Detailed design issues
Street users’ needs
6.1 Introduction

6.1.1 Street design should be inclusive. Inclusive design means providing for all people regardless of age or ability. There is a general duty for public authorities to promote equality under the Disability Discrimination Act 2005.\(^1\) There is also a specific obligation for those who design, manage and maintain buildings and public spaces to ensure that disabled people play a full part in benefiting from, and shaping, an inclusive built environment.

6.1.2 Poor design can exacerbate the problems of disabled people – good design can minimise them. Consultation with representatives of various user-groups, in particular disabled people, is important for informing the design of streets. Local access officers can also assist here.

6.1.3 Designers should refer to Inclusive Mobility,\(^2\) The Principles of Inclusive Design\(^3\) and Guidance on the Use of Tactile Paving Surfaces (1999)\(^4\) in order to ensure that their designs are inclusive.

6.1.4 If any aspect of a street unavoidably prevents its use by particular user groups, it is important that a suitable alternative is provided. For example, a safe cycling route to school may be inappropriate for experienced cyclist commuters, while a cycle route for commuters in the same transport corridor may be unsafe for use by children. Providing one as an alternative to the other overcomes these problems and ensures that the overall design is inclusive.

6.1.5 This approach is useful as it allows for the provision of a specialised facility where there is considerable demand for it without disadvantaging user groups unable to benefit from it.

6.2 Requirements for pedestrians and cyclists

6.2.1 When designing for pedestrians or cyclists, some requirements are common to both:
- routes should form a coherent network linking trip origins and key destinations, and they should be at a scale appropriate to the users;
- in general, networks should allow people to go where they want, unimpeded by street furniture, footway parking and other obstructions or barriers;
- infrastructure must not only be safe but also be perceived to be safe – this applies to both traffic safety and crime; and
- aesthetics, noise reduction and integration with surrounding areas are important – the environment should be attractive, interesting and free from graffiti and litter, etc.

6.3 Pedestrians

6.3.1 The propensity to walk is influenced not only by distance, but also by the quality of the walking experience. A 20-minute walk alongside a busy highway can seem endless, yet in a rich and stimulating street, such as in a town centre, it can pass without noticing. Residential areas can offer a pleasant walking experience if good quality landscaping, gardens or interesting architecture are present. Sightlines and visibility towards destinations or intermediate points are important for pedestrian way-finding and personal security, and they can help people with cognitive impairment.

6.3.2 Pedestrians may be walking with purpose or engaging in other activities such as play, socialising, shopping or just sitting. For the purposes of this manual, pedestrians include wheelchair users and people pushing wheeled equipment such as prams.

6.3.3 As pedestrians include people of all ages, sizes and abilities, the design of streets needs to satisfy a wide range of requirements. A street design which accommodates the needs of children and disabled people is likely to suit most, if not all, user types.

6.3.4 Not all disability relates to difficulties with mobility. People with sensory or cognitive impairment are often less obviously disabled,
so it is important to ensure that their needs are not overlooked. Legible design, i.e. design which makes it easier for people to work out where they are and where they are going, is especially helpful to disabled people. Not only does it minimise the length of journeys by avoiding wrong turns, for some it may make journeys possible to accomplish in the first place.

6.3.5 The layout of our towns and cities has historically suited pedestrian movement (Fig. 6.1).

6.3.6 Walkable neighbourhoods should be on an appropriate scale, as advised in Chapter 4. Pedestrian routes need to be direct and match desire lines as closely as possible. Permeable networks help minimise walking distances.

6.3.7 Pedestrian networks need to connect with one another. Where these networks are separated by heavily-trafficked roads, appropriate surface level crossings should be provided where practicable. Footbridges and subways should be avoided unless local topography or other conditions make them necessary. The level changes and increased distances involved are inconvenient, and they can be difficult for disabled people to use. Subways, in particular, can also raise concerns over personal security – if they are unavoidable, designers should aim to make them as short as possible, wide and well lit.

6.3.8 The specific conditions in a street will determine what form of crossing is most relevant. All crossings should be provided with tactile paving. Further advice on the assessment and design of pedestrian crossings is contained in Local Transport Notes 1/95 and 2/95 and the Puffin Good Practice Guide.

6.3.9 Surface level crossings can be of a number of types, as outlined below:

- Uncontrolled crossings – these can be created by dropping kerbs at intervals along a link. As with other types of crossing, these should be matched to the pedestrian desire lines. If the crossing pattern is fairly random and there is an appreciable amount of pedestrian activity, a minimum frequency of 100 m is recommended. Dropped kerbs should
be marked with appropriate tactile paving and aligned with those on the other side of the carriageway.

