fences or other vertical features on the inside of bends should therefore be set back and any overhanging tree branches or other vegetation cleared.

8.11.3 The area adjacent to a cycle track has an impact on personal security. Landscaping and planting should not impede forward visibility or the effect of passive surveillance from surrounding properties, nor create hiding places close to a path. A verge or clear area ideally not less than 1 metre wide may be provided on each side of a track, with planting near the track kept below 0.8 metre high. Vegetation that is likely to grow higher may be set further back.

8.11.4 The minimum recommended headroom under road signs which project above a cycle track is 2.3 metres.

8.12 Street lighting

8.12.1 Lighting is normally provided on urban routes where cycling can be expected after dark. Lighting helps users detect potential hazards, discourages crime and helps users to feel safe.

8.12.2 Cyclists using two-way cycle tracks alongside unlit carriageways may be blinded or dazzled by the lights of oncoming vehicles, particularly on tracks alongside high-speed rural roads. Drivers may also be confused when seeing cycle lights approaching on their nearside. These hazards can be reduced by, for example, locating the track as far away as possible from the carriageway edge, or by providing with-flow cycle tracks alongside both sides of the carriageway.

8.12.3 Cycle routes across large quiet parks or along canal towpaths may not be well used outside peak commuting times after dark, even if lighting is provided. In these cases a suitable street lit on-road alternative that matches the desire line as closely as possible should be considered. Subways should be lit at all times, using vandal-resistant lighting where necessary. It is not expected that routes outside built-up areas used primarily for recreation would normally need to be lit except where there were road safety concerns, such as at crossings or where the track is directly alongside the carriageway.

8.12.4 Where an off-carriageway track requires lighting, the designer needs to consider the proximity of an electricity supply, energy usage, and light pollution.

8.12.5 The Highways Act 1980, section 65(1) contains powers to light cycle tracks. Technical design guidance may be found in TR23, *Lighting of Cycle Tracks* (ILE, 1998).

8.13 Managing user conflict

8.13.1 Almost all off-carriageway routes for cyclists are used by pedestrians, and the potential for user conflict needs careful consideration. Where there is potential for conflict, separating user flows is an option but if room is limited, this may not be making best use of the width available. Alternatively, cycling speed can be reduced or accommodated.

8.13.2 It can be counter-productive to reduce cyclist speeds by restricting forward visibility where a route is intended to encourage more cycling and walking – doing so disadvantages pedestrians too and may create conflict points. In a study of user interaction on cycle tracks (Uzzell et al., 2000), the speed of cyclists was significant in perceived conflict, but limited visibility was the most important factor in actual conflict.

8.14 Access control

8.14.1 Barriers at cycle route access points are commonly provided to prevent entry by cars and vans etc. They become more of a problem for cyclists when designed to exclude motorcycles. Motorcycle barriers should only be introduced after a definite need has been established, because measures that reliably exclude motorcycles invariably exclude some cyclists, including users of tricycles, cycle trailers and hand-cranked cycles. Wheelchairs and mobility scooters will also be excluded. Dismounting to manoeuvre a cycle with an occupied child seat through barriers can be hazardous.

8.14.2 Measures to control motorcycles are only as good as the weakest point in the route boundary – if fencing can be breached, access barriers will have little or no effect. If potential misuse by motorcyclists is raised as an issue during the consultation stage of a new project, it might be better to set capital funds aside to cover the cost of barriers, should they prove necessary, and monitor the scheme in operation. If concerns are found to be justified, funds will therfore be available to address them.

8.14.3 Arrangements may be required to accommodate wheelchair users to comply with the Disability Discrimination Act 1995. A common method for allowing wheelchairs to bypass access controls is to install a gate equipped with a RADAR (Royal Association for Disability and Rehabilitation) lock. These locks can be opened with a key purchased from RADAR. However, this may still result in loss of access to some types of bicycle and tricycle, and many disabled people will not have a key.

8.14.4 Bollards are the preferred method of access control for larger vehicles, spaced a minimum of 1.2 metres apart, preferably 1.5 metres. For an additional deterrent effect, they can be installed as two staggered rows with a minimum 1.2 metres between rows (see Figures 8.5 and 8.6). Bollards should ideally be placed at least 5 metres from any bend or junction, so that riders can approach them straight on. Bollards can be hazardous on unlit routes and at sites where forward visibility is restricted by the layout or by other users.

8.14.5 Where motor vehicle access is required for maintenance, removable bollards or a self-closing gate for pedestrians and cyclists adjacent to a locked main gate can be used. Self-closing gates can also be used where gates are required to prevent livestock escaping. If there is a series of gates in close succession it may be preferable to fence off the cycle route to reduce the need for users to stop and start. This also reduces the likelihood of gates being left open. Specially designed cattle grids are available for use on cycle tracks and footpaths.

Figure 8.5 Bollard to prevent unauthorised car access (Alex Sully)

Figure 8.6 Multiple bollards (Tony Russell)

Figure 8.7 Barrier with wheelchair bypass (Tim Pheby)

Figure 8.8 A-frame barrier (Steve Essex)

8.14.6 Barriers with a wheelchair bypass are commonly used. They offer access for unladen solo bicycles and will deter most motorcyclists (see Figure 8.7). This type of barrier can cause problems for cyclists with panniers, laden tandems, tricycles, child trailers and some types of mobility scooter and is therefore unsuitable for long-distance recreational routes. The low barriers can damage cycle wheels or cause a fall if a rider fails to line up properly on approach. They may also create a trip hazard for blind or partially sighted users

8.14.7 A-frame barriers (Figure 8.8) permit ordinary cycles, tandems and most wheelchairs to pass, but they need to be carefully installed to ensure they operate as intended. They exclude some powered wheelchairs, mobility scooters and many types of bicycle trailer.

8.14.8 Where access controls are next to a carriageway they need to be set back far enough to accommodate likely users. For example, a family group waiting for others to pass through the controls could require a space 5m long to ensure all are clear of the carriageway.

8.14.9 Conventional kissing gates can be altered to accommodate solo cycles and wheelchairs but will invariably exclude most non-standard bikes including trailer bikes, trailers, tandems, tricycles and many cycles adapted for disabled users. They are not generally recommended on cycle routes.

8.15 Speed control and segregation

8.15.1 Where there is potential for conflict, it may be better to widen the route or address visibility issues rather than install controls. If this is not possible, it may be appropriate to introduce measures to slow cyclists down, such as rumble surfaces, humps, or staggered barrier arrangements (barriers should be considered last).

8.15.2 Warning features such as SLOW markings may be useful for alerting cyclists approaching a hazard. The deliberate imposition of tight radii, although inappropriate in the general run of a path, is an effective way of bringing speeds down on the approach to a potential conflict point. There should be good visibility through bends or speed-reducing features.

8.15.3 Where cycle routes are retro-fitted to pedestrian subways with right-angled approaches, cyclists can be guided away from the inside of the corner using barriers or other means (see Figure 8.9). This helps reduce the potential for conflict with pedestrians.

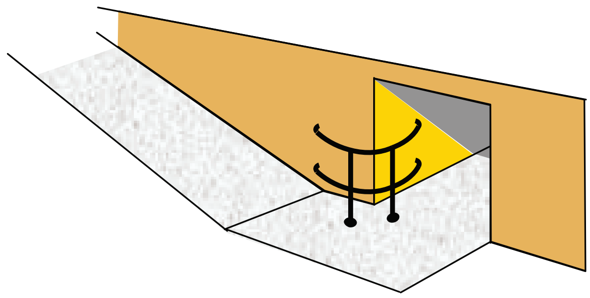

Figure 8.9 Barrier placed at foot of subway ramp

Figure 8.10 Barrier to reduce speed on approach to subway (CTC Benchmarking)

8.15.4 Barriers placed under bridges on disused railways and canal towpaths may introduce personal security issues, as people sometimes loiter and congregate at these locations. Barriers are best located in more open areas if practicable.

8.15.5 If staggered (chicane) barriers are used, the arrangement should be designed to slow cyclists rather than force them to dismount (see Figure 8.10). Chicane layouts should provide gaps of at least 1.5 metres between barriers and walls, and at least the same distance between barriers. Tandems, tricycles and child trailers require at least 2 metres between consecutive barriers.

8.15.6 Barriers and access controls need to be clearly visible. Partially sighted people appreciate colour as well as a tonal contrast in their surroundings (DfT, 2002) Yellow and black gives the greatest contrast. Retro-reflective bands should also be considered.

8.16 Tactile paving

8.16.1 Tactile paving surfaces can be used to convey important information to visually impaired pedestrians about their environment. On cycle routes, they are applied where tracks meet footways/footpaths and at intervals along some shared use routes. Detailed advice is contained in *Guidance on the Use of Tactile Paving Surfaces* (DETR, 1998b). The following complements that advice.

8.16.2 The ribbed (tramline/ladder) surface is used to indicate the start of a shared use route where cyclists and pedestrians are segregated from each other. The ribs are orientated in a ladder pattern on the pedestrian side, and tramline on the other. Tramline paving is usually laid over a distance of 2.4 metres. Ideally, it should be sited so that cyclists pass over all of the paviours in line with the ribs. If this is not possible, it may be worth considering laying it over a shorter distance to minimise the possibility of skidding.

8.16.3 The corduroy surface is used to warn visually impaired pedestrians of the presence of specific hazards. In the cycling context, it should only be used as a warning that a footway or footpath is about to join a shared route on the cyclists side. Corduroy should not be confused with ladder/tramline – they have different rib profiles.

8.16.4 In complex situations, it may be difficult to follow published guidance to the letter, and tactile paving arrangements can get a little complicated. If there is potential for this to lead to confusion, it may be better to omit some tactile paving so that the remaining (more important) tactile messages can be better understood. In such complicated situations the designer should seek advice from access officers or local representatives of visually impaired people.

8.17 Maintenance

8.17.1 Proper maintenance is essential if a cycle route is to remain attractive to users. Potholes, ruts, uncleared debris and poorly reinstated surfaces can create hazards for pedestrians and cyclists. Guidance on the maintenance and construction of cycle routes, both on and off road, may be found in the *Application Guide AG26* (Version 2) (UK Roads Board, 2003). This document can be used as a starting point for establishing maintenance standards, taking local circumstances into account. Table 8.4 gives an example of a maintenance programme for off-road routes.

