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Designing for Walking

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1. Introduction

1.1 Overview

This document explains how facilities for walking should be designed, following on from how they are planned, which is covered in "Planning for Walking". Well-designed facilities that follow desire lines, are clutter-free, and are legible to all users will assist in enabling walking journeys and improve the experience of those already walking. The design of facilities should also consider the volumes of people walking along (actual or desired) or crossing streets, and the solutions will depend on a variety of considerations. The needs of all users should be carefully taken into account and prioritised as appropriate.

It is recommended that this document is read in conjunction with Section 6.3 of Manual for Streets (MfS, 2007) and Chapter 5 of Manual for Streets 2 (MfS, 2010), both of which give a starting point to the development and improvement of facilities to improve the walking environment within residential areas and other situations, respectively. Inclusive Mobility (DfT2002) gives guidance on designing to include people with mobility impairments. "Pedestrian Facilities: Engineering and geometric design" (Schoon, 2010) gives detailed guidance on the design of many types of pedestrian infrastructure.

Although not specifically designed as infrastructure walking, 20-mph limits and zones along with the filtering out of through traffic from residential and local streets can also play a significant contribution into making places more walkable in terms of casualty reduction, road danger reduction, and improved subjective safety.

References to "people walking" are made throughout this document, but this should be taken as shorthand to include people using wheelchairs and mobility scooters as well as those using pushchairs or even children using scooters. Designing for walking must be a fully inclusive process.

1.2 The Importance of Design

Good detailed design is vital to the successful delivery of facilities for walking. Poor design can undermine the efforts of all those who seek to encourage walking and may actually weaken the intended benefits of a scheme. Designs should facilitate and accommodate people who are already walking and encourage further walking activity.

This document sets out the design considerations that affect the quality of the walking environment, options for crossing the street, assessment of routes, the use of pedestrian guardrail, the use of tactile paving, way finding, journey end facilities/interchange, and the use or impact of other street features. It should be remembered that designing for walking cannot happen in isolation, and there will be overlaps with infrastructure for other modes, which may impact on those walking positively or negatively. The quality and comfort of infrastructure for walking will also be affected by the level of maintenance, including winter service.

Broad Quay, Bristol

2. Definitions

2.1 Overview

Many terms are often used interchangeably, such as "pavement" and "footway," meaning the pedestrian area next to a carriageway (or "road"). Table 1 provides some basic definitions, which should be used to be consistent in dealing with various concepts relating to designing for walking.

3. Design Development Process

3.1 Overview

It can be easy to approach a walking project with preconceived ideas about what issues need to be addressed and then miss important matters or start a project without a clear idea of what is to be achieved and then fail to deliver proper outcomes. Setting a project brief with objectives, considerations, and outcomes in a structured way will ensure that a project remains focussed, that the right issues are addressed, and, most importantly, that early thought is given to what a successful outcome looks like. Following a structured process will then ensure that the design being developed is relevant to the issues being addressed.

3.2 Project Inception

There are a wide variety of project management methods and models and the complexity will depend on the scheme, but some general project inception stages which can be used to set up a project are set out in Table 2, and these stages can be set out in the form of a project inception report.

3.2 Capacity and Demand

The capacity of walking infrastructure can be complicated to quantify, and a qualitative analysis is often required. At the basic level, capacity can be measured as the movement of people per hour at any given point for footways or the number of people who can cross in a single green-man phase at signalised crossing. It could also relate the width of a footway or a crossing.

What a basic measurement cannot show is how "comfortable" the capacity is, and measuring this can vary with the location. For example, the capacity of a

Table 1: Basic definitions

Term	Definition
Aspect	A single coloured light associated with a traffic signal. For example, a red stop light or a green man are individual aspects.
Controlled Crossing	A facility provided to help people cross a carriageway but where they have priority over motorised traffic.
Desire Line	The route people most wish to use.
Far Side	The side of the road a person is crossing to.
Footpath	Part of the highway provided away from a carriageway for pedestrians to use.
Footway	Part of the highway provided adjacent to a carriageway for pedestrians to use.
Near Side	The left-hand side of the carriageway relative to the direction of travel. Or (when referring to pedestrian crossings) the side of the road a person is crossing from.
Off Side	The right-hand side of the carriageway relative to the direction of travel.
See Through	Situation in which road users may be able to see a traffic signal aspect, which does not relate to them, but which they may mistake as relating to them.
Level Surface	A highway layout where footways and carriageways are at the same level, with or without demarcation between the areas (sometimes called a "single surface" or a "shared surface")
Uncontrolled Crossing	A facility provided to help people cross a carriageway, but where they have no legal priority over motorised traffic.
Upstand	The visible height of a kerb above an adjacent surface, often between a carriageway and a footway, such as at a crossing point. Can also apply to a footway stepped above a cycle track.

footway within a small residential street is likely to be set in terms of a desirable footway width (see Section 4.2). When the setting is a busy shopping street, the footway width will have an influence, but the dynamic of how pedestrians use the space becomes more important in terms of those people simply moving through the space and those lingering at shops, talking to each other, etc. In this case, the space needed is likely to be greater than simply providing for flows to create a high level of pedestrian comfort.

Transport for London provides a methodology in "Pedestrian Comfort Level Guidance" (TfL2010) for assessing pedestrian comfort, which shows that even in the same location, comfort may change throughout the day depending on the type of street being assessed.

Table 2: Project Inception

Stage	Description
Introduction	What is the basic need for the scheme or what is being proposed for investigation or review? How will the scheme be funded? What is the scheme budget or is the scheme at feasibility stage?
Background	What are the detailed reasons for the scheme and what problems or issues are to be addressed? This could be as simple as a decluttering exercise, looking to provide new crossings along a route or a complete town centre public realm scheme, for example.
Scheme Objectives	Set some clear scheme objectives, which should be "SMART": • Specific (Are the objectives clear and unambiguous?) • Measurable (Can the outcomes be measured?) • Achievable (Are the objectives realistic given time, staff, resources, etc.?) • Realistic (Are the outcomes sensible given resources, time, etc.? • Timed (What is the time frame for achievement?)
Scheme Brief	The brief sets out what is to be done to achieve the objectives and can be broken down into tasks for clarity and simplicity. For example, if an objective was to review a route looking at demand for new crossing facilities, then a series of tasks could be set out, thus • Collect base data on existing traffic and pedestrian flows • Collect base data on casualty records • Undertake a local consultation with user groups and residents to see where any latent demand might be • Produce a plan showing existing desire lines, pedestrian casualty clusters, and consultation outcomes • Produce a table showing invention options, advantages and disadvantages, and costs
Option Feasibility	This could be rigidly set within the brief (and tasks) or developed to encourage alternative options, which could satisfy the scheme objectives, but in a different way. Care should be taken that this does not end up too open ended as designers could lose sight of the objectives.
Design Considerations and Constraints	Is there any specific design guidance that should be followed or will the design be expected to prioritise certain modes? When innovation is being promoted, the limitations of any guidance could be stated.
Heath and Safety Considerations	At an early stage, it is useful to think about designer responsibility under the CDM Regulations and whether the project is likely to require notification to the HSE. What type of designer risk assessments or design statements are required? In terms of design process, is a road safety audit or quality audit required?
Equalities Considerations	Is there anything at the outset that can impact people with protected characteristics either positively or negatively? If there is a negative impact, can this be mitigated or balanced? Is an equality impact analysis required?
Maintenance Considerations	What types of materials are likely to be specified? Are there likely to be any special or enhanced maintenance requirements as a result of the scheme? Are maintenance impacts positive or negative?
Monitoring Considerations	What monitoring is required to gauge how successful the project is? What baseline information is required at the outset to be able to show a change following implementation?

Unless a scheme is being promoted because of complaints or requests for new or better provision, demand is difficult to quantify. Some of the assessment techniques set out in Section 7 can help inform likely demand. In some cases, there may be latent demand, which can only be realised if a piece of infrastructure is built. For example, there may be a strong desire line to cross a busy street, but many people are put off by traffic flow or speed, but the provision of an appropriate crossing leads to new journeys that were not present before.

3.3 Data Collection

Data collection for walking schemes will vary with project type, but much of the basic physical data on the walking environment will be fairly common. In terms of pedestrian flow data, there are several options, each with different advantages and disadvantages. When being used for monitoring purposes, it is vital that the "before" and "after" information is comparable. For example, if the weather conditions are significantly different, this can alter the outcome. Different times of year or days of the week can also significantly influence outcomes.

1. Manual Counts

This is simply counting the number of people passing a given point using a hand counter. The advantages of the method is that it is relatively simple and low-cost. The operator can also classify counts into categories such as adults, children, and people using wheelchairs, but the operator will be limited in the amount of different information, which can be collected at once. The operator can also provide other observational information, which might be of use to the project. The technique can become more difficult in very busy circumstances, and if a large study is being undertaken, the level of coordination between operators needs detailed planning.

2. Automatic Counts

This method uses electronic detectors (utilising infrared beams or heat sensors) and relies on people walking past the detector. They can be deployed long term but are not able to distinguish between individuals and groups of people. Radio beam counters can be used at an angle to the path to distinguish individuals walking in groups and can be used to determine direction. Pressure pads can also be used, but as they are installed within the surface, they are not very practical. These automatic methods tend to be more suitable for footpaths as their deployment on footways are more difficult in terms of finding locations.

3. Video Surveys

This method uses video cameras mounted at a high level (perhaps 4m above ground level or higher) and can replace several manual counting points. The resulting information can either be manually viewed or analysed by software. Manual viewing can be time-consuming but can pick up issues such as road safety issues and can track individual desire lines. Software analysis is becoming more sophisticated and can be used to show desire lines, and in some cases, individuals can be tracked. Poor weather or visibility conditions can affect the process.

4. Laser Sensing

This uses a laser scanner and software to count and track trajectories (including people walking). The technique can differentiate between motor vehicles, people riding bicycles, and people walking. Processing software can make assumptions about movement where people pass behind objects and each other. The scanner needs to be placed at a low level to be fully effective and cannot give the same overview as a camera mounted well about the highway surface.

5. Attitudinal Surveys

This technique can be used actively whereby people are interviewed on street or passively where people can be invited to complete a survey by post or online. The method can be targeted at specific people or groups of people (to see what particular issues face them) or can be a sample of all users. It is useful to collect demographic information so that checks can be made that the data is not skewed; many local authorities have demographic data available that can help, but if the survey site contains a high proportion of visitors, care should be taken to ensure that the data collected is representative.

6. Other Data Sources

Other sources can provide useful background data. Casualty information is often useful in checking if there are any existing casualty patterns. For example, a location with a statistically significant pedestrian injury rate might be showing an underlying latent demand for a crossing. Crime mapping is a useful data set and can be used to underpin scheme development. For example, a shopping centre scheme that improves footfall might show a reduction in certain times of crime.

4. Basic Design Considerations

4.1 Pedestrian Networks

Strategies to encourage walking are covered in Planning for Walking. This document is concerned with the detailed layout and design of walking routes and infrastructure.

Footways and footpaths should be aligned as directly as possible between the main trip origins and destinations. People prefer to see the place to which they are walking. While gentle curves will probably be followed, sharp curves will not be followed readily unless physical barriers deter the taking of shortcuts (see Section 4.8).

Most walking journeys begin and end in buildings or transport interchanges but could also begin and end at a car park or at a cycle parking facility in a town centre, nearly all journeys include a proportion of walking within them. The relationship between the entrances to buildings and the pedestrian network is of particular significance. If there is a predominant direction from which people approach a building, developers or occupiers should be encouraged to provide an entrance to the building facing that direction.

In general, changes in level should be avoided, but when a difference in level is inevitable, the needs of people with reduced mobility must be considered. Bridges, high-level walkways, and subways should be avoided unless they relate naturally to the main entrances of nearby buildings or when crossing roads; they are well designed and accommodate the desire line of all users (see Section 6.6).

4.2 Footway and Footpath Widths

Footways and footpaths should be designed with sufficient usable width for all anticipated pedestrian activity. As public open spaces in urban areas, footways may have an important role in defining the character and attraction of streetscapes. The urban design concept may influence the footway width as much as the anticipated flow of people or usage. Care should be exercised to ensure the footway operates as intended for pedestrians.

In calculating the available footway width, unless physical features make it impossible, subtract the space occupied by street furniture, street traders, queues at bus stops, people waiting to cross roads or people accessing shops (a newspaper kiosk could be quite small but will still attract people and create queues on the footway), and people waiting to cross roads. This will leave an "effective" width of footway, which will be a more accurate representation of the usable space. Further and more comprehensive detail on basic dimensions to cater for those with mobility difficulties is given in Section 3.1 of Inclusive Mobility (DfT, 2002), and more general footway width considerations are discussed in Section 6.3 of Manual for Streets (MfS2007).

It would be wrong to be overprescriptive about footway widths. Each location needs to be assessed to determine the width requirement for pedestrians. In general, physical space requirements are dictated by the needs of people and the place. Designers should consider the range of activities that may take place, such as window shopping, street play, and groups congregating as well as the volume of people walking.

Designers should be aware that, based on the established standard of providing sufficient width for wheelchairs/mobility scooters or double buggies to pass, pedestrians require an absolute minimum obstacle-free width of 1.8m and a desirable minimum width of 2.0m.

On high-speed roads and those with a regular or high flow of Heavy Goods Vehicles (HGVs), it is preferable to allow an additional minimum of 0.6m to allow for vehicle overhangs and pedestrian "kerb shyness." Street furniture will normally be in this area. There may also be an "unusable" area of approximately 0.25 to 0.5m at the back of the footway if the footway is bounded, for example, by a wall or building.