- Informal crossings – these can be created through careful use of paving materials and street furniture to indicate a crossing place which encourages slow-moving traffic to give way to pedestrians (Fig. 6.2).
- Pedestrian refuges and kerb build-outs – these can be used separately or in combination. They effectively narrow the carriageway and so reduce the crossing distance. However, they can create pinch-points for cyclists if the remaining gap is still wide enough for motor vehicles to squeeze past them.
- Zebra crossings – of the formal crossing types, these involve the minimum delay for pedestrians when used in the right situation.
- Signalised crossings – there are four types: Pelican, Puffin, Toucan and equestrian crossings. The Pelican crossing was the first to be introduced. Puffin crossings, which have nearside pedestrian signals and a variable crossing time, are replacing Pelican crossings. They use pedestrian detectors to match the length of the crossing period to the time pedestrians take to cross. Toucan and equestrian crossings operate in a similar manner to Puffin crossings except that cyclists can also use Toucan crossings, while equestrian crossings have a separate crossing for horse riders. Signalised crossings are preferred by blind or partially-sighted people.

6.3.10 Obstructions on the footway should be minimised. Street furniture is typically sited on footways and can be a hazard for blind or partially-sighted people.

6.3.11 Where it is necessary to break a road link in order to discourage through traffic, it is recommended that connectivity for pedestrians is maintained through the break unless there are compelling reasons to prevent it.
6.3.12 Pedestrian desire lines should be kept as straight as possible at side-road junctions unless site-specific reasons preclude it. Small corner radii minimise the need for pedestrians to deviate from their desire line (Fig. 6.3). Dropped kerbs with the appropriate tactile paving should be provided at all side-road junctions where the carriageway and footway are at different levels. They should not be placed on curved sections of kerbing because this makes it difficult for blind or partially-sighted people to orientate themselves before crossing.

6.3.13 With small corner radii, large vehicles may need to use the full carriageway width to turn. Swept-path analysis can be used to determine the minimum dimensions required. The footway may need to be strengthened locally in order to allow for larger vehicles occasionally overrunning the corner.

6.3.14 Larger radii can be used without interrupting the pedestrian desire line if the footway is built out at the corners. If larger radii encourage drivers to make the turn more quickly, speeds will need to be controlled in some way, such as through using a speed table at the junction.

6.3.15 The kerbed separation of footway and carriageway can offer protection to pedestrians, channel surface water, and assist blind or partially-sighted people in finding their way around, but kerbs can also present barriers to some pedestrians. Kerbs also tend to confer an implicit priority to vehicles on the carriageway. At junctions and other locations, such as school or community building entrances, there are benefits in considering bringing the carriageway up flush with the footway to allow people to cross on one level (Fig. 6.4). This can be achieved by:

- raising the carriageway to footway level across the mouths of side roads; and
- providing a full raised speed-table at ‘T’ junctions and crossroads.
6.3.16 The carriageway is usually raised using short ramps which can have a speed-reducing effect, but if the street is on a bus route, for example, a more gradual change in height may be more appropriate (Fig. 6.4). It is important that any such shared surface arrangements are designed for blind or partially-sighted people because conventional kerbs are commonly used to aid their navigation. Tactile paving is required at crossing points regardless of whether kerbs are dropped or the carriageway is raised to footway level. Other tactile information may be required to compensate for kerb removal elsewhere.

6.3.17 Pedestrians can be intimidated by traffic and can be particularly vulnerable to the fear of crime or anti-social behaviour. In order to encourage and facilitate walking, pedestrians need to feel safe (Figs 6.5 and 6.6).

6.3.18 Pedestrians generally feel safe from crime where:
- their routes are overlooked by buildings with habitable rooms (Fig. 6.7);
- other people are using the street;
- there is no evidence of anti-social activity (e.g. litter, graffiti, vandalised street furniture);
- they cannot be surprised (e.g. at blind corners);
- they cannot be trapped (e.g. people can feel nervous in places with few entry and exit points, such as subway networks); and
- there is good lighting.

6.3.19 Streets with high traffic speeds can make pedestrians feel unsafe. Designers should seek to control vehicle speeds to below 20 mph in residential areas so that pedestrians activity is not displaced. Methods of vehicle speed control are discussed in Chapter 7.
6.3.20  *Inclusive Mobility* gives guidance on design measures for use where there are steep slopes or drops at the rear of footways.

6.3.21  Places for pedestrians may need to serve a variety of purposes, including movement in groups, children’s play and other activities (Fig. 6.8).

6.3.22  There is no maximum width for footways. In lightly used streets (such as those with a purely residential function), the minimum unobstructed width for pedestrians should generally be 2 m. Additional width should be considered between the footway and a heavily used carriageway, or adjacent to gathering places, such as schools and shops. Further guidance on minimum footway widths is given in *Inclusive Mobility*.