8.17.2 The following points should be considered:

- Cycle routes have an important role to play in helping local authorities meet a broad range of policy objectives on sustainable transport, health and, physical activity. Poor maintenance can deter cyclists and pedestrians, making these objectives harder to achieve.

- Inspection frequency and intervention levels may need to be made more onerous than suggested in AG26 in order to meet the needs of cyclists in some situations. It is worth considering consultation with local user groups on proposed maintenance standards.

- Routine and safety inspections are best carried out from a bicycle to help ensure that the inspector has a better understanding of how even small defects can affect cyclists.

- Identified problems should be rectified as quickly as is practicable. This process can be helped by, for example, introducing a fault-reporting hot-line or pre-paid postcards.

- Works affecting cycle routes should be co-ordinated to minimise inconvenience to the same degree as those in the carriageway. Reinstatements carried out by the authority and statutory undertakers should be in accordance with good practice.

- Regular sweeping is required to keep cycle tracks, lanes and bypasses clear of accumulated debris, especially where glass can be expected to accumulate, e.g. outside pubs and clubs etc.

- Regular trimming of trees, hedges and grass growing alongside cycle facilities during the growing season is recommended. The debris should be promptly cleared from the track to minimise the risk of punctures.

- The geometric and structural design of a cycle track may need to accommodate maintenance vehicles.

8.17.3 If the condition of a cycle route is allowed to deteriorate, people may stop using it. A costed maintenance programme can be secured with long-term funding if it forms part of a project's development and approval process. The day-to-day costs of inspection and low-level maintenance may be reduced by using suitably trained volunteer staff, where they are legally able to do so. One example of this is the volunteer ranger partnership on some sections of the National Cycle Network.

Table 8.4 Typical maintenance programme for off-road routes

Issue	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 (but not structures – see below) to avoid need for extra visits	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

Table 8.4 Typical maintenance programme for off-road routes – continued

Issue	Activity	Notes	Frequency	Time of year
Cycle track surface	Cut back encroaching vegetation on verges		Once a year	November, and also 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	May, July and September
	Grassed amenity areas	Include with verge maintenance	n/a	n/a
	Control of ragwort, thistles and docks etc.	See Weeds Act 1959 and Wildlife and Countryside Act 1981. Hand pull, cut or spot treat as necessary.	Before seeding	July or as appropriate
	Cut back trees and herbaceous shrubs	If necessary, allow for annual inspection of trees depending on number, type and condition	As necessary	July
Signs	Repair/replace/clean as necessary	Maintenance will largely depend on levels of local vandalism	n/a	n/a
Access barriers	Repair/replace as necessary	Maintenance will largely depend on levels of local vandalism	n/a	n/a
Fences	Repair/replace as necessary	Dependent on licence arrangements with landowner	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
Seating sculptures etc.	Maintain or repair	If present	n/a	n/a
Other	Varies	cheme-specific issues such as Sites of Special Scientific Interest, interpretation and information measures, disability access etc.	n/a	n/a

9 Junctions

9.1 Visibility criteria at junctions and crossings

9.1.1 Where a cycle track meets a road, visibility splays are required to ensure cyclists can see and be seen by approaching motorists. Splays are defined by their X and Y distances, and Figure 9.1 shows the basic layout. Figure 7.18 in the *Manual for Streets* (DfT/CLG, 2007) (MfS) shows how splays are measured on curved alignments.

9.1.2 MfS normally recommends an X distance (of 2.4 metres) which allows one car driver at a time to check along the main alignment before exiting the minor arm. Longer X distances are not generally recommended. They increase junction capacity, but they also tend to allow drivers to see enough to enable them to leave the minor arm without stopping, and this may lead to a reduction in safety.

9.1.3 The circumstances are different at a cycle track junction – for one thing, the speeds involved are lower. In this case, longer X distances are preferred, as they can reduce cycling effort and may enhance safety. Providing longer X distances makes it easier for cyclists to use the junction without stopping. This is acceptable, because a cyclist, even when moving, is unlikely to fail to notice a car approaching from the side. Cyclists are generally reluctant to stop, because they like to conserve energy, so allowing them to see along the main road while approaching it may give them more time to check properly. A longer X distance also makes a cyclist approaching or waiting at the junction more visible to drivers. A minimum X distance of 2 metres is suggested.

9.1.4 Where cycle tracks meet roads in built-up areas, minimum Y distances can be taken from Table 7.1 of MfS. For higher-speed roads, the Y distances given in the *Design Manual for Roads and Bridges* (HA, 1995) will be more appropriate.

9.2 Signalised junctions

9.2.1 Signalised junctions are one of the safest types of junction for cyclists. An advanced stop line (ASL) arrangement with a cycle feeder lane will enable cyclists to pass queuing motor vehicles on the

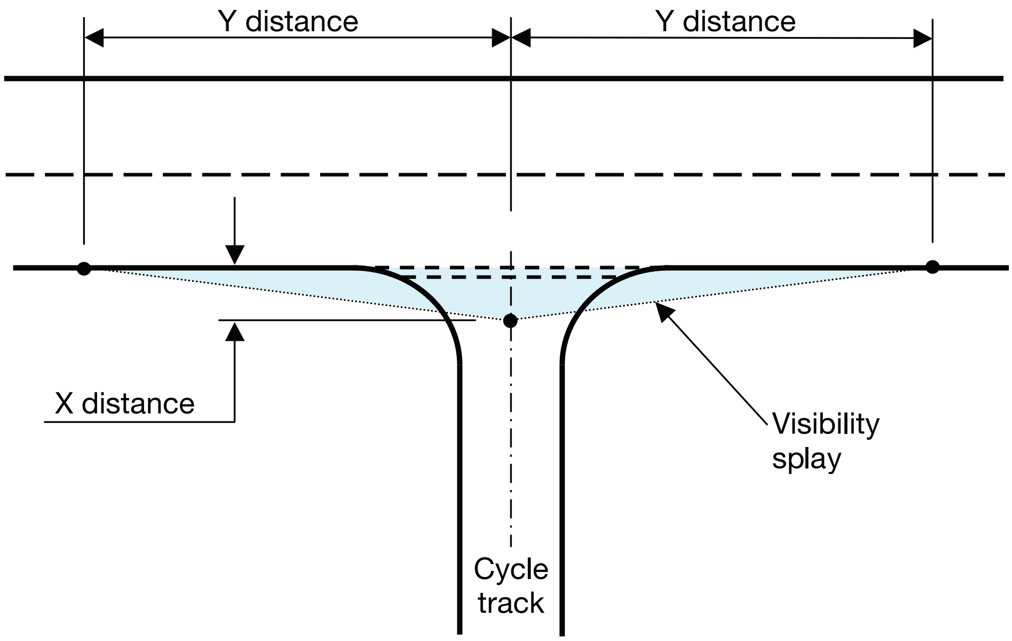

Figure 9.1 Visibility splay measurements

approach and take up the appropriate position for their intended manoeuvre before the signals change to green. ASLs are dealt with in more detail in Section 9.4.

9.2.2 Most signalised junctions do not require any special adjustment to signal timings for cyclists. At larger junctions, or where a junction arm has an uphill gradient, the intergreen period may need to be extended to ensure that cyclists are able to clear the junction before the next phase of the lights begins. Cyclists' speeds and their ability to move off are greatly affected by gradients. Where the junction is on a gradient, either the intergreen period can be extended for the appropriate signal phase (e.g. just on the uphill gradient, or possibly all stages at a large junction), or cyclists can be detected by loops or infra-red/microwave systems that extend the appropriate period only when necessary. The speed of cyclists travelling through level signalised junctions varies from around 4 m/s to 7 m/s (Wall et al., 2003).

9.2.3 Modern, well-positioned detector equipment and suitable sensitivity settings enable cyclists to be detected at most signal-controlled junctions. Figure 9.2 shows a typical loop detector arrangement. Where a cycle track forms one of the arms of a junction, loop detectors can be provided in the track to trigger the appropriate phase at the signals. Alternatively, above-ground vehicle detection equipment may be used – see TAL 16/99, *The use of above ground vehicle detectors* (DETR, 1999b).

9.3 Signalised junction layouts

9.3.1 Larger junctions with many arms, signal phases or multi-lane approaches can be more intimidating and hazardous for cyclists. If a route through a signalised junction is specifically for cyclists, it may be appropriate to provide "elephants' feet" markings (see Figure 9.3), but these require authorisation. Policy on these markings (in England, at least) has tightened up in recent years, and the Department for Transport now only considers authorising them at signal controlled junctions where the cyclist's route may not be obvious. As such, it is unlikely that the example shown would be authorised nowadays.

9.3.2 Cycle lanes that bypass the main signals can reduce delays. A dedicated left-turn cycle lane using a separate phase or green signal will enable cyclists to clear the junction ahead of other traffic. Short bypasses with their own signal head can cater for other movements, such as the example in Figure 9.4, which allows cyclists to go ahead where other traffic must turn left. If a push-button unit is provided to activate the signal, it will require authorisation. Note that, in the example shown, the signal head is incorrect, as it uses a red cycle symbol – see diagram 3000.2 of TSRGD. If it is appropriate, the bypass can be left unsignalled, using GIVE WAY markings instead.

9.3.3 Any such proposals need careful design, as it is essential that the needs of pedestrians, and particularly disabled people, are taken into account.

Figure 9.2 Loop patterns to detect cyclists, (Alex Sully)

Figure 9.3 Elephants' feet markings, (CTC Benchmarking)

Figure 9.4 Cycle-only phase at signal controlled junction (CTC Benchmarking). Note that the signal head is incorrect, as it uses a red cycle symbol.

9.3.4 If there is insufficient room in the carriageway for a bypass, it can be created by converting part of the footway to a cycle track using powers under the Highway Act 1980, such as in Figure 9.5. In this case, cyclists going straight ahead can use the track to bypass the signals at a T-junction. A good way of returning cyclists to the carriageway is to place the end of the cycle track on a build-out and parallel to the main flow. Such an arrangement minimises the potential for conflict when cyclists rejoin, and should allow them to do so without stopping.