The following effective design widths, which are clear and generally unobstructed, are recommended:

- **Absolute minimum width: 1.8m**
- **Desirable minimum width: 2.0m**
- **Preferred width 2.6m (especially adjacent to high-speed roads)**

It is not suggested that footways with widths less than 1.8m should never be provided, as it is clear that existing narrow footways do provide a level of pedestrian amenity. A 1.5m-wide footway (kerb face to back of footway) may be better than no footway at all. However, there is a lower limit where the footway width is insufficient to accommodate normal walking activity in safety. This minimum will be dictated by site specific criteria, including pedestrian flow and composition, and vehicle flow and speed. Designers should aim to create a quality walking environment with sufficient capacity to prevent pedestrian congestion, particularly on streets where there are large groups such as outside schools, shops, or visitor attractions.

When possible, designers should widen footways where pinch points would normally be created.

For example, kerb build-outs at pedestrian crossings or at bus stops can help prevent obstructions caused by waiting pedestrians, as well as providing other benefits, but there may be issues with the impact on the safety and comfort of people riding bicycles.

4.3 Changes in Level

Pedestrian areas and routes can never be absolutely level because surface water drainage must be possible. Crossfall causes difficulties for wheelchair users and should be limited to 1 in 50 (2%) wherever possible.

Changes in level are sometimes dictated by the natural topography and can add interest but are usually a simple reflection of changes in carriageway profile. Pedestrians do not like changes in level or grade. Ramps should not exceed 1 in 20 (5%) generally. In exceptional circumstances ramps can be as steep as 1 in 12 (8%), but this gradient will cause a difficulty for people with reduced mobility. If an even steeper ramp cannot be avoided, handrails should be provided on both sides of the ramp.

When footways and carriageways or cycle tracks are separated vertically, crossing opportunities will be constrained, and new problems may result. Unnecessary ramps and steps should be resisted, particularly if they are for aesthetic impact. When footways and cycle tracks are separated vertically, then consideration should be given to assist people who may wish to cross informally.

Inclusive Mobility (DfT2002) provides detailed advice on the configuration of ramps and steps and Section 6.6 deals with grade-separated crossings.

4.4 Surfacing Materials

Footway surfacing should be from durable materials, which provide good surface regularity, grip, and drain easily. In many cases, flexible surfacing will be the most practical to install and maintain, but well-specified and installed element paving is equally suitable. Loose materials, cobbles, or some riven paving will be uneven and not suitable for access by all. If there is a compelling conservation or historic reason to use uneven materials, then the designer should consider providing routes through the area constructed with flat materials. Many historic materials were readily available at the time the paving was originally laid and designers should always question their use rather than modern alternatives because of the impact on those with reduced mobility or vision.

Lighting column with supplementary task lighting for a footway

4.5 Lighting for Pedestrians

Lighting is important to ensure walking routes remain attractive for use at night in terms of personal security and ensure pedestrians are seen by other road users. For most applications, well-designed street lighting will perform this function, but for larger pedestrian areas or wide footways, additional lighting for pedestrian routes and areas will be appropriate.

To reduce street clutter, footway lights can be mounted on buildings or on existing columns. In some cases, bespoke lighting is used to create more attractive public spaces for walking. Designers should also consider the effect of sudden changes of lighting as this can cause problems for partially sighted people. Some highway authorities are switching off or reducing lighting levels during the night to reduce electricity costs and emissions. In designing such an arrangement, consideration on pedestrian use is essential, as there is a risk that some people will not use a route, which they perceive as poorly lit because of personal security considerations.

Section 10.3 of Manual for Streets (MfS2007) sets out more detailed advice on the lighting of highways, and in particular, sections 10.3.16 to 10.3.26 are relevant to designing for walking.

4.6 Drainage

Good drainage of footways and footpaths is important for user comfort (not having to walk through or avoid puddles) and, in cold weather, reduces the risk of ice.

Ice is an obvious safety issue, and the risk of falling will in some cases make people so worried about walking such routes that they are afraid to leave home.

For many situations, a simple crossfall will suffice and shed water into the carriageway to be picked up by road gullies. In these cases, gully spacings and pipe sizes should allow for the area of footway being drained. When sustainable systems are being used for drainage, these should similarly be designed to ensure flows from footways are properly dealt with. The choice of system will depend on the overall drainage strategy for the scheme or area.

When footway is at a lower level than the carriageway, or when a footway is widened into a carriageway, a fall to the carriageway may not be achievable. A fall to the back of the footway may be required, or falls to the centre of the footway may be created. In both cases, it might be possible to use a channel (e.g., either a formed unit or block a block paved soldier course) to divert surface water a short distance to an area that falls towards the carriageway, but over any greater length, it is highly likely that a stream of water within the channel will form, reducing the availability and comfort of the footway. Preformed dished channels are not suitable for areas used by pedestrians, as they can cause people to lose their footing or create a trip hazard.

Similar problems can occur with large paved areas (such as plazas) and with footpaths, when relying on grassed areas for drainage may not properly drain the area. It is therefore recommended that drainage be planned from the outset to properly remove water. This could include providing footway gullies connected to local surface water system (with small pedestrian grids), slot drains, or trench drains. Permeable surfaces, swales, rain gardens, ditches, and detention ponds can also be used, which either run to soakaways or act as a retention system before discharging to the local piped system.

Zebra crossing pedestrian lighting

Gentle gradients and a flush channel block leading to pedestrian-friendly gully grating

Care is also required at pedestrian crossings where drainage within the channel of the carriageway must be considered. Flush kerbs are required at crossings, but under heavy rain conditions, the depth of water running along the channel can lead to a puddle at the edge of the footway. Not only does this create a location for pedestrians to be splashed by passing vehicles; it also reduces comfort and is an ice risk.

A maximum 6mm upstand to the dropped kerbs for a crossing can be used as a water check, but this is no substitute for checking falls along the channel area to ensure water will flow past the crossing and not pond. When the edge of the carriageway is excavated to install a new dropped kerb for a crossing, without careful checking, there is a risk that a small local depression is created, which creates a puddle.

A carriageway gully installed just upstream (hydraulically) of the crossing point can be effective in intercepting flows before the crossing point, but when a refuge is being installed, a new gully close to the refuge can make gully cleansing more difficult in terms of temporary traffic management.

When a footway build-out or a speed table is being provided as part of a crossing facility, a “kerb bypass” can be provided that effectively provides a duct, which takes water from the carriageway channel, past the feature, and returns the water back to the channel. These units are much cheaper than new gullies but are prone to blockages where channel gradients are fairly flat or where debris (and leaves in the autumn) build up, and so regular cleansing is required.

4.7 Tactile Surfaces

When pedestrian crossings are provided, then it is important that dropped kerbs are laid flush with the carriageway surfaces so that all people can cross. Grid blister pattern tactile paving should also be provided to enable visually impaired people to distinguish the footway edge.

The Department for Transport document "Guidance on the Use of Tactile Paving Surfaces" (DfT2005a) provides substantial and very flexible detail on how tactile paving can and should be used, together with the specific types and colours of paving for specific situations, but each location is different, and judgement should be used in applying the guidance appropriately. It should be noted that DfT advice on tactile surfaces is being reviewed, and the DfT Mobility Unit should be contacted to ascertain the latest position.

Tactile paving should also be used at controlled crossings. The standard layout includes a "stem" to create an L shape so that visually impaired people can locate and orientate themselves to the crossing, whereby a zebra crossing beacon post or push button for a signalised crossing will be found on the right of the crossing point.

Other types of tactile paving are recommended for use in different locations. For example, when off-carriageway facilities are shared with or segregated from people riding bicycles, then different arrangements of tactile paving can help visually impaired people know that they are entering a shared area or so they can ensure they are within the footway area rather than a cycle track. When stepped or separated cycle tracks are provided, then tactile paving is not needed.

Red L-shaped tactile paving at a controlled crossing

Tactile paving can also be used to inform visually impaired people that they:

- **are approaching the start and end of a flight of stairs,**
- **are at the edge of a platform for an on-street tram, or**
- **are following a "safe" or "guided" route within a shared surface or pedestrianised area. This is particularly important, as otherwise these areas can be difficult to navigate, as they become an expanse of paving with few spatial cues.**

There are sometimes conflicts between the views of designers and users on the provision of tactile paving, especially those who feel the look of a scheme may be compromised by the contrasting colours and paving styles that tactile paving incorporates. Some users also report that they find tactile paving uncomfortable or painful to use. In some shared surface schemes, there has been controversy regarding decisions taken to limit or omit the use of tactile paving. If departures from the guidance are being considered, it is vital that accessibility groups are consulted at the very initial stages of design to avoid the scheme excluding people. The guidance allows a great deal of flexibility, but a major consideration for highway authorities in improving and maintaining their highway networks is to ensure any facilities they provide or substantially improve are accessible by all.

If the location of a dropped kerb is not on a desire line (which would naturally be used by visually impaired people), then tactile paving may not be needed at all. However, if being used as a crossing point, then kerbs should be flush with the carriageway surface.

There are some basic principles that should be followed:

- **The correct tactile surface for the situation should be used. For example, grid-pattern blister is always used at pedestrian crossings. If placed at the top of a flight of stairs, for example, it could be very misleading or dangerous;**
- **Red grid-pattern blisters should only ever be used at controlled crossings, zebra, pelican, puffin, toucan, or signalised junctions where "green men" are provided;**
- **Tactile areas should always have a "twin" opposite and have blisters aligned properly when used to denote crossing points to allow users to find the opposite footway and avoid becoming stranded in an area with traffic;**
- **Tactile paving should not direct users into an obstruction;**
- **When used in conjunction with segregated pedestrian and cycling facilities (but at the same**

level), the alignment of the ladder/tram-line tactile paving should be orientated so that cyclists are on the tram-line side and pedestrians on the ladder side (cyclists on the wrong side would feel a rumble from the ladder);

- **When being used in conjunction with a speed table as a crossing point, grid-pattern blister paving should be provided wherever the kerb is flush with the carriageway;**
- **When paving needs to be cut to fit the alignment, small pieces of paving should not be left as they are most likely to fail and become a trip hazard; and**
- **If tactile paving is used near an area at risk from vehicle overrun, then consideration should be given to laying it on a heavy duty base or even using rubber/composite paviours.**

If a flush dropped kerb is being provided within a loading bay to allow those loading to more easily push trollies and cages, then tactile paving is not required because there is not a dropped kerb being provided on the other side of the road. However, such dropped kerbs should not be provided if there is a risk that the dropped kerb is on the desire line for visually impaired people.

radius (perhaps keeping to the absolute desire line), there is a risk that a user could mistake the alignment of the blisters by 90° and therefore be directed into the carriageway in the wrong direction, so great care is required when designing such layouts.

In some level surface schemes, contrasting corduroy tactile paving has been used to demarcate nominal "footway" and "carriageway" areas so that visually impaired people are able to know that they are moving

Tactile paving laid in a way that could confuse people into walking across the road at an unintended location road

between the two uses of the space, but this approach should always be in consultation with access groups, as this is a departure from the use of blister surfaces to show when people are walking into an area where motor and/or bicycle traffic can be expected.

When private accesses are being connected to an existing street, a simple dropped kerb might be sufficient and which negates the need for tactile paving. It reinforces the position that drivers are crossing the footway, rather than pedestrians crossing a road. This can be taken a stage further with "blended junctions" (see Section 6.3.6).

Poorly aligned tactile paving at an uncontrolled crossing, evidence of vehicle overrun small cut pieces of paving and a long crossing distance

Western Gateway, Docklands: PedX crossing without guardrail

4.8 Guardrail

Although guardrail can be useful in limited circumstances, it is visually and physically intrusive, reduces the width of available footway, and can be dangerous for people riding bicycles on the carriageway who may become trapped between vehicles and guardrail when they could otherwise "escape" onto the footway. Guardrail is provided to restrict the movement of pedestrians, and unless their intended use is clear to pedestrians, they will be resented, and in many cases, people will simply walk on the live traffic side if it suits their desire line. There is some risk that guardrail leads to drivers becoming less aware of the presence of pedestrians (especially children because of their height), and this could create complacency in driving behaviour.

Guardrail should only ever be considered for locations where there is a real risk of pedestrians being hit by traffic should they walk onto the carriageway. For example, this could include sites with high pedestrian flows where there is a risk of people being knocked into the carriageway or when the desire line really cannot be accommodated, and so people need to be guided away from significant danger.

Guardrail is often used adjacent to pedestrian access points to parks, open spaces, and schools on the basis that small children are at risk of running into the carriageway. If this is a genuine concern, then it might be better to provide some sort of containment within the site. This type of concern is often one of a perception of danger, rather than being reinforced by a casualty history, but in situations where walking is being encouraged, then very short sections of guardrails used in this way may help address concerns. A short section of guardrail might be useful if there is a pedestrian crossing very near a school pedestrian gate to guide children and adults to the crossing. The disadvantage is that pedestrian numbers are often high at the school gate, and guardrail may reduce footway capacity.

Parking will still take place next to guardrail outside schools

Contrast between "see-through" and non-see-through guardrail

Guardrail is sometimes installed under pressure from schools to prevent parental/carer parking. In this situation, the guardrail will only serve to reduce footway capacity (when it is most needed) and encourage some parents to get their children out of vehicles on the live traffic side. If parental parking is a genuine safety issue, then appropriate parking or waiting restrictions and enforcement will be necessary. In some locations, it might be possible to widen footways so that parked vehicles would block the road that allows for a level of self-enforcement, although this might be to the detriment of people riding bicycles.