6.3.23  Footway widths can be varied between different streets to take account of pedestrian volumes and composition. Streets where people walk in groups or near schools or shops, for example, need wider footways. In areas of high pedestrian flow, the quality of the walking experience can deteriorate unless sufficient width is provided. The quality of service goes down as pedestrian flow density increases. Pedestrian congestion through insufficient capacity should be avoided. It is inconvenient and may encourage people to step into the carriageway (Fig. 6.9).

6.3.24  Porch roofs, awnings, garage doors, bay windows, balconies or other building elements should not oversail footways at a height of less than 2.6 m.
Figure 6.9 Diagram showing different densities of use in terms of pedestrians per square metre. Derived from *Vorrang für Fussgänger* 9.

6.3.25 Trees to be sited within or close to footways should be carefully selected so that their spread does not reduce pedestrian space below minimum dimensions for width and headroom (Fig. 6.10).

6.3.26 Low overhanging trees, overgrown shrubs and advertising boards can be particularly hazardous for blind or partially-sighted people. Tapering obstructions, where the clearance under a structure reduces because the structure slopes down (common under footbridge ramps), or the pedestrian surface ramps up, should be avoided or fenced off.

6.3.27 Designers should attempt to keep pedestrian (and cycle) routes as near to level as possible along their length and width, within the constraints of the site. Longitudinal gradients should ideally be no more than 5%, although topography or other circumstances may make this difficult to achieve (Fig. 6.11).

Figure 6.10 Poorly maintained tree obstructing the footway.

Figure 6.11 In some instances it may be possible to keep footways level when the carriageway is on a gradient, although this example deflects pedestrians wanting to cross the side road significantly from their desire lines.
6.3.28 Off-street parking often requires motorists to cross footways. Crossovers to private driveways are commonly constructed by ramping up from the carriageway over the whole width of the footway, simply because this is easier to construct. This is poor practice and creates inconvenient cross-falls for pedestrians. Excessive cross-fall causes problems for people pushing prams and can be particularly difficult to negotiate for people with a mobility impairment, including wheelchair users.

6.3.29 Where it is necessary to provide vehicle crossovers, the normal footway cross-fall should be maintained as far as practicable from the back of the footway (900 mm minimum) (Fig. 6.12).

6.3.30 Vehicle crossovers are not suitable as pedestrian crossing points. Blind or partially-sighted people need to be able to distinguish between them and places where it is safe to cross. Vehicle crossovers should therefore have a minimum upstand of 25 mm at the carriageway edge. Where there is a need for a pedestrian crossing point, it should be constructed separately, with tactile paving and kerbs dropped flush with the carriageway.

6.3.31 Surfaces used by pedestrians need to be smooth and free from trip hazards. Irregular surfaces, such as cobbles, are a barrier to some pedestrians and are unlikely to be appropriate for residential areas.

6.3.32 Designs need to ensure that pedestrian areas are properly drained and are neither washed by runoff nor subject to standing water (Fig. 6.13).

6.3.33 Seating on key pedestrian routes should be considered every 100 m to provide rest points and to encourage street activity. Seating should ideally be located where there is good natural surveillance.
### 6.4 Cyclists

**6.4.1** Cyclists should generally be accommodated on the carriageway. In areas with low traffic volumes and speeds, there should not be any need for dedicated cycle lanes on the street (Fig. 6.14).

**6.4.2** Cycle access should always be considered on links between street networks which are not available to motor traffic. If an existing street is closed off, it should generally remain open to pedestrians and cyclists.

**6.4.3** Cyclists prefer direct, barrier-free routes with smooth surfaces. Routes should avoid the need for cyclists to dismount.

**6.4.4** Cyclists are more likely to choose routes that enable them to keep moving. Routes that take cyclists away from their desire lines and require them to concede priority to side-road traffic are less likely to be used. Anecdotal evidence suggests that cyclists using cycle tracks running adjacent and parallel to a main road are particularly vulnerable when they cross the mouths of side roads and that, overall, these routes can be more hazardous to cyclists than the equivalent on-road route.

**6.4.5** Cyclists are particularly sensitive to traffic conditions. High speeds or high volumes of traffic tend to discourage cycling. If traffic conditions are inappropriate for on-street cycling, the factors contributing to them need to be addressed, if practicable, to make on-street cycling satisfactory. This is described in more detail in Chapter 7.

**6.4.6** The design of junctions affects the way motorists interact with cyclists. It is recommended that junctions are designed to promote slow motor-vehicle speeds. This may include short corner radii as well as vertical deflections (Fig. 6.15).

**6.4.7** Where cycle-specific facilities, such as cycle tracks, are provided, their geometry and visibility should be in accordance with the appropriate design speed. The design speed for a cycle track would normally be 30 km/h (20 mph), but reduced as necessary to as low as 10 km/h (6 mph) for short distances where cyclists would expect to slow down, such as on the approach to a subway. Blind corners are a hazard and should be avoided.