9.4 Advanced stop lines

9.4.1 Advanced stop line (ASL) arrangements comprise a stop line for motor vehicles, an additional stop line for cyclists nearer the signal heads, and a lead-in lane that allows cyclists to pass the first stop line (see Figure 9.6). The area between the two stop lines forms a reservoir for waiting cyclists to occupy. ASLs are prescribed for signalised junctions only – they cannot be used at signalised pedestrian crossings.

9.4.2 ASLs were originally introduced to reduce conflict between cyclists and motorists when pulling away from rest at signal controlled junctions. The main conflicting movements are:

- cyclists going ahead while other vehicles turn left; and
- cyclists turning right while other vehicles go ahead.

Figure 9.5 Cycle track bypass at a signalised T-junction (Patrick Lingwood)

9.4.3 Advanced stop lines are generally popular with cyclists and may thereby encourage more cycling (Scottish Government, 2001). They:

- allow cyclists to bypass queuing traffic to get to the front (via the lead-in lane);
- place cyclists in a more visible location ahead of traffic, rather than at a potential blind spot to the left of traffic; this is especially important where there are appreciable numbers of HGVs;
- allow cyclists to wait in an area relatively free from exhaust fumes; and
- make it easier for right-hand-turning cyclists to position themselves in the best location.

Figure 9.6 Typical ASL installation (Patrick Lingwood)

9.4.4 The ASL is marked using diagram 1001.2. Cyclists can feel intimidated by motor vehicles waiting behind them when the signals are red. Cycle reservoirs therefore must be at least 4 metres (and no more than 5 metres) deep, as specified in the regulations. This allows cyclists to wait a safe distance ahead of other traffic. The reservoir of the ASL extends across the full width of the lane/s and includes a cycle symbol that is an integral part of the marking. Providing a coloured surface in the reservoir can help discourage encroachment by other vehicles. Part-width ASLs covering only one lane or part of a lane require authorisation.

9.4.5 ASLs can be installed relatively cheaply. They have little or no negative impact on junction capacity if the number of all-purpose traffic lanes remains unaltered. However, capacity will be affected if an all-purpose lane is removed (Wall et al., 2003) Where an ASL is provided, the intervisibility zone for the junction is measured from a point 2.5 metres behind the cyclists' stop line (in the absence of an ASL, intervisibility is measured relative to the motorists' stop line) (HA, 2004).

9.4.6 The installation of ASLs at a large junction can be complemented with minor changes to the signal timings to help make the junction more cycle-friendly, such as additional time for cyclists to clear the junction. In most circumstances however, ASLs do not require signal timing changes (Wall et al., 2003).

9.4.7 When designing an ASL, it is important to assess the way the junction operates. The main design issues concern the position and width of lead-in cycle lanes. The following should be considered:

- the number of all-purpose lanes approaching each arm;
- the predominant motor vehicle and cycle movements at the junction, and the potential for these to conflict;
- the presence of left- or right-turning filters;
- the red time at the junction in relation to the green time (sites with longer red times work better for cyclists approaching the reservoirs);
- the normal and peak time length of traffic queues;
- the available width of carriageway; and
- the length of time it takes a cyclist to clear the junction.

9.4.8 The lead-in cycle lane of an ASL arrangement can be mandatory or advisory. The main function of a nearside lead-in lane (apart from allowing cyclists to legally gain access to the reservoir) is to allow cyclists to get past stationary vehicles waiting at the lights. As such, a minimum width of 1.2 metres is acceptable. Where traffic is generally free-flowing, a wider lane is preferred. It may be better to use a wide advisory lane, accepting that some vehicles may encroach, rather than a narrow mandatory one. It may be necessary to reduce the width of the adjacent traffic lanes to accommodate the lead-in lane. A sub-standard traffic lane width may be acceptable where there is limited use by HGVs. The provision of nearside lead-in lanes that are as long as the normal peak-time traffic queues can help to keep the route to the ASL clear of queuing vehicles.

9.4.9 Non-nearside lead-in lanes are particularly useful when the nearside all-purpose lane is dedicated to vehicles turning left. They may also be useful where a large proportion of cyclists turn right. Non-nearside lanes offer a degree of protection to cyclists who have moved away from the nearside, and can help drivers anticipate cyclists occupying this position in the carriageway. They are particularly beneficial where traffic is flowing relatively quickly and cyclists need to get into position some distance from the junction. However, they should not extend further upstream than necessary – excessively long non-nearside lanes may increase the potential for conflict between cyclists and motorists. Because non-nearside lanes often place cyclists between two rows of moving traffic, they should ideally be at least 2 metres wide to provide adequate separation (although narrower lanes may be acceptable on lightly trafficked roads). They must be marked as advisory lanes to allow motor vehicles to cross them. Non-nearside lanes should be positioned so as to avoid the section of road where most lane-changing movements are taking place, particularly those from left to right.

Figure 9.7 Cycle lead-in lane leading to ASL on the off-side of a filter lane (Patrick Lingwood)

9.4.10 Where a lane gain is dedicated to left-turning traffic on the approach to an ASL, the best option may be to start the lead-in lane a little upstream of the start of the dedicated lane. It can then continue on the off-side of the dedicated lane (see Figure 9.7). Motorists moving to the left will then cross the cycle lane, which may be much safer than expecting cyclists to cross the dedicated lane. A coloured surface is particularly useful in situations like this.

9.4.11 At some junctions it may be beneficial to provide two or more separate lead-in cycle lanes for left- and right-turning cyclists, especially where there are filter lights, but this arrangement requires authorisation. Where there are filter lights for left- or right-turning traffic, waiting cyclists should not be put in a position where they obstruct traffic moving off when the filter lane is active.

9.5 Raised tables at junctions

9.5.1 Seventy per cent of injury accidents involving cyclists take place at junctions. Raised tables such as those in Figure 9.8 create safer conditions for all users by reducing the speed at which traffic negotiates the junction. Junction tables extend from kerb to kerb and can be used at priority junctions. The use of a table can avoid the need to introduce separate cycle facilities.

Figure 9.8 Table junction (Patrick Lingwood)

9.5.2 The ramps for the table should be sufficiently far from junction mouths so that cyclists do not encounter them when turning. Build-outs, bollards and parking restrictions, as appropriate, may be needed to prevent parking around the junction.

9.5.3 The speed-reducing effect of speed tables can help mitigate problems of sub-standard visibility at junctions.

9.6 Raised entry treatment at side roads

9.6.1 Raised entry treatments, where a flat-topped road hump is placed at the entrance to a side road, can make pedestrian crossing movements more convenient (see Figure 9.9). Cyclists also benefit, because motor vehicles entering or leaving the side road do so at reduced speed.

Figure 9.9 Localised narrowing and raised table at a side road junction (Patrick Lingwood)

9.7 Roundabouts

9.7.1 For detailed design guidance on roundabouts, see DMRB Volume 6, Section 2 (HA, 1993b). Roundabouts offer capacity advantages over other forms of junction, but they can be hazardous for cyclists. Finding a safe position to occupy in the circulatory carriageway may be difficult, and cyclists are at risk of not being noticed by drivers entering or leaving the junction at relatively high speeds. Roundabouts with a dedicated left-turn slip lane to increase capacity pose an additional hazard for cyclists, especially where the lane diverges. They are not generally recommended on cycle routes.

9.7.2 Many studies show there is a higher risk of cyclist injury accidents at roundabouts compared with other junctions (Brude and Larsson, 2000). Injury accident rates for cyclists at roundabouts are up to fifteen times greater than for car occupants (Maycock and Hall, 1984). Large, unsignalled multi-lane roundabouts are generally the most hazardous and intimidating for cyclists. Some cyclists will seek to avoid them altogether, or may choose to dismount and walk across each arm.

9.7.3 Typical UK roundabouts (HA, 1993c) have entries and exits that are flared, with two or more lanes to increase vehicle capacity. Deflection may be less than desirable because of the constraints on the room available. The relatively smooth path for motor vehicles can result in high traffic speeds through the junction. Continental-style roundabouts (also known as compact roundabouts) have tighter geometry that is more cycle-friendly. They may be around 10–20 per cent safer for cyclists than signalised junctions (TRL, 2001) serving the same vehicle flows. As the geometry encourages lower speeds, cyclists generally pass through the roundabout with other traffic. Motorists are unlikely to attempt to overtake cyclist on the circulatory carriageway because of its limited width. These roundabouts can cope with flows of up to 8,000 vehicles per day (1,000 per peak hour) (Schoon and Minnen, 1994).

9.7.4 Continental-style roundabouts have arms that are aligned in a radial pattern, with unflared, single-lane, entries and exits, and a single-lane circulating carriageway. Deflection is therefore greater and the design is widely used as a speed reducing feature in mainland Europe. Technical details for continental and typical UK roundabouts are summarised in TAL 9/97 *Cyclists at Roundabouts – Continental Design Geometry* (DETR, 1997b).

9.7.5 A central island of between 20 metres and 40 metres diameter usually provides the best geometry (Brude and Larsson, 2000) for this type of roundabout. Diameters below 20 metres often provide a sufficiently straight driving path for traffic to maintain higher speeds, and diameters exceeding 40 metres can encourage higher circulating speeds.

9.8 Safety at roundabouts

9.8.1 Keeping well to the nearside on the circulatory carriageway is the typical approach adopted by less confident cyclists, but this puts them in the most hazardous position for being hit by vehicles entering or leaving the roundabout. They are less visible to motorists entering the junction, and this is where most conflicts occur.

9.8.2 Where feasible, roundabouts on cycle-friendly routes should be designed for lower vehicle speeds to allow cyclists to take up a position in the centre of the circulatory carriageway, where motorists are most likely to see them. Lower speeds also help pedestrians crossing the arms.

9.8.3 Entry and exit lanes that are aligned to be more radial than tangential to the circulating carriageway help reduce vehicle speeds by creating greater deflection. Single-lane entries and exits ensure that sightlines are not obscured by other vehicles and prevent drivers from taking a "racing line" through the roundabout.