If guardrail is being considered to prevent overrunning of footways to private premises, it would first be appropriate to consider enforcement measures or to work with the owners of the premises to provide a proper vehicle access or on-street parking bays. The latter will almost certainly be less costly than long sections of guardrail.

If guardrail is provided, then it should be continuous over the distance it is provided. Gaps left at trees, signs, lamp columns, etc., can allow small children to pass through at a location where a driver may not be expecting to see a pedestrian. When provided on approaches to pedestrian crossings (stand alone or at junctions) or at the end of a

run, then it must be of the see-through type. If provided in commercial or retail area, guardrail might prevent genuine servicing access. The provision of gated sections is rarely appropriate as in the case of the gates being left open, they will either create a safety problem for people driving or riding motorcycles/ bicycles or block the footway.

Some highway authorities have a proactive programme of guardrail removal to enhance the public realm. Care should be taken that guardrail which is genuinely required is not removed. To make removals properly considered and structured, many authorities will create an assessment framework, often with a level of independent safety checks by a safety auditor and with reference to any casualty information to support decision making. However, it is entirely possible for community and political pressure to be brought against removal, and it is important that any framework can be explained to nonprofessionals. Guardrail is often used for unofficial bicycle parking, and so any removals should consider the provision of dedicated bicycle parking provision.

If there is a desire to provide separation between pedestrians and traffic (including separation with cycle tracks), the designer should consider the use of a "clutter area/zone" behind the kerb within which to place various street features to create a buffer. Section 4.9 provides more detail.

4.9 Protection of Footways and Pedestrian Areas

Footways are provided for pedestrians, and should be kept clear as far as possible. The intentional or accidental overrun of vehicles onto footways and other areas intended for pedestrians (and sometimes cyclists) creates problems such as damage to the footway surface or street features, the safety risk of vehicles manoeuvring where people are walking, and, in some situations, the presence of vehicles constitute a security risk (see Section 10.6).

The problem can be tackled in a variety of ways, but bollards are often chosen because they are relatively cheap and prevent all but the most determined from gaining access to footways. However, they can be a major disadvantage to visually impaired people as well as those using wheelchairs, mobility scooters, or pushchairs as they create obstructions to free movement. When placed along the edge of a footway in a continuous run, they are often offset back from the carriageway (so they are not hit) that reduces the effective footway width, which has an impact on footway capacity and comfort. Continuous runs can also present a solid wall to visibility at some angles, which is an issue where people (especially children) are likely to cross the road. Some bollards are quite low such as concrete spheres or stone blocks. These may fit in with an overall palette of materials, but their height can be a problem with people falling over them.

If overrunning is an issue, it is worth exploring the reasons why. If drivers are stopping on a footway by a shop, for example, it may be that the drivers think they are helping other drivers by keeping traffic flow free without thinking about the impact on pedestrians. A solution might be to review local parking controls to give a short-term parking place by the shop so parking on the footway is not "required." Parking controls are also a useful tool where drivers use the footway to maintain two-way traffic flow. At approaches to junctions, drivers may use the footway to bypass queuing traffic to continue their journey. Assuming the junction is operating as efficiently as possible, a single bollard or

Line of bollards creating a visual barrier: Great George Street, Westminster

relocated traffic sign may solve this type of problem. When the edges of footways are occasionally overrun, it might be pragmatic to accept the problem (so long as pedestrian safety is not compromised) and construct these areas to a standard sufficient to withstand such loading. Many paving materials are available in heavy duty options, which match the overall finishes, but are much stronger. In some situations, it might be desirable to keep carriageway widths to a minimum to promote low traffic speed, but with the ability of the occasional service vehicle overrunning some areas. However, narrow carriageway widths can be intimidating for people riding bicycles and should only be used with care. On busy routes, the provision of protected cycling infrastructure can help narrow the carriageway. As well as protecting people riding bicycles, it can act as a buffer between pedestrians and vehicles. Traffic Advisory Leaflet 4/93 (DfT1993) provides some advice on preventing parking on the footways, although the advice is over 20 years old.

It is also possible to use high kerbs in areas where casual vehicle overrunning is to be deterred to make is physically difficult to gain access. Care must be taken that such kerb heights are not provided where people are likely to cross the road or lose their footing on an unexpected kerb height. Kerbs can also be used within single surface shared-space areas to protect street features such as lamp columns from vehicle collision. A colour contrast to show the "step" is helpful for partially sighted users.

When footways are wide enough, many designers create a "clutter line/zone" between the kerb and the rear of the footway. These areas can be used to contain some of the features found on the street in a coherent way, which leaves the main footway area completely free of obstructions. Features such as lamp columns, trees, cycle parking, telecommunications cabinets, seating, and traffic signs are all features that can be placed in a clutter area/zone. The presence of these features can be a good way in preventing vehicles gaining access to the footway and can replace guardrail in terms of giving some pedestrians a buffer away from the live traffic areas.

If there is no option and bollards are proposed, then they should be carefully selected for the situation. For partially sighted people, good colour contrast with the surrounding paving materials is key. For example, if the footway surface is concrete flags (being light grey in colour), black bollards create a good colour contrast. Bollards are available with coloured strips around them, which is helpful, but can be a problem when vandalised. Section 3.7 of Inclusive Mobility (DfT2002) provides additional advice.

4.10 Issues within Villages

Villages, especially village centres, have many issues in common with urban areas and designing for walking can be especially problematic when highway widths are constrained by an historic layout or even with an absence of footways. Section 2.7 of Manual for Streets 2 (MfS2010) gives some background to the issues in village centres, but the challenges facing designers are as follows:

- **Lack of footway widths or footways and often lack of space for all competing demands on the street,**
- **Speed and volume of traffic (when on main routes) and the impact on walking,**
- **Providing for parking in areas with few off-street opportunities and the impact on pedestrians, and**
- **The balance of the choice of materials to fit in with historic areas, which are robust and walking friendly.**

4.11 Issues for Mobility Scooter Users

Mobility scooters have enabled people to travel further and independently and in many ways are accommodated in a similar way to wheelchairs, but because of their larger size, turning circles, and speeds (up to 8 mph), providing for them creates additional challenges for the designer.

There are many different styles of mobility scooter available, with differing steering ability. In general, if footways are being provided of an appropriate width, then mobility scooters will be catered for general forward travel. The principal issue is one of the length and turning circle of many mobility scooters. Section 2.2 of Inclusive Mobility (DfT2002) suggests that as an absolute minimum, a manual wheelchair user can turn within a space of 1.5 × 1.5m. For mobility scooters, the turning radius is a function of forward speed and the ability of the user to steer. For example, low forward speed with a quick steering movement will give the tightest turning circle, but it will be much greater than that achievable by an experienced manual wheelchair user. Turning radii of between 0.6m (small portable units) and 1.8m (large four-wheel units) are possible.

The implication for the designer will be the width of footway available for mobility scooter users to be able to tightly turn to cross the street, space between obstructions, the radii of footways at junctions (to be able to turn from one street to the next), keeping changes in gradient smooth (because of low ground clearance or risk of overturning), and maintaining a good surface regularity to ensure all wheels maintain ground contact.

5. Relevant Legislation

5.1 Overview

There are various pieces of primary and secondary legislation that the designer should be aware of when designing for walking, which cover the safety and consistency of street layouts. Although effectively setting "rules," many areas of legislation are very flexible and allow conforming solutions to actually look and work in different ways.

5.2 Highways Act 1980

This gives legal status to the provision of footways, footpaths, etc., and deals with highway authority powers to undertake improvement works or to install features on the highway network. This also sets out the duties for maintaining networks.

5.3 The Highways (Road Humps) Regulations 1999

This governs the form, layout, signing lighting, and consultation processes associated with the provision of road humps. When speed tables or raised entry treatments are being considered, this will have most relevance in this document.

5.4 The Traffic Signs Regulations and General Directions 2015

This governs the form, layout, and use of signs and road markings. The regulations also set out how pedestrian crossings must be laid out and signed.

5.5 The Highways (Traffic Calming) Regulations 1999

This governs works that are classed as traffic calming and which features may be included in traffic calming works, how consultation on their introduction should take place, and which traffic signs should be considered for use in conjunction with the various features. There are also details on the relaxation that signs are not required within 20-mph zones.

5.6 Equality Act 2010

This consolidated various pieces of legislation, but the main impact on designing for walking is that those providing access to goods, services, and facilities are required to ensure people with "protected characteristics" are not discriminated against. The protected characteristics most likely to be affected in this case will be disabled and elderly people (in terms of physical access to, and use of the street environment). There is also the Public Sector Equality Duty, which requires public bodies consider how different people will be affected by their activities, including the delivery of policies and services and how they meet the needs of different people.

6. Crossing the Street

6.1 General Considerations

People need to cross the street, whether along links or at junctions. The type of facilities required can depend on many, often linked, factors, and these can affect the choice of provision. Every site will be different, and the designer will need to balance competing issues, although some may emerge as the most important considerations, especially when those walking need to be protected from traffic.

- **Numbers of people wishing to cross at any one time**
- **Speed and volume of traffic**
- **Crossing distance**
- **Confidence of person crossing**
- **Age of person crossing**
- **Physical or visual considerations of the person crossing**
- **Perception of danger**
- **Time of day**

Examples of linked issues are as follows:

- **High volumes of traffic at peak times when children are crossing the road to a primary school. This will include people with pushchairs who are not able to move or react as quickly as they would on their own. There is often a perception of danger amongst parents and children will not have the same awareness as adults. Subjective safety might be the main issue for users in this situation and dealing with concerns may be the prime consideration;**
- **High volumes of people crossing a road in a busy town centre where through traffic is permitted, with parking and loading taking place; and**
- **People wishing to cross a local road from a residential area to access a health centre. The volume and speed of the traffic may not be high and gaps easy to find, but the physical and visual considerations of users and their different ages might lead to different needs from crossing facilities.**

The principal design consideration is to accommodate crossings where people want to go (the "desire line"). If pedestrian crossings require large diversions from desire lines or impose substantial waiting times, they may not be used (diminishing the value of provision), or people will stick to their desire line, which may perpetuate or create a safety problem. Designers need to work hard to accommodate desire lines; otherwise layouts will fail people in use. There is a need to ensure that the width of a crossing is appropriate for the numbers of people expected to use it. A wider crossing will accommodate more people crossing at the same time.

Table 3: Suitability of pedestrian crossings

Crossing Type	Traffic Flow	Traffic Speed					Advantages	Disadvantages
		20	*30*	*35*	*40*	*50 +*		
UNCONTROLLED								
Dropped kerb Crossings	High						Simple to use. Low cost. Can be located flexibly. Can be located on desire lines	Intimidating at higher flows and speeds. Subjective safety an important consideration
	Medium							
	Low							
Flat-topped road hump	High						Level crossing surface. Give and take at lower speeds	Unsuitable for heavy, fast traffic flows. Can affect local carriageway drainage
	Medium							
	Low							
Refuge/central reservation	High						Allows crossing in two stages. Can reduce traffic intimidation for some users	Can create pinch point for cyclists. Can be prone to traffic impact
	Medium							
	Low							
Median strip	High						Crossing point along length of street. Caters for multiple desire lines	Not always accessible to all users. Can impact on cycle safety over longer distances
	Medium							
	Low							
Build-out	High						Improves visibility between pedestrians and traffic. Reduction in crossing Width	Can push cyclists into traffic. Traffic collision risk if not adequately conspicuous
	Medium							
	Low							
Side-road entry treatment	High						Level crossing surface. Give and take at lower speeds	Can create loss of control risk for motorcycles
	Medium							
	Low							
Blended junction or continuous footway	High						Level walking surface where drivers cross the footway, which continues across the junction	Some pedestrians may not feel comfortable with this nontraditional layout
	Medium							
	Low							
CONTROLLED								
Zebra crossing	High						Pedestrians have priority over traffic. Almost immediate access to crossing priority	Less suitable on faster roads. Can impact on traffic flow where pedestrians stream
	Medium							
	Low							
Signal controlled (stand-alone)	High						Favoured by many older and disabled people. Signals give clear priority to pedestrians	Can be inflexible leading to delays for both pedestrians and traffic, although puffin detection reduces issues
	Medium							
	Low							
Signal controlled (junction)	High						Can be used on higher speed roads. All green, pedestrian phase allows diagonal crossing	When staggered for traffic flow, pedestrians experience longer walking routes and times
	Medium							
	Low							
GRADE SEPERATED								
Bridges	High						No crossing delays, good subjective safety. No delays to traffic. Can be used with high traffic speeds/flows	Poor layouts with tight turns, steep ramps, steps, and long detours will exclude some people
	Medium							
	Low							
Subways/underpasses/road bridges	High						When open and see through, can be direct, convenient and feel safe to use	When isolated and without clear views through, can feel unsafe and less likely to be used
	Medium							
	Low							

Generally Acceptable ■ Design With Caution ■ Generally Unacceptable ■

The provision of at-grade crossing facilities on high-speed roads (speed limits of 40 mph and higher) is especially difficult, especially if there is a strong desire line. If being considered, it is likely that local speed reduction measures will be required or a properly designed grade separated crossing would be more appropriate. In some circumstances, uncontrolled crossing points/pedestrian refuges may be appropriate if there are gaps in traffic flow, and visibility between users is appropriate for the actual traffic speed.