**6.4.8** Cyclists should be catered for on the road if at all practicable. If cycle lanes are installed, measures should be taken to prevent them from being blocked by parked vehicles. If cycle tracks are provided, they should be physically segregated from footways/footpaths if there is sufficient width available. However, there is generally little point in segregating a combined width of about 3.3 m or less. The fear of being struck by cyclists is a significant concern for many disabled people. Access officers and consultation groups should be involved in the decision-making process.

**6.4.9** Cycle tracks are more suited to leisure routes over relatively open spaces. In a built-up area, they should be well overlooked. The decision to light them depends on the circumstances of the site – lighting may not always be appropriate.

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<thead>
<tr>
<th>Small radius (eg. 1 metre)</th>
<th>Large radius (eg. 7 metres)</th>
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<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
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<td>• Cycle and car speeds compatible.</td>
<td>• Danger from fast turning vehicles cutting across cyclists.</td>
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*Figure 6.15 The effect of corner radii on cyclists near turning vehicles.*
6.4.10 Like pedestrians, cyclists can be vulnerable to personal security concerns. Streets which meet the criteria described for pedestrians are likely to be acceptable to cyclists.

6.4.11 The headroom over routes used by cyclists should normally be 2.7 m (minimum 2.4 m). The maximum gradients should generally be no more than 3%, or 5% maximum over a distance of 100 m or less, and 7% maximum over a distance of 30 m or less. However, topography may dictate the gradients, particularly if the route is in the carriageway.

6.4.12 As a general rule, the geometry, including longitudinal profile, and surfaces employed on carriageways create an acceptable running surface for cyclists. The exception to this rule is the use of granite setts, or similar. These provide an unpleasant cycling experience due to the unevenness of the surface. They can prove to be particularly hazardous in the wet and when cyclists are turning, especially when giving hand signals at the same time. The conditions for cyclists on such surfaces can be improved if the line they usually follow is locally paved using larger slabs to provide a smoother ride.

6.5 Public transport

6.5.1 This section concentrates on bus-based public transport as this is the most likely mode to be used for serving residential areas. Inclusive Mobility gives detailed guidance on accessible bus stop layout and design, signing, lighting, and design of accessible bus (and rail) stations and interchanges.

Public transport vehicles

6.5.2 Purpose-built buses, from ‘hoppers’ to double-deckers, vary in length and height, but width is relatively fixed (Fig. 6.16).

6.5.3 Streets currently or likely to be used by public transport should be identified in the design process, working in partnership with public transport operators.

6.5.4 Bus routes and stops should form key elements of the walkable neighbourhood. Designers and local authorities should try to ensure that development densities will be high enough to support a good level of service without long-term subsidy.

6.5.5 In order to design for long-term viability, the following should be considered:

- streets serving bus routes should be reasonably straight. Straight routes also help passenger demand through reduced journey times and better visibility. Straight streets may, however, lead to excessive speeds. Where it is necessary to introduce traffic-calming features, designers should consider their potential effects on buses and bus passengers; and
- layouts designed with strong connections to the local highway network, and which avoid long one-way loops or long distances without passenger catchments, are likely to be more viable.

6.5.6 Bus priority measures may be appropriate within developments to give more direct routeing or to assist buses in avoiding streets where delays could occur.

6.5.7 Using a residential street as a bus route need not require restrictions on direct vehicular access to housing. Detailed requirements for streets designated as bus routes can be determined in consultation with local public transport operators. Streets on bus routes should not generally be less than 6.0 m wide (although this could be reduced on short sections with good inter-visibility between opposing flows). The presence and arrangement of on-street parking, and the manner of its provision, will affect width requirements.

![Figure 6.16 Typical bus dimensions](image)
6.5.8 Swept-path analysis can be used to determine the ability of streets to accommodate large vehicles. Bus routes in residential areas are likely to require a more generous swept path to allow efficient operation. While it would be acceptable for the occasional lorry to have to negotiate a particular junction with care, buses need to be able to do so with relative ease. The level of provision required for the movement of buses should consider the frequency and the likelihood of two buses travelling in opposite directions meeting each other on a route.

**Bus stops**

6.5.9 It is essential to consider the siting of public transport stops and related pedestrian desire lines at an early stage of design. Close co-operation is required between public transport operators, the local authorities and the developer.

6.5.10 First and foremost, the siting of bus stops should be based on trying to ensure they can be easily accessed on foot. Their precise location will depend on other issues, such as the need to avoid noise nuisance, visibility requirements, and the convenience of pedestrians and cyclists. Routes to bus stops must be accessible by disabled people. For example, the bus lay-by in Fig. 6.17 deflects pedestrians walking along the street from their desire line and the insufficient footway width at the bus stop hinders free movement.