9.8.4 In areas of frequent traffic congestion, cycle lanes on the approach and departure arms (but not the actual circulatory carriageway) can be useful. Cycle lanes on the circulatory carriageway are far less straightforward and are covered in Section 9.10

9.8.5 Excessive visibility to the right for motorists entering a roundabout can result in high speeds on entry. Where this is a problem, drivers can be slowed by installing sight screens to the right of entry lanes to reduce visibility (see Figure 9.10). However, care is required to avoid this making cyclists on the circulatory carriageway more vulnerable to vehicles entering the junction.

Figure 9.10 Visibility to the right reduced by sight screens (Alex Sully)

9.8.6 A circulatory carriageway of around 5–6 metres wide will discourage most motorists from attempting to overtake cyclists. In general, an outside carriageway diameter of 30 metres will accommodate the largest typical vehicle (Brilon and Vendehey, 1998).

9.8.7 A overrun apron around the central island can offer a tighter geometry for cars by increasing the island's effective diameter, while still allowing larger vehicles to use the junction (also see Section 5.4). To be most effective, it should be slightly raised and/or textured, but hatching is sometimes used.

9.9 Large roundabouts

9.9.1 It is not usually possible to achieve sufficient deflection at multi-lane roundabouts when traffic flows are light, because motorists can straighten their path through the junction by using more than one lane. If such a situation is causing problems for cyclists, the following design questions need consideration:

- Can an alternative, relatively direct route be provided for pedestrians and cyclists to avoid the junction altogether?
- Would the roundabout still have enough capacity if it were to be reduced to single-lane operation?
- Is there scope for reducing individual entries or exits to single lane operation?
- Can the roundabout be signalised?

9.9.2 Accidents involving cyclists can be reduced by around 70 per cent on roundabouts with full-time signals on all or some of the arms (*Local Transport Today*, 2005; TfL, 2005; Lines, 1995).

9.9.3 If none of the above is practicable, it may be worth introducing peripheral cycle tracks, possibly with Toucan crossings on the arms. Peripheral cycle tracks offer a safe alternative, but they add considerably to the journey time and effort involved.

9.10 Cycle lanes on roundabouts

9.10.1 The idea of marking cycle lanes on roundabouts may appear, at first glance, to be a relatively simple one, but it is not. Cycle lanes on roundabouts must be very carefully considered. There is little evidence to suggest that they offer any safety benefit to cyclists, and they may introduce additional hazards. Some cycle lanes on roundabouts have been removed because they led to a deterioration in the accident rate.

9.10.2 Designers should first decide how the lanes are intended to benefit cyclists and then balance this with the problems they can give rise to. It is possible that annular nearside cycle lanes can highlight the presence of cyclists on the roundabout, but against this is the risk that cyclists using the lanes may be taking up an inappropriate position, particularly near exit arms. To a driver, it may appear that a cyclist approaching an exit arm in such a lane intends taking that exit because of his position in the circulatory carriageway. If the driver intends to leave at the same exit, he may attempt to overtake and be confronted with the cyclists turning across his path. On busy roundabouts, it is important that the cyclist takes up a prominent position nearer the centre of the carriageway to ensure that drivers understand the intended manoeuvre, and, for this reason, annular lanes are not generally recommended.

9.10.3 An innovative roundabout at Heworth Green in York (Pheby, 2004) (see Figure 9.11) has wide cycle lanes, a reduced circulatory carriageway width, tight geometry and a smaller outside diameter than conventional roundabouts. It has led to a decrease in cycle casualties at the site. The lanes only position a cyclist close to the perimeter when he or she intends leaving at the next exit – otherwise, the cyclist is positioned away from the perimeter. The success of

Figure 9.11 Roundabout with innovative cycle lane arrangement (Patrick Lingwood)

the York design might in part be attributed to the large volume of cycle traffic using the junction, but it illustrates how the intelligent use of lane markings can help guide cyclists away from conflict points.

9.11 Mini-roundabouts

9.11.1 Mini-roundabouts share many characteristics with other roundabouts, the major difference being that the central island is replaced by a circular road marking between 1 metre and 4 metres in diameter. In some cases, the marking is placed on a shallow dome (max. height 125 mm) to encourage drivers to pass around it rather than over it. Mini-roundabouts can be fitted into a smaller space than priority junctions require. Further guidance is given in *Mini roundabouts – good practice guidance* (DfT/CSS, 2006).

9.11.2 Mini-roundabouts do not generally carry much higher risk to cyclists than signalised junctions (Kennedy and Hall, 1997). They can be used as a speed-reducing feature, but they require adequate deflection on all arms to achieve this. In Figure 9.12 a raised table and overrun areas with textured surfaces have been used to reduce speeds and encourage lane discipline at a spacious junction where drivers might be tempted to cut the corners. A mini-roundabout allows cyclists to make right turns with relative ease, compared with a priority junction.

Figure 9.12 Mini-roundabout, raised junction and textured surfacing (Patrick Lingwood)

10 Cycle track crossings

10.1 Introduction

10.1.1 LTN 1/95 *The Assessment of Pedestrian Crossings* (DoT, 1995a) describes the procedures for assessing pedestrian crossings, and similar considerations may be applied to cycle track crossings. The following site characteristics are taken into account:

- location;
- visibility;
- complexity;
- crossing traffic (e.g. cyclists, pedestrians, or both);
- vehicle flows and speeds;
- road accidents.

10.1.2 When deciding on the most suitable type of crossing, the following factors need to be considered:

- current difficulty of crossing;
- potential delay to traffic using the road;
- potential delay to cyclists crossing the road;
- road capacity;
- correspondence from interested parties;
- installation costs;
- operating costs.

10.1.3 The potential options are:

- do nothing;
- provide a crossing where the carriageway has priority over the cycle track;
- provide a crossing where the cycle track has priority over the carriageway (but see below);
- provide a signalised crossing; or
- provide a grade separated crossing.

10.1.4 If traffic flows and speeds can be reduced, a simple crossing facility may be all that is needed. Such an approach might also address road safety issues at the site.

10.1.5 Table 10.1 is indicative of the appropriate treatments for a stand-alone crossing of a two-way carriageway. It is a guide only, and individual locations should be assessed on a case-by-case basis.

Table 10.1 Crossing types

85th percentile speed	Traffic flow (two-way daily)	Type of crossing
< 50 mph	<6,000	Cyclists give way to road traffic
< 50 mph	< 50 mph	Cyclists give way to road traffic plus central refuge – urban
< 60 mph	<10,000	Cyclists give way to road traffic plus central refuge – rural
< 50 mph	>8,000	Signal controlled, including Toucans
> 50 mph	>8,000	Grade separated crossing – urban
> 60 mph	>10,000	Grade separated crossing – rural

10.2 Cycle track crossings on links

10.2.1 The simplest form of cycle crossing is where a track meets the road at a dropped kerb. Figure 10.1 shows a typical layout. Where it is not clear to cyclists approaching the crossing that they are about to meet a road, it may be worthwhile adding markings (and possibly signs) to indicating that they give way.

10.2.2 If the road has a speed limit of 30 mph or less, the crossing may be placed on a flat-topped road hump. If so, it needs to be made quite clear to cyclists that they must give way. Markings may need to be supplemented by signs on the cycle track. A coloured surface may also be useful when the crossing is placed on a road hump.

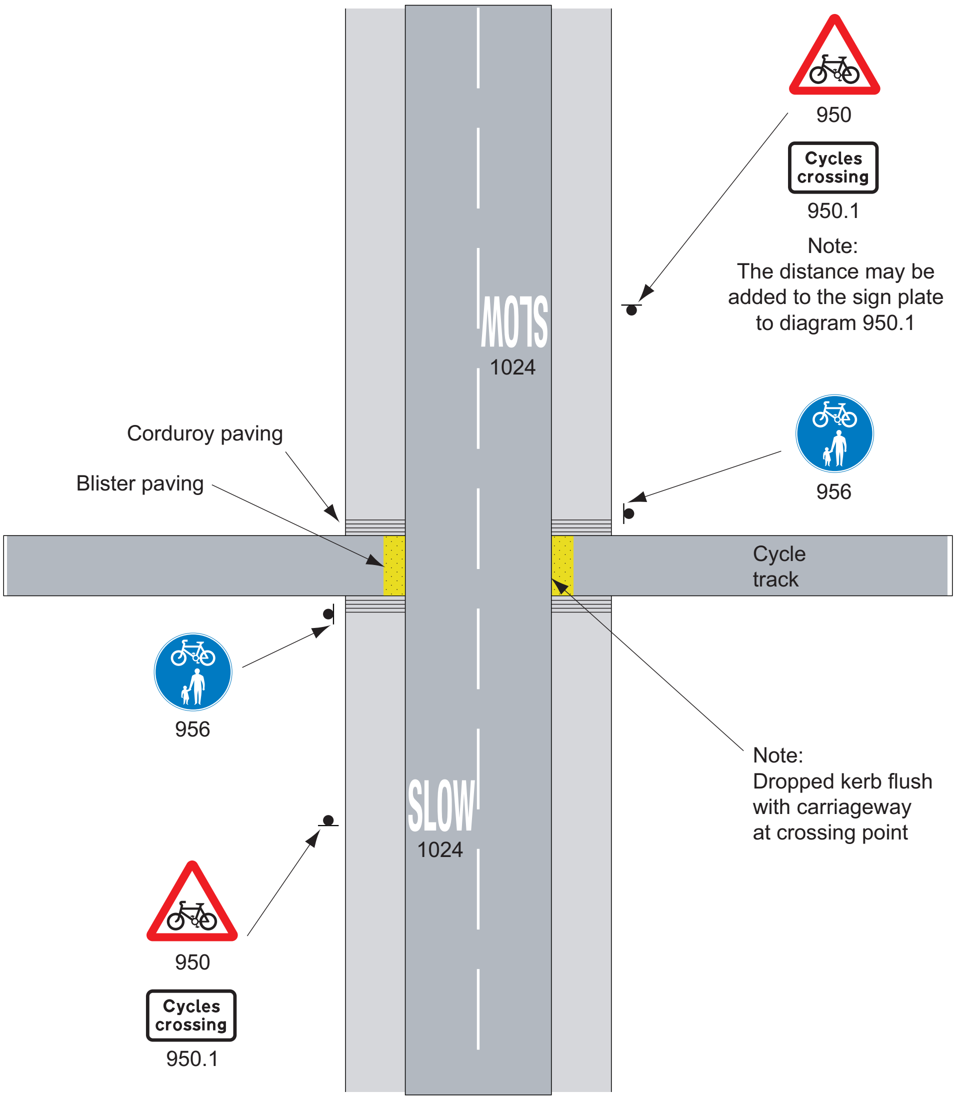

Figure 10.1 Typical cycle crossing

10.2.3 It is possible to give a cycle track priority over the road being crossed, but this approach needs careful consideration, because of the potential consequences of a driver failing to recognise the need to give way. GIVE WAY markings (diagrams 1003 and 1023) should be accompanied by GIVE WAY signs (to diagram 602). Cycle priority crossings can only be used on a road hump/speed table, and it is important that the arrangement provides good intervisibility between drivers and cyclists. Figure 10.2 shows a typical layout.