Controlled facilities on high-speed roads (using traffic signals) can be placed at junctions where traffic is being controlled, but if placed in a stand-alone position, there is a significant risk of pedestrians relying on a green aspect rather than being aware if traffic is actually stopping. In these situations, informal crossings might be safer as these require people to wait for a gap in the traffic and make a decision to cross. However, the subjective safety of such informal crossings may suppress demand in any case. For the young, elderly, and people with learning difficulties, speed perception might not be as acute as it is for other people.

Further advice on the design of pedestrian crossing facilities is set out in Local Transport Note 2/95 "The Design of Pedestrian Crossings" (DfT1995a).

Table 3 sets out the general issues facing the designer when considering crossing type, but the key message is that each site is different, and it is vital to visit the site at different times of day (and night) to observe desire lines and behaviour. There is also merit in asking people using the facilities what would help them and local access groups are often keen to be involved with design of new facilities and they will be able to bring good local knowledge to a scheme. Of course, traffic speed and flow can change with time, and so a crossing, which is acceptable today, may not be acceptable in the future.

"Generally acceptable" will be crossing types that are relatively straightforward to implement for the given traffic speed and flow type. "Design with caution" means that the type of crossing will be acceptable, but the designer will need to exercise special care. For example, a pedestrian refuge on a higher speed road will require more sideways clearance from traffic and certainly passively safe signposts and bollards. "Generally unacceptable" will be crossing types that are almost always unsuitable for the given traffic speed and flow type, although in very special circumstances and with special care the facility might be acceptable.

The designer should always be aware that the posted speed limit may not be necessarily the actual traffic speed (which could be higher or lower). It is desirable for traffic speed and flow to be measured over a period of time and the 85th percentile speed being used to inform the design. Although a 40-mph speed limit would indicate a high-speed road, 85th percentile speeds about 35 mph will require increased care. It may be that a facility may only be used for a certain part of the day, and so matching speed data to this part of the day could influence the crossing type. Traffic flow can also be very useful in making decisions. For example, an informal crossing of a street may be all that is required for most of the day, but for peak hours, the gaps in the traffic may not be sufficient for some people.

6.2 Types of Crossing Facilities

When crossing facilities are provided at the same level as the carriageway, these are known as "at grade" crossings and include treatments such as zebra crossings, pedestrian refuges, and raised tables. Depending on the arrangement, the crossing point will involve either pedestrians (and cyclists in some cases) crossing down to the general carriageway level (dropped kerbs) or traffic being raised to or near the level of the footway (road hump).

Raising traffic above normal carriageway level may be helpful in reducing traffic speed and make the crossing more accessible for users, especially people using wheelchairs, motorised scooters, and pushchairs, or where changes in level are difficult to traverse (those using walking sticks for example). The provision of step-free crossings at all junctions should be the overriding aim, which will contribute to a fully accessible and walkable pedestrian network.

At-grade crossings are split into two types: uncontrolled and controlled. Uncontrolled crossings do not afford pedestrians any particular priority over motorised traffic, although some layouts may result in some drivers deciding to give way. Some pedestrians may decide to assert priority over drivers, but this cannot be relied on. When people are already crossing a side road, drivers are expected to give way (Highway Code, Rule 170).

Multilane approaches to at-grade crossings (including bus lanes) can be a problem when slow-moving traffic in one lane "masks" people crossing from drivers in the faster-moving lane. If this is likely to be an issue, then signalised crossings should be considered, although the signal arrangements need to be reasonably visible to all drivers.

When crossing facilities are not provided at grade, they are known as "grade separated" and include the provision of bridges and underpasses/subways. Grade-separated crossings are often less favoured because they usually require pedestrians to deviate from their

Multi-lane approaches to crossings can create issues where pedestrians are "masked" by slow moving or stationary traffic

desire line and travel further because of the extra distance needed to negotiate ramps or stairs. They are also often unpopular as poor design, lighting, and maintenance can make them threatening, leading to personal safety concerns. When this is the case, they will be ignored by people who may choose to make the crossing directly regardless, putting themselves and others at risk. In some circumstances, a grade-separated crossing may be the only method of crossing safely.

When good desire lines can be maintained, with gentle gradients and when seclusion is minimised with open views (mainly subways/underpasses), then grade separation can be convenient to pedestrians who will not need to wait to cross. Delays are also removed for drivers.

6.3 Uncontrolled Crossings

6.3.1 Dropped Kerb Crossings

Dropped crossings may be provided either:

- **to allow vehicles to gain access across footways into buildings or onto land; or**
- **to assist people, especially those with a mobility impairment, a push-chair/buggy, trolley, or mobility scooter, when crossing a carriageway.**

A pair of dropped kerbs opposite each other can be provided to allow all people to cross. If being provided on a distinct desire line, the dropped kerbs should be provided with appropriate tactile paving. Kerbs should be laid flush, and ramps should have gentle gradients. To make the crossing more visible to drivers, brightly coloured posts can be positioned close to the kerb at the crossing. When the carriageway is wide or traffic flows higher, refuges can be used to help people cross in two stages (see later).

Consideration can be given to the use of contrasting materials on the carriageway at the crossing point. This can encourage drivers to allow pedestrians to cross at these locations; care should be taken that pedestrians do not confuse a change in materials as giving the same priority as on a controlled crossing. Should a driver not afford priority to a pedestrian or a pedestrian assumes priority, the consequences for the pedestrian could be severe.

Poorly laid dropped kerbs will not be accessible to all

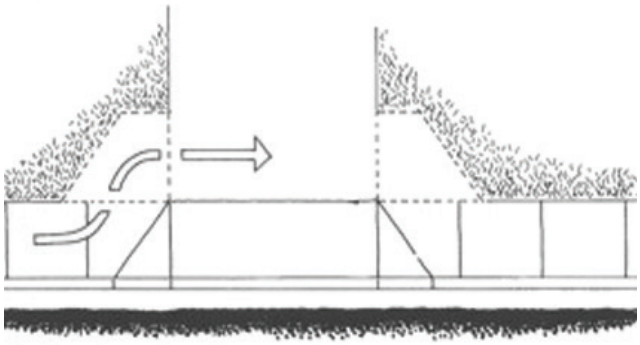


Figure 1: Dropped kerb with diverted footway to allow alevel landing (FHWA Designing sidewalks and trails for access)

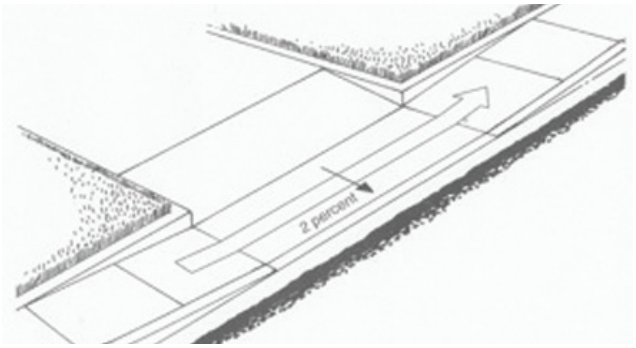


Figure 2: Vehicle access with full width of footway dropped (FHWA Designing sidewalks and trails for access)

Vehicle crossings should be kept to an absolute minimum, and their provision and construction should be controlled by the highway authority. In some circumstances, planning permission may be necessary. There may be a vertical face of up to 25 mm to the upstand of a dropped kerb at a vehicle crossing to ensure that surface water is retained on the carriageway. If the vehicle access leads to a crossfall of more than 2%, a path of at least 1m in width with a 2% crossfall should be provided if possible (Figure 1). Another solution is to drop the whole footway, though this can cause difficulties for drainage and be inconvenient for pedestrians (especially those with mobility impairments) if there are multiple accesses (Figure 2). It is also possible to keep most of the footway flat with the area immediately adjacent to the carriageway dropped within the distance of a pair of quadrant kerbs.

At locations where significant numbers of people are likely to want to cross a carriageway, the kerbs should be dropped to facilitate crossing with prams or pushchairs and by people using wheelchairs or mobility scooters. There should be no vertical face on the upstand of a dropped kerb at a pedestrian crossing, as this can cause a wheelchair user to tip over. When kerbs are dropped, the slope of the ramp should not be greater than 8% (1:12), but a gradient of 5% (1:20) or flatter is preferred (Figure 3). A level landing at least 1m wide beyond the ramp should be provided.

Care should be taken to assist visually impaired people at appropriate crossing points, and reference should be made to the most recent DfT guidance. Tactile surfaces should be used to identify the presence of a dropped kerb where pedestrians are likely to cross (DfT 1991a). Only blister tactile pacing should be used, comprising rows of flat-topped "domes" 5 mm (±0.5 mm) high. It should be noted that DfT advice on tactile surfaces is being reviewed, and the DfT Mobility Unit should be contacted to ascertain the latest position.

Tactile paving is considered in detail in Section 4.7. When a pair of dropped crossings are being used to help people cross the entrance to a side road, then a decision will be required as to the appropriate location for the crossing point. The starting position should be the desire line, but this could mean that people have to cross a relatively wide and intimidating distance. If possible, kerb radii should be tightened so that the crossing distance can be reduced, the waiting area enlarged, and the speed in which traffic can turn is reduced. Keeping to the desire can also be an issue where people have to look over their shoulder to check for traffic, which might be difficult for some.

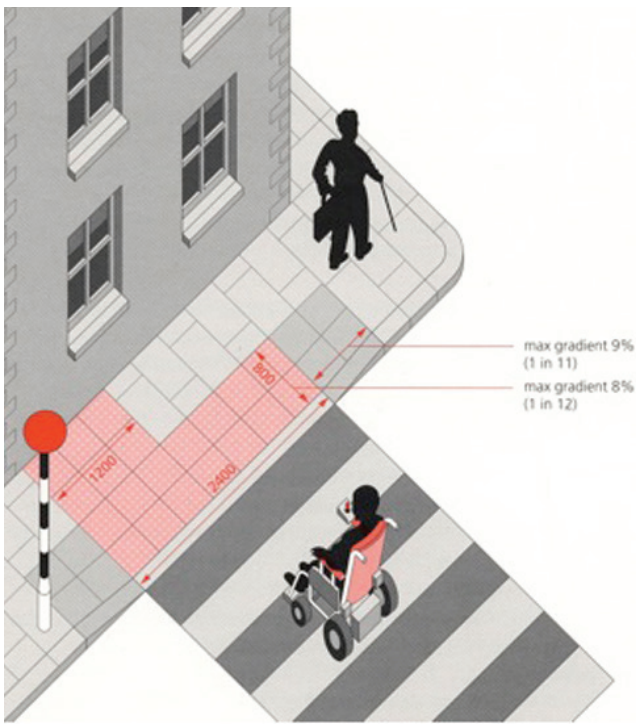


Figure 3: Dropped kerb at zebra crossing. Note level landing beside building (DfT Inclusive Mobility)

Flush dropped kerb with tactile paving and a gentle ramp

Crossing points can be set into the side road to reduce the crossing distance and thus reduces the angle through which people have to turn to check for traffic, but users can be put into a position where they cannot see or be seen (where a high boundary is adjacent to the footway). Utility chambers (especially telecommunications) are often placed in the footway at junctions, which can make the provision of dropped crossings more difficult or costly if adjustments or diversions to utility equipment is required.

6.3.2 Flat-topped Road Humps

Flat-topped road humps (sometimes called "speed tables") can be used as uncontrolled crossings when there is a need to reduce traffic speed (either locally or as a part of a larger scheme) and/or provide a crossing when it is desirable to raise the carriageway levels to those of the footways. They can also be provided across an entire junction becoming a combination of a speed table and side road entry treatment, but care should be taken to ensure that the crossing points are legible. When the carriageway surface is at the same level as the footway, appropriately designed tactile paving should be used to assist visually impaired people to locate the footway edge. When flush crossing points are provided, then the rest of the speed table should have a kerb upstand with the footway.

See Section 6.3.5, Side Road Entry Treatments, for some of the more detailed design considerations in terms of tactile paving and surfacing materials

6.3.3 Pedestrian Refuges and Median Strips

Pedestrian refuges are a relatively low-cost type of uncontrolled crossing and consist of a kerbed "island" generally placed in the centre of the carriageway together with a dropped kerb on each opposing footway.

There will be an area within the island with similarly dropped kerbs (or an area flush with the carriageway) to allow people to wait (the "standing area"). The dropped kerbs and waiting area will generally be provided with tactile paving to allow visually impaired people to locate the crossing position and refuge area.

Refuges and median strips allow people to cross the road in two halves and can be used when gaps in traffic flow can be found, but the gaps in opposing traffic flows do not occur at the same time. They also allow people intimidated by a wide (but not necessarily busy) carriageway to cross in two halves. Refuges can be used within the side road entry of a wide junction and allows people to concentrate of fewer traffic movements at a time. They are particularly helpful for younger and older people and people with learning difficulties, who can find it difficult to judge gaps in the second stream of traffic.

Refuges and median strips (depending on local circumstances) can also be used as part of crossing facilities associated with controlled crossings (zebra, puffin, etc.) and at junctions (controlled or uncontrolled). They can also be shared with people riding bicycles, but it will often be the case that demarcation will be needed to reduce conflict.

It is often the case that refuges are formed with a pair of kerbed/paved units either side of the pedestrian standing area. These kerbed units can also be preformed or constructed from prefabricated steel formers in a D shape, although the latter can sustain damage and present a sharp edge to the tyres of vehicles (especially when the running lane is narrow). Precast and preformed products are also widely vailable.