6.5.11 Bus stops should be placed near junctions so that they can be accessed by more than one route on foot, or near specific passenger destinations (schools, shops, etc.) but not so close as to cause problems at the junction. On streets with low movement function (see Chapter 2), setting back bus stops from junctions to maximise traffic capacity should be avoided.

6.5.12 Bus stops should be high-quality places that are safe and comfortable to use. Consideration should be given to providing cycle parking at bus stops with significant catchment areas. Cycle parking should be designed and located so as not to create a hazard, or impede access for, disabled people.

6.5.13 Footways at bus stops should be wide enough for waiting passengers while still allowing for pedestrian movement along the footway. This may require local widening at the stop.

6.5.14 Buses can help to control the speed of traffic at peak times by preventing cars from overtaking. This is also helpful for the safety of passengers crossing after leaving the bus.
6.6 Private and commercial motor vehicles

6.6.1 Streets need to be designed to accommodate a range of vehicles from private cars, with frequent access requirements, to larger vehicles such as delivery vans and lorries, needing less frequent access (Fig. 6.18). Geometric design which satisfies the access needs of emergency service and waste collection vehicles will also cover the needs of private cars. However, meeting the needs of drivers in residential streets should not be to the detriment of pedestrians, cyclists and public transport users. The aim should be to achieve a harmonious mix of user types.

6.6.2 In a residential environment, flow is unlikely to be high enough to determine street widths, and the extent of parking provision (see Chapter 8) will depend on what is appropriate for the site.

6.6.3 In some locations, a development may be based on car-free principles. For example, there are options for creating developments relatively free of cars by providing remotely sited parking (e.g. Greenwich Millennium Village, see Fig. 6.19) or by creating a wholly car-free development. Such approaches can have a significant effect on the design of residential streets and the way in which they are subsequently used.
6.7 Emergency vehicles

6.7.1 The requirements for emergency vehicles are generally dictated by the fire service requirements. Providing access for large fire appliances (including the need to be able to work around them where appropriate) will cater for police vehicles and ambulances.

6.7.2 The Building Regulation requirement B5 (2000)\textsuperscript{10} concerns ‘Access and Facilities for the Fire Service’. Section 17, ‘Vehicle Access’, includes the following advice on access from the highway:
- there should be a minimum carriageway width of 3.7 m between kerbs;
- there should be vehicle access for a pump appliance within 45 m of single family houses;
- there should be vehicle access for a pump appliance within 45 m of every dwelling entrance for flats/maisonettes;
- a vehicle access route may be a road or other route; and
- fire service vehicles should not have to reverse more than 20 m.

6.7.3 The Association of Chief Fire Officers has expanded upon and clarified these requirements as follows:
- a 3.7 m carriageway (kerb to kerb) is required for operating space at the scene of a fire. Simply to reach a fire, the access route could be reduced to 2.75 m over short distances, provided the pump appliance can get to within 45 m of dwelling entrances;
- if an authority or developer wishes to reduce the running carriageway width to below 3.7 m, they should consult the local Fire Safety Officer;
- the length of cul-de-sacs or the number of dwellings have been used by local authorities as criteria for limiting the size of a development served by a single access route. Authorities have often argued that the larger the site, the more likely it is that a single access could be blocked for whatever reason. The fire services adopt a less numbers-driven approach and consider each application based on a risk assessment for the site, and response time requirements. Since the introduction of the Fire and Rescue Services Act 2004,\textsuperscript{11} all regions have had to produce an Integrated Management Plan setting out response time targets (\textit{Wales: Risk Reduction Plans}\textsuperscript{12}). These targets depend on the time required to get fire appliances to a particular area, together with the ease of movement within it. It is therefore possible that a layout acceptable to the Fire and Rescue Service (FRS) in one area, might be objected to in a more remote location;
- parked cars can have a significant influence on response times. Developments should have adequate provision for parking to reduce its impact on response times; and
- residential sprinkler systems are highly regarded by the FRS and their presence allows a longer response time to be used. A site layout which has been rejected on the grounds of accessibility for fire appliances may become acceptable if its buildings are equipped with these systems.

6.8 Service vehicles

6.8.1 The design of local roads should accommodate service vehicles without allowing their requirements to dominate the layout. On streets with low traffic flows and speeds, it may be assumed that they will be able to use the full width of the carriageway to manoeuvre. Larger vehicles which are only expected to use a street infrequently, such as pantechnicons, need not be fully accommodated – designers could assume that they will have to reverse or undertake multi-point turns to turn around for the relatively small number of times they will require access.

6.8.2 Well-connected street networks have significant advantages for service vehicles. A shorter route can be used to cover a given area, and reversing may be avoided altogether. They also minimise land-take by avoiding the need for wasteful turning areas at the ends of cul-de-sacs.