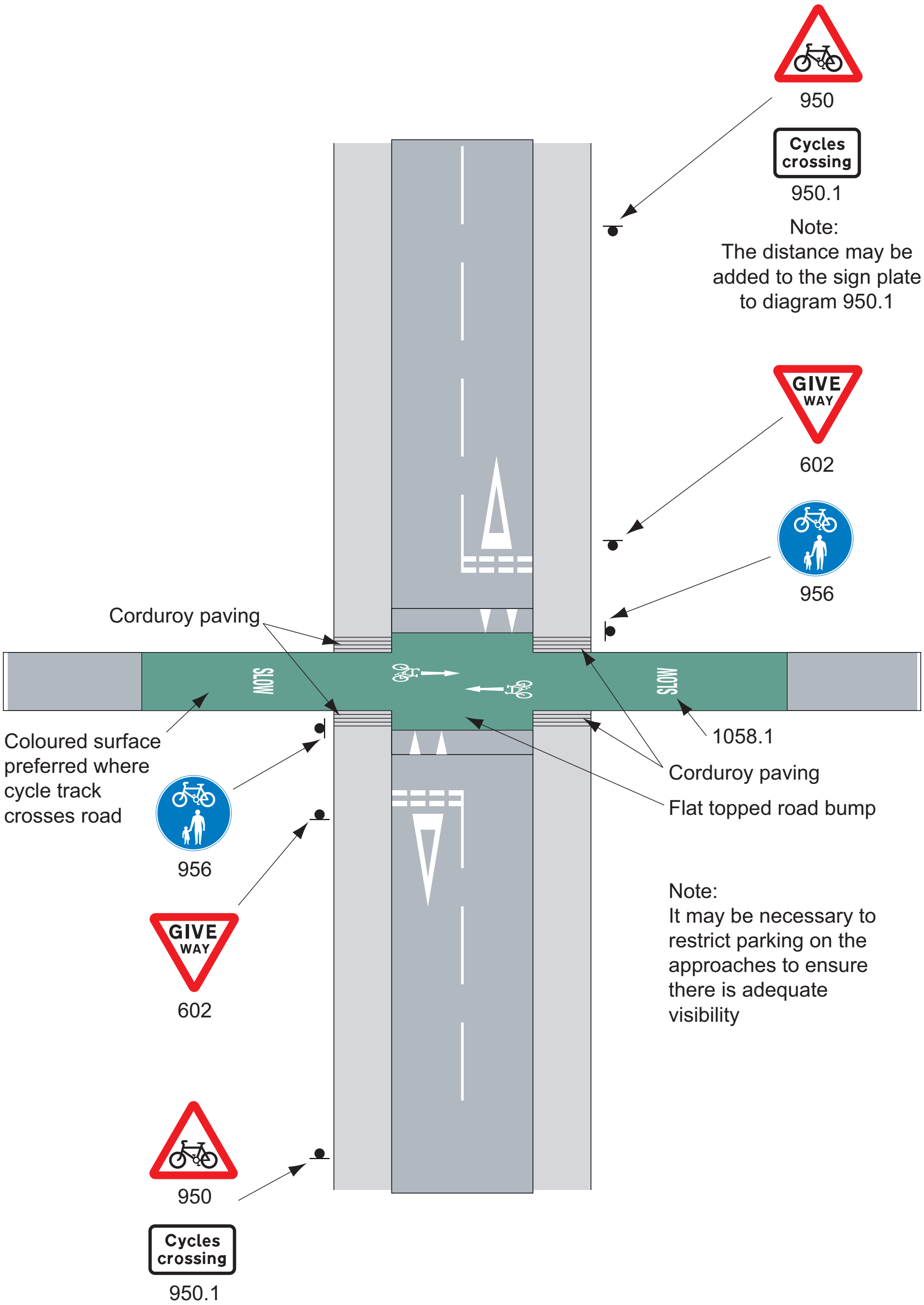

Figure 10.2 Typical cycle priority crossing

Figure 10.3 Cycle priority crossing over quiet road. Note that the sign to diagram 602 is incorrectly positioned (Rob Marshall)

10.2.4 Cycle priority crossings are best suited to quieter locations (see Figure 10.3) and where flow along the cycle track exceeds flow along the road. Note that, in this example, the sign to diagram 602 is incorrectly positioned. It should have been placed about 1 metre or so closer to the camera, so that it is sited just upstream of the give way marking to diagram 1003.

10.2.5 Justification for priority crossings is not straightforward, because the situations where they work best tend to be those where they are least needed. Designers should therefore consider whether a non-priority crossing on a road hump might be a better solution. In such situations, cyclists would generally be able to cross without stopping anyway.

10.2.6 Where cycle routes cross roads with speed limits above 30 mph or where vehicle flows are high, it can be difficult to find an adequate gap in the traffic to cross the carriageway in one movement. A central refuge allows crossing to be undertaken in two easier movements, but the arrangement needs to be carefully designed to avoid the refuge creating pinch-points that can disadvantage cyclists using the carriageway.

10.2.7 The crossing should be wide enough for pedestrians and cyclists to conveniently pass each other, and preferably not less than 3 metres (HA, 2005a), especially where family groups are likely. The central refuge should be at least 2 metres deep to ensure that a typically sized bicycle does not encroach upon either carriageway. A depth of 3 metres will accommodate a cycle towing a trailer, or a tandem.

Figure 10.4 Jug-handle turning at busy non-priority crossing (Patrick Lingwood)

10.2.8 A straight line crossing is generally preferred, as central sheep-pen refuges increase the potential for conflict with pedestrians. Also, in practice there is often insufficient width available for these refuges to accommodate the swept path of a tandem or a cycle towing a trailer turning into them. If the crossing is signalised, then, depending on traffic conditions, it may be appropriate to allow cyclists to cross both carriageways in one phase. This enhances route continuity and coherence for pedestrians and cyclists. It may be particularly useful on a busy cycle route linking, say, a town centre and an adjacent development separated by an inner ring road.

10.2.9 Where cyclists travelling along a busy carriageway need to turn right to join a cycle track on the opposite side, it may be appropriate to get them to the central refuge via a jug-handle turning on the nearside (see Figure 10.4). This gives them a safe waiting area away from moving traffic and provides good visibility for crossing the carriageway.

10.3 Cycle track crossings near junctions

10.3.1 When travelling along links, cyclists often feel safer on a track than on the carriageway itself, and tracks are particularly attractive to new cyclists. However, cycle tracks alongside carriageways can be problematic where they cross the mouths of side roads. Frequent side road crossings are inconvenient because cyclists generally have to slow down or stop at each side road. The crossings point may also be blocked by vehicles waiting to join the main road.

10.3.2 Of more concern is the potential for conflict between cyclists and motor vehicles. It can be difficult for cyclists to take in traffic approaching on the main carriageway as well as the side road itself. They need to look directly to their left and right, and ahead and behind along the main carriageway, before deciding whether they need to stop or not. This can make crossing hazardous, particularly for younger cyclists who may find it difficult to judge speeds and anticipate the movements of other vehicles.

10.3.3 In addition, drivers turning into or out of a side road may focus their attention on vehicles on the main road. In doing so, they may fail to notice cyclists approaching the side road crossing point. This is further complicated by two-way cycle flow. Cycle tracks parallel to the carriageway tend to be used in both directions, and drivers may not anticipate this. In particular, drivers turning right from a main road into a side road may not notice cyclists on the track to their right travelling in the same direction.

10.3.4 A report into cycle tracks crossing minor roads (Pedler and Davies, 2000) concluded that "the risk (of crossing the minor road) must be weighed against the risks to cyclists using the major road. The safer option will depend on a variety of site-specific factors. If satisfactory crossings of minor roads cannot be provided, the creation of a cycle track may not be a sensible option".

10.3.5 Good intervisibility between vehicles on the main road and cyclists on the track is essential to enable drivers wishing to enter the side road to judge the speed and positioning of cyclists. Drivers on the main road should be able to see the crossing and cycle track approaches well in advance of the junction.

10.3.6 Crossings can be modified to mitigate hazards to cyclists and pedestrians. Possible modifications include localised carriageway narrowing with tight kerb radii, and placing the crossing on a flat-topped road hump (see paragraph 10.2.2). Where the crossing is placed on a road hump, it may be better if it is "bent out". Figure 10.5 shows such an arrangement – in this case, a cycle-priority crossing is shown.

Figure 10.5 Bent-out cycle track crossing (Alex Sully)

10.3.7 On a bent-out crossing, the cycle track approaches are deflected away from the main carriageway to create a gap of one or two car-lengths between the main road and the crossing. A gap of about 5 metres is required to accommodate one car. The arrangement allows drivers turning into the side road extra time to notice the crossing and provides somewhere for them to stop for crossing cyclists without obstructing traffic on the main road. It also allows a vehicle waiting to exit the side road to do so without blocking the crossing point.

10.3.8 These crossings can operate safely, but designers need to keep their potential for conflict in mind before deciding on whether to cater for cyclists on a parallel cycle track. If there are several side road crossings within a short distance, or where two-way flows on the side road can exceed 100 vehicles per hour, it may be better to keep cyclists on the carriageway.