Flat-topped road hump across entire junction. Flush kerb and tactile paving provided at crossing points with upstand left elsewhere

Refuges can be provided at a variety of widths, which depends on site conditions. A width of 1.2m is the absolute minimum that can be provided and still contain traffic signs/illuminated bollards. Although "keep left" bollards and/or signs are often justified, they are not always necessary, and so local context is important. Refuges will need to be conspicuous both day and night because of the risk of vehicle collision. A distance of 1.2m is inadequate for more than individual pedestrians and are not wide enough for those using wheelchairs, mobility scooters, or pushchairs. If all users are to be accommodated, then a 2m-wide refuge is required (1.8m as a minimum); otherwise, a different type of crossing will need to be considered.

The length of a refuge will determine the number of people who can cross together, and the overall area will determine the standing capacity where a group of people are crossing together. The standing capacity of a refuge should reflect the volume of people likely to cross at peak times, and consideration should be given to volumes of people accessing the refuge from both directions at once.

Refuges should be positioned where the majority of people wish to cross, but if this cannot be accommodated because of compelling safety or space reasons, then it may be acceptable to use pedestrian guardrail, signage, or a tactile surface to guide people to the crossing place (see Section 4.8 for matters relating to guardrails). Refuges should not be sited where pedestrians and drivers cannot maintain a view of each other. When parked vehicles obstruct these views and the refuge is in the best place, then the imposition of waiting restrictions will be required.

Refuges near bus stops help with accessibility to bus services, but if they are too close, then traffic flow may become blocked by a stationary bus, and some drivers may decide to pass on the wrong side of the refuge. Bus stops on opposite sides of a road should be positioned so that buses stop tail to tail, with a pedestrian crossing between them (see Planning for Public Transport in Developments Chapter 6: CIHT1999).

Refuges/median strips can create significant problems for people riding bicycles where drivers attempt to overtake them close to or at the refuge position. When remaining lane widths are less than 4.5m (as in many urban situations), there is insufficient space for drivers to overtake comfortably. Different crossing facilities may therefore be required in such cases. If the alternative is a controlled crossing, this may be cost-prohibitive or create safety problems for pedestrians if the crossing is lightly used, and those driving through on a regular basis do not expect to stop.

Unless a refuge is also provided, flat-topped speed humps will not allow crossing of the road in two halves and may not be appropriate on a major route if they would create unacceptable impacts on bus operations or the emergency services. It might be better to make the refuge larger and reduce the traffic lane to 3m so that people riding bicycles can dominate the lane over traffic when passing the refuge, although this will not be acceptable to most people because of intimidation by vehicles. Refuges are also features that can assist with reducing traffic speeds, and so consultation with user groups will be important. Clearly, the use of refuges demonstrates the competing demands for road space.

Pedestrian Refuge: wide and deep enough for use by both pedestrians and people riding bicycles

Median strips are areas between two carriageways (often in high street situations) where people can pause between the two opposing flows of traffic to cross in two halves and can be formally provided or informally used. People can also walk along a median strip whilst waiting for a gap to appear, and so their progress is less impeded than where statically waiting to cross.

Some people will use areas of carriageway hatched with road markings to pause (although never designed for pedestrians). Others may use kerbed and paved or grassed areas to cross. When specific provision is made, paved areas with materials providing a contrast to the carriageway should be used. These areas are sometimes available for traffic to use occasionally to pass stationary vehicles.

The disadvantage with this type of provision is that many people need dropped kerbs to be able to cross the road, and so if a median strip is being designed, it should have clear locations with dropped kerbs at regular intervals or be complemented with more formal crossing facilities, and in this case, similar design considerations to refuges would apply.

Both refuges and median strips might encourage drivers to stop to allow people to cross, as they know that there is a safe area in the carriageway for people to be crossing in two parts. Like refuges, median strips can create poor cycling conditions if the traffic lanes are narrow.

6.3.4 Kerb Build-outs

To reduce the crossing width, an area of footway can be built out into the carriageway. Build-outs can be used with both controlled and uncontrolled crossing facilities. Depending on the site circumstances, two-way traffic will be maintained (with narrower lanes) or traffic will be expected to pass on a "give-and-take" basis or with priorities shown. Kerb build-outs reducing the crossing distance for pedestrians and can improve the visibility between pedestrians and motorists (Figure 4). As with pedestrian refuges, the arrangement can create pinch points for people riding bicycles.

6.3.5 Side Road Entry Treatments

This type of crossing is generally uncontrolled (but can include traffic signal or zebra crossings, subject to site conditions) and relies on raising the carriageway to the same level as the footway. In some cases, the side road is narrowed or the radius of the junction kerb line is reduced, with the aim of reducing traffic speed entering and exiting the side road.

Some entry treatments simply use coloured surfacing, paving texture/types, or signs to convey a message. For example, red surfacing within the side road of a junction

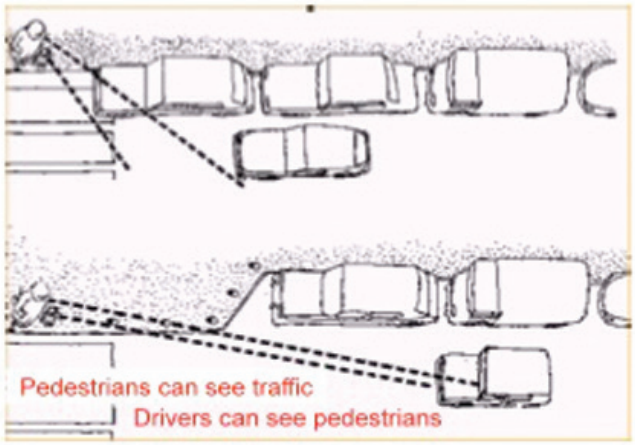


Figure 4: Kerb build-outs can improve pedestrian visibility

is sometimes used in addition to traffic signs and road markings to denote the start of a 20-mph zone.

For traffic entering the side road, the entry treatment can help explain to the driver that they are entering a street, which may have a different character to the main road (leaving a main road for a residential street for example). Entry treatments can also assist people with mobility impairment in crossing the side road as the levels are similar to those of the footway.

Entry treatments can create some ambiguity as to who has priority, although a pedestrian already crossing should be given priority by drivers. Some drivers may give way to pedestrians and some pedestrians may assume they have priority, and so it is important to look at the local conditions. Drivers giving way whilst turning

Kerb build-out

into the side road may not be expected by those following (notwithstanding that they may be following too closely), leading to shunt collisions, although the low speeds promoted will go some way to mitigate the issue, and this is not considered a major consideration.

Selection of materials can also send messages to users. If the entry treatment is surfaced in materials similar to the surrounding carriageway, then pedestrians are more likely to assume traffic priority. If surfaced in materials similar to the footway, then pedestrians may assume priority.

The design of the entry treatment should provide for tactile paving appropriate for the site.
Tactile paving should be provided where the footway is left flush with the carriageway; otherwise, visually impaired people may not be aware they are walking into the carriageway. There will be a trade-off between the junction radius and providing the crossing point on the desire line and the need to cut tactile paving when meeting a radius kerb. The issues of insetting the crossing position are in Section 6.4.

Entry treatments where the carriageway is raised could fall within the Highways (Road Humps) Regulations 1999; and therefore, certain design and consultation criteria would apply (TSO1999). In general terms, the regulations stipulate that a hump (including a flat-topped speed table being used as an entry treatment) should be between 25 and 100mm high and at least 900mm in length, and certain organisations must be consulted before a decision is taken on implementation. There is no prescription on the shape of road humps or appropriate ramp gradients, but the designer should be able to show whether or not the treatment is a hump for the purposes of the regulations.

Side road entry treatment using a speed table

6.3.6 Blended or Continuous Footway Junctions

Common outside the UK, this type of treatment continues the footway across a side road at the general footway levels and with the general footway materials, strengthened for traffic use. Drivers are expected to give way to pedestrians and negotiate the crossing of the footway as they would if using an access to a private site. This approach can used with cycle tracks in parallel with the footway.

As most users will not be familiar with the layout, some pedestrians may feel intimidated continuing along a footway, which goes over a side road and engagement with access groups is recommended.

Blended junction, Bromells Road, Clapham. Footway continues across junction using slightly smaller element paving for strength

6.4 Controlled Crossings

6.4.1 Zebra Crossings

Zebra crossings are a type of controlled crossing and provide priority for pedestrians over traffic, but they are not appropriate in all circumstances.

Zebra crossings work well where traffic and pedestrian flows are relatively low. As flows get higher, their operation can break down as large numbers of pedestrians may prevent traffic moving; and large vehicle flows may prevent pedestrians establishing themselves on the crossing. Similarly, where traffic speeds are higher than about 30mph, pedestrians will find it difficult to use the crossing, and in these circumstances, another crossing type should be considered or vehicle speeds reduced.

Zebra crossings are more flexible in terms of positioning and accommodating desire lines than signal-controlled crossings that need to be set back from junctions as drivers may mistake them as controlling the whole junction. In general, zebra crossings should not be positioned within 5m of a junction approaching a side road.

Visibility is important at any crossing. Drivers and pedestrians must be able to see and be seen, and drivers must be able to register the presence of a crossing in time to slow down and stop. An 85th percentile speed of 30 mph would normally require a minimum forward visibility of 50m (DfT1995a). They can be flexible when pedestrian flows vary during the day. For example, when placed on a desire line near a railway station, the high pedestrian flows generated at peak times can efficiently cross the road without having to wait. At quieter times, traffic will not be hindered, and smaller groups of pedestrians and individuals are able to cross on demand.

The layout, traffic signs, and road markings used at Zebra crossings are prescribed in legislation (TSO2015). They are indicated by the familiar flashing yellow globes on black-and-white striped posts (known as Belisha beacons). The white stripes of the posts may also be internally illuminated.

On the approaches and exits to the crossing, zigzag markings must be provided along the edge of the carriageway to create the "controlled area." Within this area, waiting, loading, and overtaking is prohibited except in some specific circumstances. The regulations require a standard number of eight zigzag markings on both approach and exit, but there is considerable flexibility on how they can be placed and their dimensions. The layout used will depend on the carriageway width, traffic flow direction, whether a refuge is provided and other site specific circumstances.

The waiting and overtaking bans imposed by the zigzags keep the crossing area clear to help maintain visibility of the crossing for all users. While eight zigzags is the standard number required under the regulations, they can be reduced where the highway authority considers the layout or character of the road makes it necessary. An absolute minimum of two zigzags must be provided on both approach and exit sides of a crossing.

It should be noted that this flexibility is not intended to be a means to providing parking bays near zigzags or to allow reduced numbers of zigzags to be provided for purely aesthetic reasons. Reducing markings for these reasons can risk reducing visibility.

It should also be noted that where a crossing is provided on a build-out so that a lay-by is created next to the crossing, the zigzags must follow the kerb line into the lay-by. Providing parking behind zigzag lines is not permitted within the regulations.

Zebra crossing

Zebra crossing with refuge

Pedestrian refuges may be incorporated in the layout of a zebra crossing, which may be useful when the carriageway is wide or slow/stationary traffic can mask the visibility of people crossing (although this can create a pinch point for people riding bicycles). Additional yellow globes are required when a refuge is provided as drivers (and people riding bicycles) are able to treat each half of the crossing as a separate crossing. In some situations, this can be helpful in maintaining traffic flow.

The regulations governing road humps do not allow them to be placed within the controlled area of a zebra crossing or within 30m of the centre of the crossing area (TSO1999), but they are permitted if centred on the crossing point (as a speed table) and can extend either side for whatever distance is required so long as the hump is equally covering the approach and exit to the crossing. Suitable traffic signs should be provided to warn drivers of the layout unless within a 20-mph zone.

At night, the safe operation of a zebra crossing relies on approaching drivers being able to see pedestrians clearly, not only on the crossing itself but also on the adjacent footways. Streets with significant numbers of pedestrians should be lit to a high level which will normally provide adequate illumination of any zebra crossing within the area. Sites should be inspected in the dark to be able to understand any prevailing site conditions, including the risk of glare for drivers. An experienced street lighting engineer should be involved in the design of pedestrian crossings.

Direct illumination of the crossing and footways may be desirable. Spot lights attached to beacon posts do not give a satisfactory level of illumination, and so the use of lighting columns to act as beacon posts is more suitable. These posts have the lower section painted with black-and-white stripes with the amber globes either bracket mounted or centre mounted onto the post at an appropriate height. Lanterns with asymmetric photometry are then used on top of the post to vertically illuminate the crossing and footways, which directly lights the person waiting or crossing. This type of arrangement can be costly but is very effective and has become the norm for many highway authorities.

6.4.2 Signal-Controlled Crossings

Stand-alone signal-controlled crossings share many similarities with zebra crossings in terms of design and layout, the use of refuges and flat-topped speed tables, and forward visibility. However, they should normally not be placed within 20m of a junction, as there is a risk that drivers will mistake the associated traffic signals being present to control the junction.