6.8.3 However, some sites cannot facilitate such ease of movement (e.g. linear sites and those with difficult topography), and use cul-de-sacs to make the best use of the land available. For cul-de-sacs longer than 20 m, a turning area should be provided to cater for vehicles that will regularly need to enter the street. Advice on the design of turning areas is given in Chapter 7.
Waste collection vehicles

6.8.4 The need to provide suitable opportunities for the storage and collection of waste is a major consideration in the design of buildings, site layouts and individual streets. Storage may be complicated by the need to provide separate facilities for refuse and the various categories of recyclable waste. Quality of place will be significantly affected by the type of waste collection and management systems used, because they in turn determine the sort of vehicles that will need to gain access.

6.8.5 Policy for local and regional waste planning bodies is set out in Planning Policy Statement 10: Planning for Sustainable Waste Management (PPS10)13 and its companion guide. PPS10 refers to design and layout in new development being able to help secure opportunities for sustainable waste management. Planning authorities should ensure that new developments make sufficient provision for waste management and promote designs and layouts that secure the integration of waste management facilities without adverse impact on the street scene (Wales: Refer to Chapter 12 of PPW14 and TAN 21: Waste15).

6.8.6 The operation of waste collection services should be an integral part of street design and achieved in ways that do not compromise quality of place. Waste disposal and collection authorities and their contractors should take into account the geometry of streets across their area and the importance of securing quality of place when designing collection systems and deciding which vehicles are applicable. While it is always possible to design new streets to take the largest vehicle that could be manufactured, this would conflict with the desire to create quality places. It is neither necessary nor desirable to design new streets to accommodate larger waste collection vehicles than can be used within existing streets in the area.

6.8.7 Waste collection vehicles fitted with rear-mounted compaction units (Fig. 6.20) are about the largest vehicles that might require regular access to residential areas. BS 5906: 2005 notes that the largest waste vehicles currently in use are around 11.6 m long, with a turning circle of 20.3 m. It recommends a minimum street width of 5 m, but smaller widths are acceptable where on-street parking is discouraged. Swept-path analysis can be used to assess layouts for accessibility. Where achieving these standards would undermine quality of place, alternative vehicle sizes and/or collection methods should be considered.

6.8.8 Reversing causes a disproportionately large number of moving vehicle accidents in the waste/recycling industry. Injuries to collection workers or members of the public by moving collection vehicles are invariably severe or fatal. BS 5906: 2005 recommends a maximum reversing distance of 12 m. Longer distances can be considered, but any reversing routes should be straight and free from obstacles or visual obstructions.

6.8.9 Schedule 1, Part H of the Building Regulations (2000)16 define locations for the storage and collection of waste. The collection point can be on-street (but see Section 6.8.11), or may be at another location defined by the waste authority. Key points in the Approved Document to Part H are:

- residents should not be required to carry waste more than 30 m (excluding any vertical distance) to the storage point;
- waste collection vehicles should be able to get to within 25 m of the storage point (note, BS 5906: 200517 recommends shorter distances) and the gradient between the two should not exceed 1:12. There should be a maximum of three steps for waste collection.

Figure 6.20 Large waste collection truck in a residential street.
6.8.10 Based on these parameters, it may not be necessary for a waste vehicle to enter a cul-de-sac less than around 55 m in length, although this will involve residents and waste collection operatives moving waste the maximum recommended distances, which is not desirable.

6.8.11 BS 5906: 2005 provides guidance and recommendations on good practice. The standard advises on dealing with typical weekly waste and recommends that the distance over which containers are transported by collectors should not normally exceed 15 m for two-wheeled containers, and 10 m for four-wheeled containers.

6.8.12 It is essential that liaison between the designers, the waste, highways, planning and building control authorities, and access officers, takes place at an early stage. Agreement is required on the way waste is to be managed and in particular:

- methods for storing, segregating and collecting waste;
- the amount of waste storage required, based on collection frequency, and the volume and nature of the waste generated by the development; and
- the size of anticipated collection vehicles.

6.8.13 The design of new developments should not require waste bins to be left on the footway as they reduce its effective width. Waste bins on the footway pose a hazard for blind or partially-sighted people and may prevent wheelchair and pushchair users from getting past.

**Recycling**

6.8.14 The most common types of provision for recycling (often used in combination) are:

- ‘bring’ facilities, such as bottle and paper banks, where residents leave material for recycling; and
- kerbside collection, where householders separate recyclable material for collection at the kerbside.

6.8.15 ‘Bring’ facilities need to be in accessible locations, such as close to community buildings, but not where noise from bottle banks, etc., can disturb residents. There needs to be enough room for the movement and operation of collection vehicles.