10.4 Cycle track with cycle lane at side road crossing

10.4.1 As a result of concerns over the safety of parallel cycle tracks crossing side roads, it is becoming common European practice to reintroduce cyclists to the main road in advance of a junction. Cyclists pass the junction on the carriageway and then rejoin the cycle track.

Figure 10.6 Cycle track transition to with-flow cycle lane (Patrick Lingwood)

Figure 10.7 Traffic light at end of cycle track (Rob Marshall)

10.4.2 Cyclists join the road in line with the main flow on build-outs ramped to carriageway level (see Figure 10.6) and use an advisory cycle lane that continues past the junction until it rejoins the cycle track. If a build-out is not possible, the cycle track may need to give way where it joins the carriageway

10.4.3 The advantage of this arrangement is that it gives the cyclist unambiguous priority at the junction. The solution precludes two-way use of the cycle track. The merge onto the carriageway should be at least 30 metres from the junction to reduce the risk of conflict with left-turning traffic.

10.5 Signal-controlled crossings

10.5.1 Where a cycle track enters a signal-controlled junction, cyclists can be provided with a dedicated phase in the signalling sequence (see also Section 9.3). If the track is used solely by cyclists, with pedestrians catered for elsewhere, the signal aspect to diagram 3000.2 can be used (see Figure 10.7). Note that, in this particular arrangement, pedestrian flow across the cycle track should also be controlled by signals, although the example shown does not make this clear. It may be necessary to have a back-up push-button unit for cyclists. This will require authorisation.

10.5.2 A Toucan crossing is a signal-controlled crossing for pedestrians and cyclists (see Figure 10.8). Detailed advice on the design of Toucan crossings is given in LTN 2/95, *The design of pedestrian crossings* (DoT, 1995b). Toucan crossings can use nearside or far side pedestrian/cyclist signals (but not a combination of both), and may be installed at junctions or as stand alone crossings. If the footway and cycle track on the approach to the Toucan are segregated, segregation should stop short of the waiting area (which should be shared use). If a nearside signal aspect for pedestrians and cyclists is used, it must be positioned so that users look towards approaching traffic when looking at the signal. Nearside signal aspects on Toucan crossings can often be obscured by waiting pedestrians. A second, higher-level signal on the near side may be useful at busy crossings.

10.5.3 Staggered or split crossings are not generally recommended for cyclists, because they can cause delay to people crossing and give rise to potential conflict between cyclists and pedestrians, but in some locations they may be the only practicable design solution. Refuges at staggered

Figure 10.8 Toucan crossing with central refuge and nearside aspects (Alex Sully)

Figure 10.9 Two-way cycle track leading to a parallel crossing (Rob Parsey

Figure 10.10 Cycle bridge suspended from a railway viaduct (Tim Pheby)

crossings should be at least 2 metres wide between barriers to accommodate cyclists, and the stagger should be arranged so that users are facing oncoming traffic on the lane that they are about to cross.

10.6 Parallel crossings

10.6.1 When separate pedestrian and cycle routes meet to cross a road, a parallel crossing may be appropriate (see Figure 10.9). This is especially useful in places where there are relatively high cycle and pedestrian flows across the road.

10.7 Grade separated crossings

10.7.1 Grade separated crossings for pedestrians and cyclists comprise foot/cycle bridges and pedestrian subways adapted for cycle use. In heavily trafficked situations, they can be safer than other types of crossing, but they increase crossing distances and require the use of ramps and stairs. Grade separated crossings should be reasonably direct, with good sight lines throughout. These facilities should be light, open and well maintained. The relative isolation of some bridges and subways can give rise to personal security concerns.

10.7.2 Grade separated crossings are considerably more expensive than surface crossings and may require land-take as well as special drainage arrangements. They are rarely the preferred option, except at high-risk sites on major roads.

10.7.3 Plans to convert existing subways, bridges and tunnels to shared use should not unduly inconvenience pedestrians. The crossing should ideally be as safe and attractive as its at-grade equivalent, to help ensure it will be used. Sometimes existing canal, river or railway bridges and tunnels can provide opportunities to create attractive grade separated crossings (see Figure 10.10).

10.7.4 Where a new road scheme is to feature grade separated crossings, the need to acquire sufficient land should be considered in the early planning stages.

10.8 Ramp gradients and parapet heights

10.8.1 Ramps must accommodate the needs of wheelchair users and other disabled people. A gradient of 5% is optimum for limiting route distance while ensuring the ramp is easy to climb. The generally preferred gradient is therefore 5 per cent, with 8 per cent as the absolute maximum (DfT, 2002). However, shallower gradients can be used where the ramp is on the desire line, such as where a footpath alongside a road is gently raised to footbridge level. Individual flights must not exceed 10 metres, and intermediate resting places should be at least 2 metres long. Stepped ramps are not recommended because of the problems they create for wheelchair users and people with impaired mobility.

10.8.2 Bridges for cyclists should ideally have a parapet height of 1.4 metres (1.8 metres if also providing for equestrian use). On existing structures this cannot always be achieved, but it should not necessarily preclude their use as crossings for cyclists.

10.9 Wheeling ramps alongside steps

10.9.1 Where cycle routes are introduced onto routes originally designed mainly for pedestrian use only, such as canal towpaths or railway footbridges, flights of steps are sometimes unavoidable. To assist cyclists, wheeling ramps may be added to one or both sides of the flights using steel sections or by forming them in concrete. A channel 100 mm wide and 50 mm deep is generally suitable (see Figure 10.11).

10.9.2 Wheeling ramps should not obstruct convenient access to the handrail nor be located in the centre of the steps where they might form a trip hazard. In most cases the ramp is fitted to one side, usually on the right for people climbing.

10.9.3 Locating the wheeling ramp close to the wall minimises the trip hazard for pedestrians, but this reduces convenience for cyclists as the bicycle needs to be supported at more of an angle (see Figure 10.12). This is made more difficult if pannier bags are fitted.

10.9.4 Ideally for cyclists, the distance between the ramp and the wall should be enough to ensure that the pedals and handlebars do not clash while the bike is being held reasonably vertically, but the actual position will depend on site-specific conditions such as the width of the stairs, the hand rail arrangement, and the amount of pedestrian flow.

10.9.5 Steel sections should ideally have a non-slip surface so that the tyres grip the ramp on descent. Fixing arrangement should not involve bolt heads etc protruding into the running surface as they may damage the tyres. Where the wheeling ramp is formed in concrete it may be preferable to fill in the gap between the ramp channel and the wall.

Figure 10.11 Channel section wheeling ramp fitted to existing footbridge (Adrian Lord)

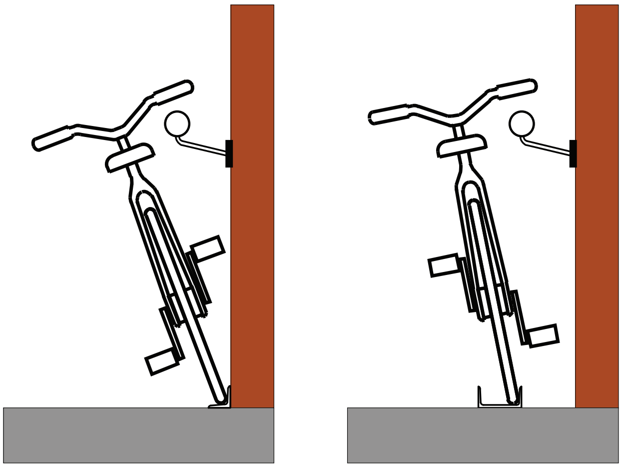

Figure 10.12 Typical wheeling ramp installations

10.10 Headroom and width

10.10.1 New subways for use by cyclists ideally require headroom of 2.4 metres (2.7 metres for lengths over 23 metres) and widths of at least 5 metres to minimise the potential for conflict between cyclists and pedestrians (HA, 1993d). New bridge decks and ramps should also be sufficiently wide to accommodate segregation if necessary. Typically, a minimum width of 4 metres is required in urban applications, while on lightly used off-road routes in rural areas 2-metre wide bridge decks may be acceptable.

10.10.2 The headroom in existing pedestrian subways is typically 2.3 metres, and routes under canal bridges often have less clearance. The restricted height or width available should not lead to automatic rejection of a proposal to permit cycling. It may represent the best available option if potential risks to users can be managed.

11 Cycle parking

11.1 Locations for cycle parking

11.1.1 Good-quality cycle parking is a key element in developing a cycle-friendly environment. The absence of secure, convenient cycle parking can be a serious deterrent to cycle use. Cycle parking should be provided at major destinations, public buildings, schools and colleges, hospitals, large employment sites, public transport interchanges and leisure attractions (Figure 11.1). Parking should also be provided at local journey attractors such as parades of shops, health clinics, supermarkets and leisure venues such as cinemas and theatres (Figure 11.2). Space for cycle parking within residential areas is also important, as it can be a major factor affecting the decision to own a bicycle.

11.1.2 Proximity to the destination is the major influence on a cyclist's choice of where to park (Taylor and Halliday, 1997), regardless of the journey purpose. The use of the bicycle as a feeder to public transport can also be a valuable component of a strategy to encourage more people to cycle (Taylor, 1996). For long-stay parking at public transport and employment sites, security is a major factor when choosing whether or not to cycle. Location and level of security are the main issues to be addressed when considering the amount and type of cycle parking.