There are four types of signal-controlled crossing:

- **"Pelicans" are the oldest type of crossing and are for pedestrians only. They use far-side pedestrian signals with red and green figures, and red, amber and green signals for traffic. The steady green "invitation-to-cross" figure is followed by a flashing green figure/flashing amber phase, both of which are fixed. New pelican crossings are not permitted, and they will be gradually replaced with the modern PedX or puffin crossings as they reach the end of their working lives. For the purposes of this document, it is assumed they are no longer a design option.**

Photo 22: Pelican crossing

- **"PedX" crossings are for pedestrians only. They use far-side pedestrian signals with red and green figures and standard vehicle signals. They are effectively a junction facility provided as a stand-alone crossing. The steady green "invitation-to-cross" figure is followed by a blackout, while drivers see the usual traffic signal sequence.**
- **"Countdown" is an optional addition to the PedX crossing (and so not a crossing in its own right). It uses an extra aspect to count down the blackout period - the amount of time left to cross the road when the green figure goes out. The blackout is a fixed period, and as such, countdown is not compatible with situations where a variable blackout is used.**
- **"Puffins" are for pedestrians only and use near-side pedestrian demand signals with red and green figures. The steady green "invitation-to-cross" figure is followed by an all-red period in which both pedestrians and drivers see a red signal. Drivers see the usual traffic signal sequence of red, red/amber,**

Puffin pedestrian aspect

and green. They have an extendable all-red crossing period, which is demanded by both kerbside and on-crossing detectors.

- **"Toucans" are for both pedestrians and people riding bicycles and use either far-side or near-side pedestrian/cyclist signals, but generally follow puffin detection principles and are demanded by push button. Many highway authorities are opting for near-sided pedestrian/cycle signals.**

The basic sequences of the signals used at signal-controlled crossings are shown in Table 4.

The prescribed traffic signals, signs, and road markings for signal-controlled crossings are set out in TSRGD. They are required to have the same zigzag-controlled area as zebra crossings (see above).

The general siting arrangements are the same for all arrangements. The use of kerbside and on-crossing detection for puffin crossings gives significant advantages to both pedestrians and drivers. The on-crossing detection allows the all-red period to be extended for those that need more time, for example, some elderly people or for large groups. When people cross before being invited by the green man, the demand can be cancelled without requiring vehicles to stop, reducing delays for drivers.

Countdown is intended to help pedestrians by giving them more information about how much time is available to complete their crossing. However, it may lead to some feeling hurried or intimidated and therefore discouraged from using the crossing.

Signalised crossings require vehicle speed detection. In lower speed situations, microwave vehicle detectors (MVDs) will be used. When 85th percentile speeds of above 35 mph are encountered, then it is likely that vehicle speed detection loops will also be required. The provision of these loops with associated ducting and draw pits will substantially add to the cost of the crossing.

All signal-controlled crossings must use approved equipment and must comply with current regulations regarding position and mounting height.

Toucan crossing, far-side aspect

Countdown aspect

Table 4: Basic signal sequences for signalised crossings

Pedx		Pedx With Countdown		Puffin		Toucan	
Pedestrian	Driver	Pedestrian	Driver	Pedestrian	Driver	Pedestrian/ Cyclist	Driver
		Countdown					
	Red signal to vehicles, red man (plus cycle for toucan)						
	Green signal to vehicles, red man (plus cycle for toucan)						
	Blackout to pedestrians/cyclists (toucan), no signal lit						
	Red and amber signal to drivers (stop)						
	Amber signal to drivers (prepare to stop)						
Countdown	Countdown aspect to pedestrians						

Two signal heads must be provided on each approach to enable drivers to see one signal head clearly on approach and one while waiting at the stop line. At most crossings, this can be normally achieved with one primary and one secondary signal, the latter mounted at either the centre or off-side of the road. The use of "primary" visors (which are cut away) on the secondary signal heads is normally recommended to improve the visibility of the signal from the stop line.

However, if the road is particularly wide or the approach alignment is poor, it may be necessary to install additional signals. In these circumstances, the provision of extra signals needs to be carefully considered at the design stage. The aim should be to provide the minimum number of signal heads necessary.

While reducing the number of signs and posts is generally desirable, in the case of traffic signals, the risk of driver confusion and distraction caused by too many signs on the signal posts should be borne in mind. For this reason, the types of additional signs that can be mounted on signal posts have been restricted to those prescribed in TSRGD.

Access for maintenance should be a key consideration, and trees and other vegetation should be trimmed to keep sight lines clear.

The push buttons should be mounted so that the push button is between 1.0 and 1.1m above the ground and on the right-hand side from the point of view of someone crossing.

For toucan crossings, push-buttons are provided on both the left and right sides. For puffin crossings, the box should be mounted to the right of the pedestrian and at the kerb edge nearest to the approaching traffic. This may mean that additional push buttons are needed for staggered crossings.

6.4.3 Two-Stage Signalised Crossings

Two-stage signalised crossings are commonly used when the carriageway is particularly wide, and people may have difficulty crossing in one stage. They can also help balance traffic delays by splitting the crossing movement. Two stage crossings can either be staggered or straight through (nonstaggered). Two-stage signalised crossings can lead to long delays for pedestrians and require more room than single-stage crossings, as a relatively large central

refuge island must be provided as a waiting area. The size of the waiting area should be large enough to accommodate the expected numbers of pedestrians and to cater for people using wheelchairs, mobility scooters or pushchairs. Providing a staggered toucan crossing is rarely acceptable because of the difficulty of people riding bicycles have in negotiating the stagger and the potential for conflicts with pedestrians.

In general, when a carriageway is between 11 and 15m, a two-stage crossing may be considered. When the carriageway width is over 15m, a two-stage crossing is more likely to be required.

If a staggered crossing is provided, then it should be arranged so that those waiting within the refuge area are facing oncoming traffic (a left/right stagger). A right/left stagger may be needed in some situations for traffic capacity reasons. Traditionally, guardrails have been used to form a central waiting area, and this may be appropriate on high-speed roads, but in low-speed situations, a kerb upstand within the refuge area may suffice. This will provide some protection for pedestrians and allow visually impaired people to negotiate the stagger without the need for unsightly guardrail. This arrangement also allows people to ignore the stagger and cross in one movement if they feel comfortable to do so, maintaining their desire line.

Two-stage nonstaggered toucan crossing with nearside aspects to prevent "see through"

Straight-through two-stage crossings should be installed with a relatively wide central area or with the two crossings at different angles (with a decent waiting area between). This arrangement will work best if the central area is wide enough to make it clear to users that the crossing operates in two distinct stages so that they are not likely to mistake a green signal intended for the second stage of the crossing. Use of nearside pedestrian signals will help with potential see-through issues. Care should be taken to ensure that the correct tactile paving and push button arrangement is provided. As the crossings are separate, pedestrian aspects for each crossing are needed and care should be taken to avoid "see through" from one crossing aspect to the other crossing. As a starting point, a waiting area of 4 to 5m should be considered appropriate for this arrangement.

6.4.4 Audible and Tactile Signals

At stand-alone signalised crossings, or at junctions where traffic is held at an "all red" to allow pedestrians to cross, audible signals should be provided to assist visually impaired people. The audible signal sounds during the steady green figure phase. Audible signals are not suitable when there are multistage crossings owing to the potential for people to mistake the signal given on one arm for that on another, potentially allowing them to step into traffic.

Tactile cone under a push button

Tactile signals should always be provided at all signal-controlled crossings. These consist of a small ridged cone fitted to the underside of the push button unit that rotates when the green figure is shown. Their provision is particularly important when audible signals cannot be provided or are switched off overnight (to avoid disturbing people living close by), as they then become the only means by which visually impaired people can navigate the crossing.

6.4.5 Use of High-Grip Surfacing

High-grip surfacing may be provided on the approaches to controlled crossings. If provided, it should be extended to the crossing studs to reduce the risk of vehicle brakes locking between a high-grip surface and the prevailing (lower-grip) surface. If coloured high-grip surfacing is being used, care should be taken that it does not detract from the clarity of the crossing markings. Coloured high-grip surfacing generally has a shorter design life than black/grey.

Some designers use coloured high-grip surfacing on the approach to the stop line and black/grey between the stop line and studs, but this does create additional maintenance complications.

High-grip surfacing should be applied to an existing carriageway surface that is sound; otherwise, design life will be reduced. Failed high-grip surfacing can mean a loss of grip continuity, which can cause loss of control-type crashes; powered two-wheelers are particularly vulnerable. In terms of the length applied, 1m per 1 kph before the stop line is often used as a general guide and equates to 50m of surfacing at 50 kph (30 mph), although measured 85th percentile speed should be used rather than posted speed limit.

Some designers do not specify high-grip surfacing if it can be shown through speed measurement, grip testing, and with consideration of local conditions. Some proprietary inlaid surfacing can achieve high levels of skid resistance and may be desirable for some applications.

If a crossing needs highlighting with coloured surfacing, the designer should consider if the style of crossing is in the correct position or appropriate, as there may be a need to reduce actual traffic speeds or improve forward visibility.

Coloured surfacing should not be placed on the approaches to an uncontrolled crossing, as it may confuse drivers and pedestrians who might think the rules of a controlled crossing apply. Some designers specify coloured surfacing to highlight the crossing area on signalised crossings. This is not a requirement but might help highlight the crossing area. Coloured surfacing within the crossing area of a zebra crossing is discouraged because of the requirement for black-and-white stripes, although the black tends to be the prevailing carriageway surface colour. If the prevailing carriageway surfacing is highly coloured, then black stripes may need to be painted or a section of surfaced in black materials.

6.5 Traffic Signals at Junctions

The incorporation of signal-controlled crossings at junctions can include near side or far side aspects depending on site layout, including toucan crossings and countdown. They use the same signals and sequences as the puffin or PedX crossings described above. Detailed advice is given in Traffic Advisory Leaflet 5/05: Pedestrian facilities at signal-controlled junctions (DfT 2005b).

All-round pedestrian phases can be provided, in which all traffic is stopped to allow pedestrians to cross. These provide the best service to pedestrians, as the crossing time is clear and unambiguous, and can be provided with audible signals, but they can have an adverse effect on junction performance in terms of cycle time for all users. An all-round phase can facilitate the provision of diagonal crossings.

Multistage crossings are often used within junctions to allow pedestrians to cross with certain vehicle movements. They are generally a product of providing for maximum vehicle capacity rather than pedestrian

Multistage crossing at a junction

convenience. To cross a single arm or to get to the opposite corner, several crossing stages have to be negotiated. Waiting areas for pedestrians should be large enough to accommodate the expected numbers of pedestrians, particularly people using wheelchairs or pushchairs who also need space to turn.

Diagonal crossings can be used when there are very high pedestrian demands and an "all-red" traffic phase. The most well-known example is Oxford Circus in London, which has two diagonal crossings. Because of the complexity of the crossing and following consultation with access groups, it was decided to exclude dropped kerbs and tactile paving on the diagonals because they could provide a confusing layout and many users preferred to use the crossing points on the arms of the junction. The scheme also reallocated areas of road space to pedestrians in what is a very busy shopping and tourist area.

6.6 Grade-Separated Crossings

Grade-separated crossings have been traditionally used when people are at high risk when crossing roads with fast and heavy traffic flows. Footbridges and underpasses/subways have been used to ensure that people are physically safe from traffic, but they can create problems of personal safety (especially with subways) and can create longer and more inconvenient pedestrian routes with people often having to contend with stairs and ramps. Many people feel safer being nearer traffic on the basis that they are provided with natural surveillance rather than the isolation that grade separation can bring if not properly designed. In addition, footbridges and subways carry long-term ongoing maintenance liabilities. Unless a well-designed accessible installation is possible, and acceptable to all users, other options should be considered.

Footbridges mean that crossing the road can take place without having to wait for a crossing opportunity and does not affect traffic capacity, but the layout of ramps and steps can make the actual walking distance far greater than at the surface

The most successful examples of grade separation are those where natural desire lines are fully accommodated, personal security and isolation problems are not created and when it is the traffic which undergoes the change in level. The change in level for a subway is less than for a footbridge, as the clearance height for pedestrians is 2.5m compared to 5.03m for road traffic.

Any change of level should be accommodated with ramps on the desire line, with stairs provided as a secondary facility. One of the issues with footbridges and subways is that to maintain a comfortable and usable ramp at an accessible gradient, it will be very long. A maximum gradient of 5% (1 in 20) for a ramp, together with flat landing areas, can create substantial land take for a footbridge or a subway and can make the length of crossing a substantial diversion compared with crossing at-grade. Inclusive Mobility (DfT2002) provides detailed layouts.

Grade separation does not necessarily mean that pedestrians change level from their desire line. It could mean that the road to be crossed is raised on a flyover or lowered within a cutting or tunnel (letting vehicle engines do the work of overcoming the gradients). This type of treatment is only likely to be considered for a major project, but it would be very direct and convenient for pedestrians.

Oxford Circus, London: All-red traffic phase letting people cross on all four arms of the junction as well as both diagonals

Footbridges should be at least 2m wide (1.8m absolute minimum) and at least 4m if being used by cyclists, who will also need a higher parapet - 1.15m for pedestrians, 1.4m for cyclists, and 1.8m for equestrians (where the rider expects to be mounted). When the site is exposed or there is a risk of objects being thrown on the carriageway below, then the bridge might need to have a much higher parapet or in extreme cases, be covered with a headroom of least 2.3m and higher if used by cyclists.

A footbridge will potentially be a very prominent structure, and so it may be appropriate for a design team to have access to advice on aesthetics. Some bridges may be suitable as a landmark structure; others will need to blend into surroundings. As is often the case, the decisions will be made on the individual site circumstances, but function and convenience for users must take precedence.

Subways should be designed with clear through visibility, which will lessen the effects of some people being averse to going underground. Designs without areas for people to hide will help reduce the concerns with personal safety. Materials that reflect available light and deaden sound should be used.