6.8.16 Underground waste containers may be worth considering. All that is visible to the user is a ‘litter bin’ or other type of disposal point (Fig. 6.21). This collects in underground containers which are emptied by specially equipped vehicles. There were some 175 such systems in use in the UK in 2006.

6.8.17 Kerbside collection systems generally require householders to store more than one type of waste container. This needs to be considered in the design of buildings or external storage facilities.

6.8.18 Designers should ensure that containers can be left out for collection without blocking the footway or presenting hazards to users.
Street geometry
Chapter aims

- Advise how the requirements of different users can be accommodated in street design.
- Summarise research which shows that increased visibility encourages higher vehicle speeds.
- Describe how street space can be allocated based on pedestrian need, using swept path analysis to ensure that minimum access requirements for vehicles are met.
- Describe the rationale behind using shorter vehicle stopping distances to determine visibility requirements on links and at junctions.
- Recommend that the design of streets should determine vehicle speed.
- Recommend a maximum design speed of 20 mph for residential streets.

7.1 Introduction

7.1.1 Several issues need to be considered in order to satisfy the various user requirements detailed in Chapter 6, namely:

- street widths and components;
- junctions;
- features for controlling vehicle speeds;
- forward visibility on links; and
- visibility splays at junctions.

7.2 Street dimensions

7.2.1 The design of new streets or the improvement of existing ones should take into account the functions of the street, and the type, density and character of the development.

7.2.2 Carriageway widths should be appropriate for the particular context and uses of the street. Key factors to take into account include:

- the volume of vehicular traffic and pedestrian activity;
- the traffic composition;
- the demarcation, if any, between carriageway and footway (e.g. kerb, street furniture or trees and planting);
- whether parking is to take place in the carriageway and, if so, its distribution, arrangement, the frequency of occupation, and the likely level of parking enforcement (if any);
- the design speed (recommended to be 20 mph or less in residential areas);
- the curvature of the street (bends require greater width to accommodate the swept path of larger vehicles); and
- any intention to include one-way streets, or short stretches of single lane working in two-way streets.

7.2.3 In lightly-trafficked streets, carriageways may be narrowed over short lengths to a single lane as a traffic-calming feature. In such single lane working sections of

Figure 7.1 Illustrates what various carriageway widths can accommodate. They are not necessarily recommendations.
street, to prevent parking, the width between constraining vertical features such as bollards should be no more than 3.5 m. In particular circumstances this may be reduced to a minimum value of 2.75 m, which will still allow for occasional large vehicles (Fig. 7.1). However, widths between 2.75 m and 3.25 m should be avoided in most cases, since they could result in drivers trying to squeeze past cyclists. The local Fire Safety Officer should be consulted where a carriageway width of less than 3.7 m is proposed (see paragraph 6.6.3).

7.2.4 Each street in the network is allocated a particular street character type, depending on where it sits within the place/movement hierarchy (see Chapter 2) and the requirements of its users (see Chapter 6). Individual streets can then be designed in detail using the relevant typical arrangement as a starting point. For example, one street might have a fairly high movement status combined with a medium place status, whilst another might have very little movement status but a high place status. The typical arrangement for each street character type can then be drawn up. This may be best

**Case study**

**Newhall, Harlow**

**Figure 7.3** On-street parking and shallow gradient junction table suitable for accommodating buses.

Newhall demonstrates that adherence to masterplan principles can be achieved through the use of design codes (Fig. 7.3) that are attached to land sales and achieved by covenants.

A list of key dimensions was applied:
- Frontage to frontage – min 10.5 m;
- Carriageway width – min 4.8 m, max 8.8 m;
- Footway width – min 1.5 m;
- Front gardens – min 1.5 m, max 3 m;
- Reservation for services – 1 m; and
- Design speed – 20 mph.

The design is based on pedestrian priority and vehicle speeds of less than 20 mph controlled through the street design.
represented using a plan and cross-section as illustrated in Figure 7.2.

7.2.5 These street types can be defined in a design code, as demonstrated at Newhall, Harlow (see Newhall, Harlow box).

Swept path analysis

7.2.6 Swept path analysis, or tracking, is used to determine the space required for various vehicles and is a key tool for designing carriageways for vehicular movement within the overall layout of the street. The potential layouts of buildings and spaces do not have to be dictated by carriageway alignment – they should generally be considered first, with the carriageway alignment being designed to fit within the remaining space (Fig. 7.4).

7.2.7 The use of computer-aided design (CAD) tracking models and similar techniques often proves to be beneficial in determining how the street will operate and how vehicles will move within it. Layouts designed using this approach enable buildings to be laid out to suit the character of the street, with footways and kerbs helping to define and emphasise spaces. Designers have the freedom to vary the space between kerbs or buildings. The kerb line does not need to follow the line of vehicle tracking if careful attention is given to the combination of sightlines, parking and pedestrian movements.