Figure 11.1 Cycle parking in town centre (Adrian Lord)

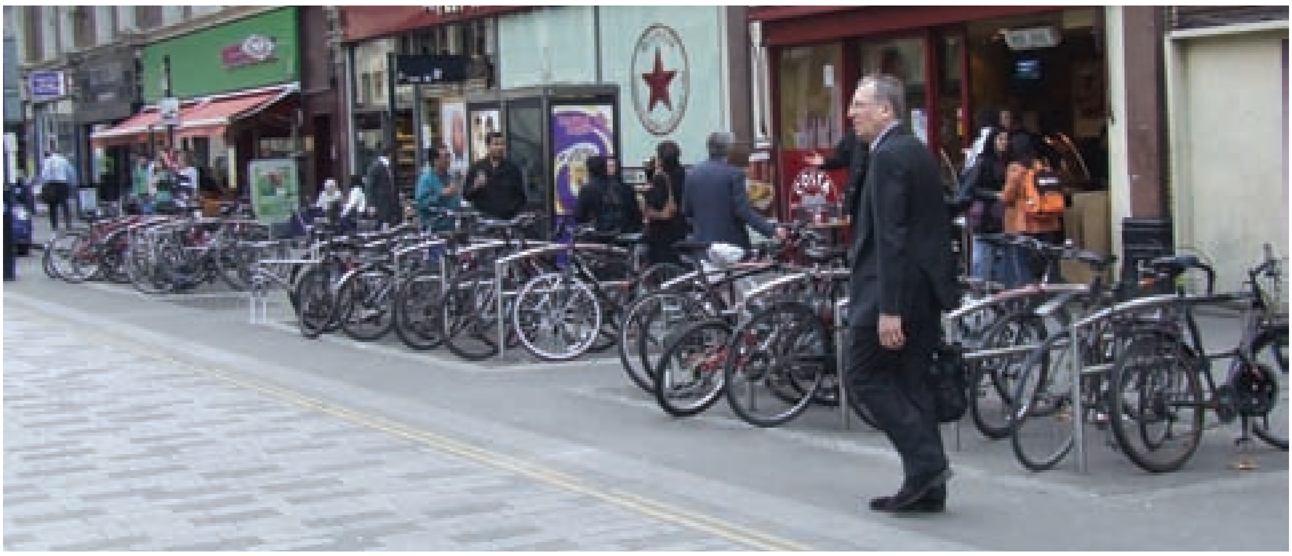

Figure 11.2 Cycle parking on a main street (Patrick Lingwood)

11.1.3 A count of the cycles locked to street furniture such as sign poles and railings can help to indicate sites where there is an unsatisfied demand for cycle parking and how many spaces are required. Where existing stands are regularly filled, consideration should be given to increasing parking provision.

11.1.4 New cycle parking facilities should meet existing demand, with some capacity for future growth. Local authorities may monitor the use cycle parking stands to ascertain demand and provide additional places where necessary. Regular monitoring may also enable under-used stands to be identified and relocated, and abandoned cycles identified for removal.

11.2 Residential cycle parking

11.2.1 Cycle parking for residents and visitors is covered in detail in the *Manual for Streets* (DfT/CLG, 2007). This will generally mean covered secure cycle parking within a building, garage, garden shed or a communal area with restricted access. Cycle parking stands for visitors are also useful at flats, sheltered accommodation and student residences.

11.2.2 Ground-floor storage space within the curtilage of a house is also valuable for people with pushchairs and wheelchairs and may help to encourage walking journeys. The choice of transport mode for short urban journeys depends on minor differences in time and convenience, and the difference between car and cycle is often marginal (DTLR, 1999d). The presence of a cycle ready and available at the front of a house, rather than locked away at the back, can therefore be a significant factor in cycle use. In some developments in the Netherlands, parking space for cars is deliberately designed out of residential forecourts, so that cars have to be parked in less convenient locations.

11.2.3 Chapter 8 of the *Manual for Streets* (DfT/CLG, 2007) gives further advice on cycle parking.

11.3 On-street cycle parking

11.3.1 Part IV of the Road Traffic Regulation Act 1984 allows for the provision of off-street parking places for vehicles and authorises the use of any part of a road as a parking place. These powers are extended by Section 63 of the Act to allow provision "in roads and elsewhere of stands and racks for bicycles". A single Order under the Act can be used to cover cycle parking in the whole of an administrative area. However, all the individual sites must be set out in an accompanying Schedule.

11.3.2 In vehicle-restricted areas, section 115B of the Highways Act 1980 (inserted in Schedule 5 of the Highways Act 1982) enables a local authority to place objects or structures on a highway to provide a service for the benefit of the public or a section of the public. Where pedestrianised areas have been introduced under section 249 of the Town and Country Planning Act 1990, this also gives local authorities the powers to place objects or structures on the highway.

11.3.3 If waiting and loading restrictions are in force, bicycles (like other vehicles) may not be legally parked on the carriageway or the footway, unless exempt from the Order.

11.3.4 There is usually a compromise between convenience for cyclists and the needs of other road users, but cycle parking areas should not present a hazard to pedestrians, especially to blind or partially sighted people or place users in danger from motor traffic. Cycle parking should always be designed into plans for urban regeneration or remodelling of town and city centres.

11.4 Cycle parking equipment

11.4.1 The Bike Parking and Security Association offers guidance (BP&SA, 2003) for the quality manufacture and installation of cycle parking equipment to be used in the public domain. The criteria for the provision of suitable cycle parking facilities extend beyond the design and construction of individual units. This includes such factors as location, overall layout design and integration with the surrounding environment.

11.4.2 The most popular and adaptable design is the Sheffield stand (Figure 11.3). It is simple and effective, being based on an inverted U-shaped metal tube. The Sheffield stand is widely acknowledged as being the most convenient design for general on-street bicycle parking and is recommended for most parking applications (DETR, 1997a). The stands are easy to install and provide a high level of security when combined with a quality cycle lock. If the stands are installed under shelters (as in Figure 11.4) or within secure-access buildings, design criteria for good long-stay cycle parking can also be met.

11.4.3 There are many variations on the basic Sheffield stand. The most useful one has an additional crossbar, which provides extra security and support for smaller bicycles. The crossbar also acts as a low-level tapping rail for visually impaired people (see Figure 11.3). In a row of stands, the end stands should be fitted with a tapping rail. Other variants include features to help prevent the front wheel from turning, and "M" shaped Sheffield stands that offer a greater variety of locking points. "Toast-racks" of Sheffield stands, comprising usually three or five stands joined together, are easier to install, but some designs where the ground level bar is constructed of the same tube as the racks can be less convenient to use. Stands can be supplied in a variety of designs to tie in with other street furniture and finished in plain galvanised steel, a range of powder coated colours or with a durable plastic coating, which is less likely to damage paintwork. Stands can either be set into concrete footings to a depth of 300 mm or bolted to the surface of paved or tiled areas using security bolts.

11.4.4 The usual dimensions are: length 700–1000 mm (700 mm recommended); height 750mm (+/– 50 mm); tube diameter 50–90 mm (larger diameter is more secure, since there is less space to lever apart "D-type" locks); corner radii 100–250 mm. Stands placed 1000–1200 mm apart will accommodate two bicycles on each stand. The ends of stands should be 600 mm clear of walls and kerbs to allow for the bicycle wheels. A stand placed parallel to a wall or kerb should be at least 300 mm from the wall to allow use on one side only, or 900 mm to allow use of both

Figure 11.3 Sheffield stand with tapping rail and contrasting banding at beginning of row (Tony Russell CTC)

Figure 11.4 Covered on-street parking (Rob Marshall)

sides. A bike-length of clear space in front of the stand is required to enable cyclists to wheel their bikes into place.

11.4.5 Sheffield stands can be equally attractive to motorcyclists. If they are using stands intended for cyclists, it may be worthwhile providing additional motorcycle parking nearby.

11.4.6 Wall loops, bars and locking rings can be used to provide a space-efficient parking arrangement where bikes are leaned against walls (see Figure 11.5). They are best suited to short-stay parking needs and located where passing surveillance and/or CCTV enhances security. Designs are typically simple rings and bars.

11.4.7 Loops or bars 600–750 mm from ground level will be close to the top tube of a conventional adult bike. They should project no more than 50 mm from the wall and be spaced at intervals of at least 1800 mm to prevent cycles from overlapping. Local authorities will need to seek agreement with private owners to attach such devices to walls adjacent to the highway boundary if they do not own the boundary wall.

11.4.8 Designs such as double-decker stands (see Figure 11.6) and vertical hangers may be wall-mounted or free-standing. Some are spring-loaded or fitted with gas struts to make lifting easier. Most devices for commercial use can be fitted with locking bars to enable use in public places. Double-decker stands typically require a ceiling height of at least 2.7 metres and sufficient space in front of the stands to enable the bike to be loaded on to the stand. Fixing the stands at an angle of 45 degrees can help to minimise the aisle width between rows of stands if space is tight.

11.4.9 Cycle lockers enable bags, battery lights and other accessories to be left on the cycle while it is parked. Lockers provide weather protection and additional storage space for helmets, panniers and clothing. Several locking options are available, including keys and padlocks, smart cards and number keypads. As lockers can be visually intrusive, they are not appropriate for all locations.

11.4.10 Lockers for public use (see Figures 11.7 and 11.8) and other secure cycle parking facilities (see Figure 11.9) often require some form of supervision and management to prevent abuse or vandalism or to meet the security requirements for public transport interchanges. They are best suited to staffed locations or places where there is a lot of public activity, such

Figure 11.5 Rings or wall bars can provide low-cost unobtrusive cycle parking (Patrick Lingwood)

Figure 11.6 Spring-assisted stacking cycle rack (Tony Russell CTC)

Figure 11.7 Lockers and stands in town centre (Adrian Lord)

Figure 11.8 Cycle stands including storage for helmets and other accessories (Rob Marshall)

as the ground floors of multi-storey car parks, railway stations or large workplaces. Lockers typically have a capital cost more than five times as much per bike space as a Sheffield stand, as well as the ongoing management cost, but this cost may be recovered if they can be commercially rented. The panels may also offer opportunities to rent advertising space.

11.4.11 Some cyclists are prepared to pay a reasonable charge (DETR, 1997b), although inconvenient administration arrangements or poor choice of site will deter potential users. Some manufacturers offer a master key or over-ride system to enable lockers at rail stations and airports to be opened by security staff. It is common practice in the Netherlands for locker space or other secure cycle parking at stations to be booked either online or using a mobile-phone-based payment system or a smart card such as a public transport pass. This enables the same locker to be used by many people rather than just a single key holder, but at the same time provides the operator with a record of who is using a locker in the event of a security incident. Similar schemes are being introduced in the UK.

Figure 11.9 Secure pay-as-you-go cycle park (Adrian Lord)

Figure 11.10 Cycle parking, sales, hire and repair centre (Adrian Lord)

11.5 Cycle centres

11.5.1 Cycle centres are common in the Netherlands, where they typically provide space for between 1100 and 4000 bicycles. There is usually a full-time attendant staffing the facility. The cost of the facility may need to be subsidised by the local authority, as there is limited potential for it to be commercially viable on its own. Centres offer secure and convenient parking and usually a range of other services, including cycle hire, sales, repairs and local and tourist information (see Figure 11.10). A newsagent shop or café may be included as part of the business to enhance viability.