If people riding bicycles are to share a subway, then the widths should be increased to facilitate ease of use. A minimum headroom of 2.3m is also required, although 2.5m is better. "No cycling" signs are often placed at subways because of a perception that bicycles are dangerous. The design and safety considerations should be no different than from providing any facility (whether shared-use, shared-segregated, or separated), and the designer should remember that riders face the same difficulties in crossing the road as pedestrians. Given the high cost of providing a subway or a bridge, they should be designed for use by both those walking and cycling.

Footbridges and subways should be surfaced with appropriate nonslip materials, be properly drained, and have handrails on both sides of any stairs and ramps. Step nosings and handrails should be in a contrasting colour to assist visually impaired people.

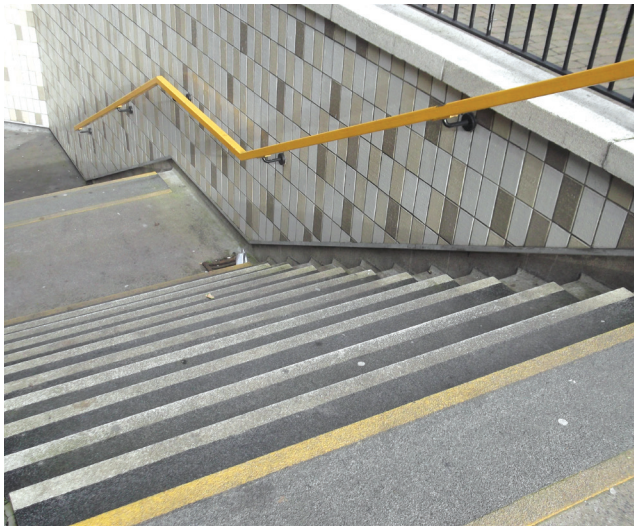
Wayfinding may be helpful so people can easily reach their destination, especially when several subways are used together (into and out of large roundabouts or gyratories, for example). They should be well lit, and at a human scale, avoiding deep shadows, provide good colour rendering of surfaces, and with vandal-resistant luminaires to ensure that they are always available for use. It is also important to select materials that are easy to maintain and keep clean, as a dirty or vandalised facility will keep people from using it.

6.7 Roundabouts

Roundabouts are provided to improve traffic flow, which can create problems for people wishing to cross their approaches. Kerbed roundabouts often have wider and multiple traffic lanes, which are clear barriers to walking. Multilane approaches can mean that people crossing one lane of traffic are masked and cannot be seen by drivers in other lanes.

It is not recommended that stand-alone signalised crossings are provided within 20m of the give way point on a roundabout arm in case a driver mistakes a green

Shared-use bridge over Rotherhithe New Road, which is at a much lower level than the residential area the bridge serves



Step nosings and handrails in a contrasting colour

signal for priority on the roundabout. This can mean that the crossing point is often taken away from the desire line. Zebra crossings might be acceptable, but the same problems persist with multilane approaches in terms of people crossing being masked.

The best solution for pedestrians is to provide a compact (or continental) roundabout, which has single-lane entries and exits, and a tight geometry to promote low speeds. Refuges or zebra crossings can more easily be provided and afford pedestrians a better level of service. Speed tables can be incorporated into the design as well either at the crossing points or as a treatment to the entire roundabout. It might be desirable to set crossing points back from the edge of the roundabout to allow drivers to approach crossings squarely and to allow vehicles to stop without affecting those on the circulatory area of the roundabout.

With mini-roundabouts, the setback of the give way point will mean that any crossings provided (such as a refuge) will also be set back, and so intervisibility with drivers on other arms could be an issue.

6.8 School Crossing Patrols

A school crossing patrol (SCP) enables traffic to be controlled at a very specific location when other crossing facilities may not be appropriate or normally needed or when high flows of children at peak times needs to be managed. Patrols are also known as "lollipops" because of the distinctive sign used by the patrol officer to direct traffic to stop.

The decision to provide a patrol rests with the local authority and a consistent policy with assessment criteria should be developed to manage requests. Criteria could include:

- **Traffic volumes, composition, and speed**
- **Serving main routes to schools**
- **The complexity of the road layout and adjacent junctions**
- **The volume and age of child pedestrians**
- **The availability of a safe waiting place with sufficient waiting capacity**
- **Sight lines and visibility**
- **Street lighting and signing**
- **Traffic fumes**

Patrols can be very flexible in terms of operating location, and their presence can be highlighted with the use of advanced warning signs (children warning sign with "patrol" sub-plate) and flashing amber "wig-wag" warning signals where the 85th percentile traffic speed is higher than 35 mph or forward visibility to drivers is reduced below 100m (often when parked vehicles are an issue).

Careful selection and training of patrol officers is essential, especially when operating on a signal-controlled crossing as a patrol should not stop traffic when the signals indicate otherwise. Patrols can be helpful at zebra crossings in managing pedestrian flow, which would otherwise hold traffic for long periods of time.

Patrol officers find it difficult to operate at locations featuring pedestrian refuges, as they need to cover to halves of a road at once. At a zebra crossing with a refuge, drivers are able to treat the crossing as two separate entities, and it is unlikely that enough standing area is available for high numbers of pedestrians to wait within.

If specific facilities are being planned to assist a patrol, it is vital that the SCP manager is fully involved in the process. Designers interested in the specific issues relating to the operation and assessment of school crossing patrols should consider the advice given in the "School Crossing Patrol Service Guidelines" (RSGB2012).

Crossing patrol sign with "wig-wag" signal

7. Assessment and Monitoring of Routes, Crossings, and Footways

7.1 Overview

There are often competing demands for crossings or walking route improvements, and so a way of assessing and ranking schemes may be useful. For routes, quantitative assessment is more difficult, and frameworks are often more applicable in measuring qualitative aspects. For crossings, there are methods where road traffic capacity versus pedestrian delay can be assessed or frameworks can be used, which provide a more qualitative view. Footways can be assessed for condition, comfort, and capacity.

The CIHT guidelines "Providing for Journeys on Foot" (CIHT 2000) contains a section on the monitoring of pedestrian schemes. Two appendices give checklists for pedestrian schemes, a pedestrian review form for local groups of pedestrians, and a local highway authority mobility checklist.

7.2 PERS

Route assessments will generally be qualitative and involve observation of existing conditions but can use a scoring system such as that used by the "Pedestrian Environment Review System" (PERS).

PERS is a methodology developed by TRL (with input from Transport for London for the second version) for assessing the walking environment, including crossings, streets, and routes. The approach reviews the walking environment by using six review frameworks, which apply to specific components of the pedestrian environment. These are:

1. Links (footways, subways, and footbridges)

Guidance states that links can be divided into sections if very long or reviewed in total

2. Crossings (formal and informal)

This is defined as any designated or undesignated crossing where a pedestrian route intersects with a highway. Auditors are allowed to choose to include side road crossings or not, depending on the audit taking place.

3. Routes (between key destinations)

This is defined as any number of links and crossings and a way that links trip origin and trip destination, such as home to work.

4. Public transport waiting areas (bus stops, tram stops, taxi ranks)

Any designated area where people are required to wait to use public transport, such as bus stops and train stations. Larger public transport waiting areas may be considered as interchange spaces.

5. Public spaces (squares and parks)

These may vary in size from small plazas to parks. The public spaces are defined as not being specifically for pedestrians but used as part of a pedestrian's route.

6. Interchange spaces (spaces between different modes)

This is defined as the areas around and between public transport access points such as train stations and bus stops. They allow travellers to change between transport modes. The guidance states that PERS should only be used to assess the external public interchange space (under local authority control), not the interior.

The six components are broken down further into parameters. The following tables outline the parameters, which aim to examine both infrastructure and interaction in the pedestrian environment:

PERS audits are coordinated by a trained "assessor" who will give each parameter a score on the -3 to +3 range. The scores should be justified with detailed comments on the reasoning. This data is entered into the PERS software, where it can be sorted, analysed, and used to create graphs and maps. The data can also be compared to maps of pedestrian casualties, crime statistics, and land use data.

The PERS system has five key stages:

1. Definition of the study area

The study area should be defined on a base map, with all the pedestrian environments – links, crossings, and public spaces to be reviewed. All auditors should have a copy of the base map.

2. Identification of review stages

In this stage, the complete list of pedestrian environments should be broken down and divided up amongst auditors. The guidance for auditing these environments should be reviewed.

3. On-street evaluation

The auditors review their assigned environment using the summary sheets and scoring guides. Scores and comments are noted down for later input into the PERS software.

4. Data input and analysis

At this stage, the scores and comments gathered are entered into PERS software for each environment reviewed. The software assigns each environment and subsections an overall score.

5. Display and review of outputs

The results can be presented graphically using charts or on a mapping system using a green, amber, and red legend.

7.3 Community Street Audits

This methodology was developed by Living Streets (Connolly, Early, and Holdsworth, 2002). Community street audits are a method for evaluating the quality of the street environment from the point of view of people who use it rather than those who manage it.

The methodology is straightforward. Small groups of people walk the area to be audited with a trained facilitator and look for good and bad points along the way. As issues are identified, they are noted on large-scale maps and briefly described on report sheets. At the end of the audit, the facilitator will feed back the findings to ensure that the details are correct. The role of the facilitator is to stimulate discussion on all aspects of the street environment.

Living Streets community street audit methodology introduced eight categories of the pedestrian environment and proposed that all of these need to be considered by traffic engineers, urban designers, land use and transport planners, and other professionals. Living Streets community street audit categories are shown in Table 6.

7.4 Design Guidance: Active Travel (Wales) Act 2013

A walking route audit tool is contained within Appendix B of the Design Guidance: Active Travel (Wales) Act 2013 (WG2013). The audit tool has 20 issues to be

Table 5: Detailed PERS parameters

Link Review	Crossing Review	Route Review
Effective width	Crossing provision	Directness
Dropped kerbs	Deviation from desire line	Permeability
Gradient	Performance	Road safety
Obstructions	Capacity	Personal security
Permeability	Delay	Legibility
Lighting	Legibility for sensory-impaired people	Quality of the environment
Tactile information	Dropped kerbs	
Colour contrast	Gradient	
Personal security	Obstructions	
Surface quality	Surface quality	
User conflict	Maintenance	
Quality of the environment		
Maintenance		

Public transport waiting areas	Interchange Space review	Public Space review
Information to the waiting area	Moving between modes	Moving in the space
Infrastructure to the waiting area	Identifying where to go	Interpreting the space
Boarding public transport	Personal safety	Personal safety
Information at the waiting area	Feeling comfortable	Feeling comfortable
Safety perceptions	Quality of the environment	Sense of place
Security measures	Maintenance	Opportunity for flexibility
Lighting		
Quality of the environment		
Maintenance and cleanliness		
Waiting area comfort		

examined over five categories and can be applied to existing or proposed routes:

- **attractiveness**
- **comfort**
- **directness**
- **safety**
- **coherence**

Each of the 20 issues are given a score: 0 for poor provision, 1 for adequate provision, which should be improved if possible, and 2 for good quality provision. The Active Travel Act includes a requirement for local authorities to produce maps of active travel routes and related facilities (known as "existing maps"). The maps will inform improvements over time to develop "integrated network maps," and of course, a common methodology is required for route assessment. Currently, any route which scores under 28 (out of 40 points) will require improvement before it can be in the existing or integrated network maps.

Of course, this is an assessment method that can be applied to any scheme, as it gives a consistent basis for scoring, and any threshold can be picked for prioritisation purposes.

7.5 Generic Assessment Methods

Generic assessments can examine many issues such as:

- **capacity**
- **clutter**
- **surface conditions (trips, regularity, etc.)**
- **footway lighting**
- **crossing opportunities**
- **crossings**
- **wayfinding**
- **landscape provision**
- **barriers/obstructions**
- **diversions in the route**
- **bus or tram stop access**
- **personal safety**

Any assessment method should start with setting clear objectives; trying to deal with too many issues at once can make the process overly complicated, and if projects are being ranked, then it will be hard to differentiate. It may be useful to look at issues which can be dealt with more simply first.

If an audit process is being used to rank interventions or compare the "before" and "after" conditions, it is important that auditors follow consistent approaches.

7.6 Crossing Assessment

Crossings can form part of a route assessment as set out previously, but when being assessed as a stand-alone facility, a similar framework approach might be useful.

Local Transport Note 1/95 (DfT, 1995b) provides an example framework for the assessment of crossings, which takes into account both the quantitative and qualitative in developing and choosing options. Although less likely to be used now, it is possible to look at a mathematical relationship between road-traffic and pedestrian flows to determine if a crossing is required (mainly in terms of minimising road-traffic delay) although this does not take into account other important issues such as severance. The type of user at a given location may influence a decision.

Table 6: Community Street Audit Categories

Aspect	Description
Footway surfaces and obstructions	Quality and mix of materials, footway condition, inspection and manhole covers, position, alignment, and condition of street
Facilities and signage	Toilets, benches, litter bins, lighting, trees, and signage for pedestrians
Maintenance and enforcement issues	Litter, footway cleanliness, repair and patching, fly posting and graffiti, and parking enforcement
Personal security	Lighting levels, sight lines, natural surveillance, antisocial behaviour, and escape routes
Crossing points and desire lines	Both formal crossings (zebras, pelicans, and puffins) and informal (no specific provision), including consideration of desire lines (e.g., the routes that people want to take)
Road layout and space allocation	The share of space allocated to different users and the relationship of different elements of the street to each other
Aesthetics	Beauty and interest, public art, fountains, statues, and green space
Traffic	Traffic speed and volume, air pollution, noise, and smell

For example, visually impaired people may feel more confident in using signal-controlled facilities because they are given positive cues when they should cross. The key is to use a method of assessment appropriate to the situation and if ranking sites for treatment, the approach should be consistent.

When pedestrian flows are low and road traffic flows are high, the provision of a controlled crossing will create sporadic periods of congestion, and so a refuge may be appropriate so long as regular crossing gaps appear in the flow. As the balance changes, the type of facility will change to a point where pedestrian flows and traffic flows will both be high, making the decisions on balance more difficult. In these situations, it may be better to look at moving numbers of people (regardless of mode) through the junction, and so the balance may be in favour of pedestrians. When pedestrian flows are high but road-traffic flows are light, crossing opportunities will be more regular, but some users may still feel intimidated.

Caution should be exercised when using pedestrian flows as a guide to need. Low pedestrian flows may be an indication of people being intimidated by traffic or finding it difficult to cross and therefore are not crossing the road. If this is suspected, then it is worth undertaking further local research to see if a crossing would actually encourage people to cross and therefore influence the crossing type. Research could include letter drops to local residents or engagement with community and user groups.

7.7 Footway Assessment

A footway in poor condition will not make its use attractive or comfortable and will often relate to maintenance issues such as trips, depressions, drainage issues, utility trenches, etc. A framework approach can allow different condition aspects to be scored, thus allowing ranking for improvements. Comfort can include similar issues but is also concerned with reviewing aspects such as appropriate longitudinal gradients (especially at in-line crossings), crossfalls, as many users find it difficult to deal with when they are steep (e.g., through vehicle crossings), and surface regularity (but not trips).

Capacity considerations not only would deal with physical width in terms of the numbers of pedestrians who can pass a point over time but also features which intrude on available width such as street furniture and footway parking. Again, many of these issues can be included within a wider route assessment as set out above.

7.8 Prioritisation of Interventions and Consistency

Using assessment frameworks will allow the objective comparisons to be made between competing schemes where resources are limited. It might also be desirable to introduce weighting elements in prioritisation. For example, if a condition survey is undertaken, areas with a higher footfall, near schools or community facilities, may attract a higher weighting.

It is vital that any system used for assessment (and monitoring) is consistent as views between auditors may skew results. Auditors should provide notes to explain how they reached their decision so that others may properly understand their views at the time the audit was undertaken.

7.9 Monitoring Schemes

Local authorities will need to monitor and evaluate the effects of at least some of the pedestrian schemes that they implement. They should identify the actual effects to see if they were similar to those predicted. Schemes most likely to be monitored and evaluated are large schemes, innovative schemes, or a sample of typical smaller schemes, where it is infeasible to evaluate all of them.

Many of the criteria for monitoring will be similar to those used in the appraisal of the scheme prior to implementation, the difference being that actual values can now be used instead of predictions. When feasible, monitoring should also include a survey of users' views. Do pedestrians like the scheme? Do they feel it is safe and convenient to use?

Some schemes, such as the provision of a new pedestrian route or a green commuter plan, may require more than a single "after" survey to properly identify the outcomes. Regular monitoring over a period of several years or more may be required. In such cases, it will be necessary to establish surveys that can be repeated cost-effectively, under the same conditions and with sample sizes that are statistically robust. It is usually not practical to monitor a large range of measures so it will be necessary to concentrate on one or two key indicators.

These may also be the same indicators used in local transport plan targets. It will also be necessary to have one or more "control" sites to provide data on background trends. Questions that will be important to answer include:

- **How have walking flows changed?**
- **Has walking increased or decreased among particular groups?**
- **How do users view the new arrangements and opportunities provided?**
- **How do local retailers and over commercial operators such as proprietors of pubs or cafés view the new arrangements?**

8. Wayfinding

8.1 Overview

The fear of getting lost in an unfamiliar area is a barrier to walking, especially when pedestrian routes are not directly between places of interest. There are a profusion of pedestrian wayfinding systems in the UK, ranging from simple finger-post signs mounted above head height to area-wide designed schemes such as the Legible London project and similar schemes in Brighton and Bristol, which use coordinated finger posts, directional signage at decision points, and maps, which help users plot routes at key points.

Wayfinding does not always rely on mapping information or signs on the street. Landmarks, bus stops, stations, surfacing details, tactile paving, paper maps, and mobile phone applications are also methods by which people navigate the urban environment on foot.

8.2 Design Considerations

When designing any wayfinding system, it is important to understand who the information is aimed at. Thought should be given to aspects such as to what sort of format would suit the end user, whether a direct but perhaps less safe route is preferable to a longer but safer route or if distance or journey time information is required.

If physical infrastructure is being provided, then it should be at the human scale. For example, a finger-post assembly mounted above head height with a dozen destinations is unlikely to be of value to the user. A map rotated to reflect the local street layout viewed from the user's orientation and at eye height might be more helpful.

Street name plates (SNPs) are an underestimated method of wayfinding, especially if used in conjunction with a street map. They are often seen on buildings, on high posts, or low-level posts. Whilst low-level SNPs are at a human scale, text size can be selected so that they are easily seen on buildings, which can help people see their route ahead. Placing SNPs on buildings will require agreement with the owner, and the signs are often lost with redevelopment. Building numbers or names displayed in clear and prominent locations can also help people find their ultimate destination, especially if located within a long street.

Some bus network operators use maps placed with timetable information at bus stops. These can be useful for passengers arriving at a stop wishing to then walk a short distance to their destination or make a note of the location of the stop they need to use for the return journey.

Example of a street map, Bristol

Tactile surfaces can be used by visually impaired people for help with moving through large open spaces – a guidance path surface. This is explained in detail within Section 4.2 of Inclusive Mobility (DfT2002) and Chapter 6 of Guidance on the Use of Tactile Surfaces (DfT2005). It is also desirable to provide information within buildings so that people can find an appropriate exit to start their journey or to be able to plan their walking route. Shopping centres, stations, and other transport interchanges are particularly useful places that provide wayfinding information.

9. Journey End Facilties and Interchange

9.1 Overview

Walking as a mode may comprise the whole journey or just a small part, but the provision of appropriate journey end or interchange facilities will help support the mode. Access points to buildings should be easily identifiable and convenient. For example, with a new office development, the provision of the building's pedestrian access near a bus stop will mean that moving between the building and the bus stop is very convenient.

If there is a direction from which most pedestrians will approach the building, the entrance should be that side rather than around the outside of the building.

Street name plate on railings, which avoids additional posts

Once people who have arrived by car or bicycle are out of their vehicles/off their bicycles, they become pedestrians and will need to continue on to their ultimate destination.

9.2 Considerations

It is important to continue the principles set out in this document as public areas give way to private areas in terms of direct walking routes taking primacy over traffic routes, wayfinding, and route quality.

Journey-end facilities will depend on the circumstances. For an office or a supermarket, it would be appropriate to provide seating and toilet facilities in a public area for the use of visitors or customers at either end of their journey. For employees, somewhere to hang wet coats, lockers, and possibly showering facilities will be of use.

Good-quality, direct, walking routes help make the transition between modes easier. This could incorporate an extension of the local wayfinding system for consistency, maps at bus stops, bus stop names/numbers clearly displayed, or some other way of providing interchange information.

10. Street Features

10.1 Competing Demands

Because of the competing demands on streets and the varied purpose they serve, features and facilities may create positive or negative issues when designing for walking. Footways are often areas where many functions compete for the same space, and so care should be taken so that their use to enable people to walk to and from their destination isn't impaired (traffic signs are often placed within the footway for example). Street features can be useful to visually impaired people, and while clutter-free environments are generally desirable, care should be taken to ensure that large open spaces can still be navigated by all.

10.2 Street Trees

Street trees provide much-needed softening of the urban landscape, can provide shade, and help create a sense of place. When designing layouts using trees, it is useful to get specialist advice from an arboriculturalist who will be able to give guidance on, for example, likely height and spread of the trees which in the future could block the views of CCTV cameras or driver views of traffic signals. For new tree planting schemes, it may be helpful to have a two-year maintenance period to ensure new trees survive through two summers. Trees and planting can also be helpful in some situations where forward visibility needs to be constrained.

Trees can damage the structure of the highway (especially footways), and so appropriate species should be specified. Tree pits comprising root barriers will ensure that roots are encouraged to grow deeply rather than at the surface. The use of porous blocks, asphalt, or resin-bound materials as surfacing to tree pits will allow some movement and can be replaced if damaged. Grills will trap debris and can create a tripping problem if lifted by roots and are generally best avoided. Trees will have a design life and will ultimately need to be felled and replaced.

10.3 Seating

Seating and other places to rest are essential for those with reduced mobility or for people who might need to rest on their journey. Ten percent of adults cannot

walk 400m without a rest, and 5% cannot walk 50m without a rest. Seating can help provide a sense of place as part of a coordinated approach to landscape design, but care should be taken that seating does not obstruct desire lines. Seating can take place informally on features such as walls, steps, or with something installed for the purpose, but purpose-designed seating with the seat at an appropriate height, arm rests, and a back will be of benefit for many users.

10.4 Bus and Tram Stops

The flag associated with a bus stop provides an opportunity to display service information and gives a reference point for bus drivers to stop at. Shelters at bus and tram stops are primarily provided to give waiting passengers refuge from wind and rain. However, the positioning of flags and shelters can affect pedestrian desire lines and available footway width. Heavily used stops create problems for pedestrians when queuing passengers block footways, and so they should be laid out with other users in mind.

10.5 Footway Parking and Loading

Footways are provided for pedestrians and encroachment by vehicles parking or loading reduces the comfort and ease of use of footways, forces pedestrians into the carriageway to pass vehicles (especially people using wheelchairs and pushchairs), and, in some cases, leads to people not wishing to leave their homes, as they feel unsafe. In addition, the surface and structure of the footway can be damaged, and buried utilities can be affected as they are installed far shallower in footways than carriageways.

Informal seating

Footway parking leaves a narrow and unwelcoming environment

In London and in other parts of the country, footway parking is generally prohibited (GLC1974) by traffic regulation orders. A very unusual example of a local variation operates in Exeter where a prohibition similar to that in London exists (ECA1987). Local authorities (which have taken on decriminalised parking enforcement) have a wide variety of policies in terms of what is deemed acceptable for footway parking, but in general, the effective footway widths set out in Section 4.2 above should be the first point of reference.

A minimum desirable width of 1.5m left for pedestrians might be acceptable in limited circumstances to facilitate footway parking, but over long distances and with walls, fences or hedges adjacent to a footway as well, it creates an unattractive and, in many instances, an intimidating environment to walk along. Footway parking is often provided or tolerated to keep the carriageway free for traffic flow or when off-street parking is limited or not available, but this is not conducive to quality provision for pedestrians.
In cases where footways are very wide or a decision has been taken to provide footway parking with minimum effective footway widths, the designer should consider other issues such as the following:

- **Impact of footway parking near junctions and crossings where pedestrians and drivers have their views reduced by vehicles parked on the footway.**
- **Further reduction in effective width caused by street furniture, telecommunications cabinets, etc.**
- **Potential need to strengthen footways sufficient for parking rather than foot traffic.**
- **Consultation with utility owners in terms of impact on buried utilities and impact of vehicles being parked over access covers.**

Footway loading provision creates similar issues to those of footway parking, although the stopping of vehicles is more likely to be for short periods of time. However, delivery vehicles are substantially heavier and wider than cars and this needs to be taken into account for any designed facility.

Footway loading bays can be a benefit where highway space is generally being reallocated to footway provision, but loading facilities are still required for adjacent premises (which may have no other means for deliveries). A single surface footway loading bay or "loading pad" (often provided in a contrasting paving material) is open for use by pedestrians when not needed for loading and can address frontager concerns on such schemes. Such bays can be restricted by time so that the footway is fully available at the busiest pedestrian times.

Level surface footway loading bay allows for essential servicing of shops but is fully available to pedestrians when loading is not taking place

10.6 Anti-terrorism

Bollards and other physical measures are increasingly being used to protect key buildings and infrastructure from terrorism in the form of a vehicle-based explosive devices. The impact of such attacks depends on the size of the device and how close it can be placed to the sensitive location (known as "stand-off") and in many cases, the separation between the carriageway and a building that a footway offers is attractive to designers in terms of the reduction of blast impact. However, the placement of physical measures creates many issues similar protecting footways as set out in Section 4.9 and severely degrade the level of service for pedestrians.

10.7 Control Barriers and Bollards

Guardrail and bollards have been dealt with above, but there is a specific issue where they are used to prevent vehicle, motorcycle, or bicycle access to alleyways or short footpath links. The use of staggered barriers is widespread, and while they may deal with unauthorised access, they exclude people using wheelchairs, mobility scooters, and pushchairs. The pragmatic solution is to use a single bollard or line of carefully placed bollards to prevent car access (1.7m centres deal with most situations). Unauthorised access by motorcycles will need to be dealt with by enforcement. For cycling, if there is space, then it is better to design to allow access with enforcement being a last resort.

Arrangements of staggered barriers can completely prevent access for some users

10.8 Cycling

Although this document is about designing for walking, it has touched on some cycling issues. Design guidance for high-quality cycling infrastructure is emerging, but it is clear that designing for cycling should not adversely affect pedestrians, and so features such as shared-use, unsegregated cycle tracks and crossings are less favourable in many instances, and it is recommended that designers keep themselves appraised of current developments.

Multistage crossing at a junction

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12. Useful Resources

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