11.6 Cycle parking site considerations

11.6.1 The following is a summary of good practice based on a comparison of cycle parking provision in a number of mainland European railway stations (Sully, 1998). Specific advice to train operating companies is available in *Bike and Rail Policy 2006* (DfT, 2006).

- Parking facilities should be easy to find and as close to destinations as practicable. Numerous small clusters of stands in a town centre are generally preferable to one large parking area. If stands are under-used in any particular position, they can be relocated to areas of higher demand if appropriate.
- Parking facilities should be fit for purpose and easy to use. Stands that support the cycle by gripping the front wheel alone should be avoided, because of the damage they can cause (this does not apply where the cycle is suspended vertically by the front wheel). Stands should have sufficient space around them to ensure they are convenient to gain access to (parallel stands should be at least 1 metre apart, for example). Stands that require cycles to be lifted are generally not preferred, although, where room is limited, they may be necessary and appropriate.
- The appearance of a cycle parking facility should be appropriate to its surroundings. Abandoned cycles should be promptly removed to preserve the appearance and capacity of parking provision.
- Cycle parking should not be sited in areas where it may give rise to personal security concerns, or where the stands or cycles parked in them can create trip hazards.
- Public transport interchanges, places popular with tourists and other such attractors should be provided with cycle parking facilities appropriate to demand. These locations may generate sufficient custom to sustain cycle centres providing cycle sale, hire and repair.
- Bicycles are usually secured with owners' locks, although some arrangements make this unnecessary. Where appropriate, owners should be able to secure the cycle frame. Public locking mechanisms such as coin-operated locks should be easy to understand and operate.
- Charges for lockers, staffed parking etc., should be minimised to encourage use. Payment/registration processes should be as simple as possible. Automated carousels or smart card operation should not create delays at peak periods.
- Long-term parking for regular users should ideally be placed within a secure access area and protected from the weather. The level of weather protection for other parking should be appropriate for the length of stay.

12 Public transport integration

12.1 Bike and ride

12.1.1 There is considerable scope for combining cycling with journeys on public transport such as a train, tram, coach or bus. Specific advice on bike and rail integration can be found in *Bike and Rail Policy 2006* (DfT, 2006). This section provides a summary of issues, but more detailed information on good practice is also available in *Bike and Rail: a Good Practice Guide* (CA/DfT, 2004). The combination of cycle and public transport overcomes many of the limitations of either mode, providing journey solutions that can offer a similar level of flexibility, convenience and speed to those of car journeys. For many journeys it offers benefits, such as being able to avoid the inconvenience and expense of trying to find a parking space, and the risks and health problems associated with long distance driving. A large proportion of the population lives within 5 miles (a 20-minute cycle ride) of a railway station. Bike–rail has good potential to replace car-centred commuting for longer journeys.

12.1.2 The basic bike and ride options are:

- riding to the bus/tram/train stop, leaving the bicycle securely parked and using public transport for the remainder of the journey; or
- riding to the stop, taking the bicycle on public transport and using it at the other end; or
- keeping an additional bicycle parked at the far stop (e.g. a city centre station) and using it to complete the journey.

12.1.3 Bike and ride is important in strategic transport planning because it allows quick and easy access to trams and trains and, in rural areas in particular, longer-distance bus and coach services. Cycling is typically four times quicker than walking, and journey times are often comparable to driving, so promoting cycle access can increase the catchment area of stops and stations – see *Bike and Rail: a Good Practice Guide* (CA/DfT, 2004).

12.2 Cycle carriage on trains

12.2.1 There is limited access to in-vehicle carriage of cycles on commuter routes during peak hours, although growing numbers of commuters overcome this problem by using folding bikes, which can be taken on almost all heavy and light rail services as hand luggage. General information is available in the National Rail Cycling by Train leaflet. Specific advice can be obtained from individual train operating companies.

12.2.2 Rail operators make various provisions for cycle carriage and allow its use at the conductor's discretion. Some bus and coach operators in England and Wales provide for limited carriage of bicycles, in some cases on external racks or trailers. Most heavy rail franchise agreements require that some dedicated provision is made for cycle carriage although presently this often amounts to only one or two cycle spaces per train.

12.2.3 Because of variations between operators and differing levels of provision offered by different rolling stock within the same operating company, good local information about what is available is important. Provision of "flexible space" inside vehicles can help to increase peak hour passenger loading while providing for cycle carriage during the off peak period.

12.2.4 Dwell times for heavy and light rail services are not usually affected by cycle carriage. Cycle access is facilitated and dwell times can be minimised if the cycle storage area is clearly marked on the outside of the train, ideally at a height that will not be obscured by passengers waiting to board. Dwell times are potentially an issue for cycle carriage on urban buses, but at present in the UK most bus services that carry cycles on external racks are on rural routes with greater distances between stops.

12.3 Routes to stations and stops

12.3.1 Many travellers might be prompted to cycle if the journey to a station or a stop is convenient and cycle parking facilities available. Depending on the service frequency and destinations served, a 20-minute cycling isochrone and a 10-minute walking one will define the areas in which to concentrate connecting routes to stations.

12.3.2 Local promotion of bike and ride may need to be aimed at communities and workplaces, using area maps or personal travel planning techniques. The duration of the whole journey will affect the likelihood of people using bike and ride. Bike and ride can be promoted as a healthy lifestyle option and a better use of time – for example, the "in-vehicle" element of the journey offers opportunities for reading and relaxation.

12.4 Cycle-friendly interchange

12.4.1 Secure long-stay cycle parking is required at multi-modal public transport interchanges, heavy rail stations, park and ride sites and principal bus and coach stations. There may also be opportunities to introduce long-stay parking facilities within the vicinity of well-used light rail and bus stops in some areas, and at the outer terminus of suburban heavy and light rail lines.

12.4.2 In stations, cyclists can benefit from ramps and lifts as an alternative to flights of stairs and, where these cannot be provided, wheeling channels on steps. Stations with automated ticket barriers also require a gated access that can be used by cyclists, wheelchair users and people with pushchairs and young children.

12.4.3 Cycle parking areas within the interchange should be clearly signed and sited in areas with high levels of passive surveillance such as platforms, concourses or near main entrances (see Figure 12.2). Where this is not possible, CCTV coverage may be required. There are specific security restrictions concerning the type and location of cycle parking permitted at some mainline railway stations.

12.4.4 Maps of the local cycle route network can be made available at information centres or displayed at the station, with routes clearly signed from the forecourt.

12.4.5 Busier stations offer potential for cycle centres offering secure parking, repairs and hire (see Chapter 11). There is also potential to develop low-cost cycle hire at key stations using automated pay-as-you-go systems (see Figure 12.3).

Figure 12.2 Clear signs to cycle parking at London Bridge station (Adrian Lord)

Figure 12.3 Automated cycle rental point at station (Adrian Lord)

12.5 Cycle and tram routes

12.5.1 Cycles are carried on some services on the continent (e.g. Basel, Strasbourg, Montpellier and street-running parts of Stuttgart), but at present UK light rail operators exclude non-folding bicycles (some even exclude folding bicycles if not bagged), so quality cycle parking provision is important.

12.5.2 There is limited experience of mixing cycles and street-running trams within the UK, but existing schemes have offered valuable lessons. Many of the factors that make a good cycle route, such as gentle gradients, quiet streets and direct routes to key destinations, also make good tram routes. This can give rise to clashes between existing cycle routes and proposed tram routes.

12.5.3 Provided there is sufficient space, the introduction of a new tram system may create an opportunity for funding to develop a high-quality cycle route superior to existing provision. This may be achieved by creating new off-carriageway routes and possibly reducing motor traffic in areas where trams use the carriageway. However, measures are still likely to be required to reduce problems for cyclists riding along tram routes.

12.5.4 Many new tram systems incorporate measures to alleviate such problems. These include Toucan crossings, provision for crossing at right angles to the tracks, and displaced cycle lanes at tram corners and kerbside stops.

12.5.5 Probably the most significant factor to consider is the difficulty for cyclists crossing tram rails at a narrow angle. No practicable material has been found to fill the gap to prevent cycle wheels from being deflected by the rails, but some skid resistance can be built in. Crossing rails at an angle close to 90 degrees is safer, but drivers may not expect this manoeuvre. Where space is available and conditions allow, offering cyclists a route where they can avoid crossing the rails is ideal.

12.5.6 Tram boarders, like bus boarders, are localised footway build-outs at stops to improve passenger access. At a tram stop, the build-out can deflect cyclists towards the nearside rail, making them cross it at a shallow angle. Signing and marking schemes with wide crossing angles have been used, but at less heavily used stops it may be worth considering allowing the cycle track to pass behind the boarder – see also Section 6.4. The potential for conflict between cyclists and passengers boarding or alighting the tram may make such a solution impracticable at busier stops.

12.5.7 Trams can be so quiet that a cyclist does not hear them coming against the noise of other traffic, and the tram cannot stop quickly enough if a cyclist crosses its path or fails to avoid it. Tram operators already include cycle awareness training for drivers, but published promotional material such as route maps should seek to educate cyclists about the particular dangers. Cycle training in areas with tram systems could include dealing with trams as part of its syllabus.

12.5.8 Further guidance on integrating cycle infrastructure with tram and light rail systems is given in *The Interaction of cyclists and rapid transit systems* (MVA Consultancy, 1998).

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Cycling England: www.cyclingengland.co.uk

Department for Transport: www.dft.gov.uk

Sustrans: www.sustrans.org.uk

Transport for London: www.tfl.gov.uk

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Cycle Infrastructure Design

Encouraging more people to cycle is increasingly being seen as a vital part of any local authority plan to tackle congestion, improve air quality, promote physical activity and improve accessibility. This design guide brings together and updates guidance previously available in different Local Transport Notes and other advice. It is hoped that, by bringing together relevant advice in a single document, this guide will make it easier for local authorities to decide what special provision, if any, is required to encourage more people to cycle.

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