Shared surface streets and squares

7.2.8 In traditional street layouts, footways and carriageways are separated by a kerb. In a street with a shared surface, this demarcation is absent and pedestrians and vehicles share the same surface. Shared surface schemes work best in relatively calm traffic environments. The key aims are to:
- encourage low vehicle speeds;
- create an environment in which pedestrians can walk, or stop and chat, without feeling intimidated by motor traffic;
- make it easier for people to move around; and
- promote social interaction.

7.2.9 In the absence of a formal carriageway, the intention is that motorists entering the area will tend to drive more cautiously and negotiate the right of way with pedestrians on a more conciliatory level (Fig. 7.5).

7.2.10 However, shared surfaces can cause problems for some disabled people. People with cognitive difficulties may find the environment difficult to interpret. In addition, the absence of a conventional kerb poses problems for blind or partially-sighted people, who often rely on this feature to find their way around. It is therefore important that shared surface schemes include an alternative means for visually-impaired people to navigate by.
7.2.11 Research published by the Guide Dogs for the Blind Association in September 2006\(^1\) illustrated the problems that shared surfaces cause for blind or partially-sighted and other disabled people. Further research to be carried out by the Guide Dogs for the Blind Association will consider how the requirements of disabled people can be met, with a view to producing design guidance in due course.

7.2.12 Consultation with the community and users, particularly with disability groups and access officers, is essential when any shared surface scheme is developed. Early indications are that, in many instances, a protected space, with appropriate physical demarcation, will need to be provided, so that those pedestrians who may be unable or unwilling to negotiate priority with vehicles can use the street safely and comfortably.

7.2.13 When designing shared surface schemes, careful attention to detail is required to avoid other problems, such as:
- undifferentiated surfaces leading to poor parking behaviour;
- vulnerable road users feeling threatened by having no space protected from vehicles; and
- the positioning and quantity of planting, street furniture and other features creating visual clutter.

7.2.14 Subject to making suitable provision for disabled people, shared surface streets are likely to work well:
- in short lengths, or where they form cul-de-sacs (Fig. 7.6); and
- where the volume of motor traffic is below 100 vehicles per hour (vph) (peak) (see box); and
- where parking is controlled or it takes place in designated areas.

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7.2.15 Shared surface streets are often constructed from paviours rather than asphalt, which helps emphasise their difference from conventional streets. Research for MFS has shown that block paving reduces traffic speeds by between 2.5 and 4.5 mph, compared with speeds on asphalt surfaces (Fig. 7.7).

**Home Zones**

7.2.16 Home Zones are residential areas designed with streets to be places for people, instead of just for motor traffic. By creating a high-quality street environment, Home Zones strike a better balance between the needs of the local community and drivers (Fig. 7.8). Involving the local community is the key to a successful scheme. Good and effective consultation with all sectors of the community, including young people, can help ensure that the design of individual Home Zones meets the needs of the local residents.

**Research on shared space streets**

A study of public transport in London Borough Pedestrian Priority Areas (PPAs) undertaken by TRL for the Bus Priority Team at Transport for London concluded that there is a self-limiting factor on pedestrians sharing space with motorists, of around 100 vph. Above this, pedestrians treat the general path taken by motor vehicles as a ‘road’ to be crossed rather than as a space to occupy. The speed of vehicles also had a strong influence on how pedestrians used the shared area. Although this research project concentrated on PPAs, it is reasonable to assume that these factors are relevant to other shared space schemes.

The relationship between visibility, highway width and driver speed identified on links was also found to apply at junctions. A full description of the research findings is available in Manual for Streets: redefining residential street design.²
Table 7.9 Illustrative junction layouts.

Home Zone in England is set out in the Quiet Lanes and Home Zones (England) Regulations 2006 and guidance is provided in Department for Transport Circular 02/2006. Procedure regulations are yet to be made in Wales, but traffic authorities may still designate roads as Home Zones.

7.2.20 Developers sometimes implement ‘Home Zone style’ schemes without formal designation. However, it is preferable for the proper steps to be followed to involve the community in deciding how the street will be used.

7.2.21 In existing streets, it is essential that the design of the Home Zone involves significant participation by local residents and local access groups. In new-build situations, a partnership between the developer and the relevant authorities will enable prospective residents to be made aware of the proposed designation of the street as a Home Zone. This will pave the way for the formal consultation procedure once the street becomes public highway.

7.2.22 Further guidance on the design of Home Zones is given in Home Zones: Challenging the Future of Our Streets, the Institute of Highway Incorporated Engineers’ (IHIE) Home Zone Design Guidelines and on the website www.homezones.org.uk.

7.3 Junctions

7.3.1 Junctions that are commonly used in residential areas include:
- crossroads and staggered junctions;
- T and Y junctions; and
- roundabouts.

Figure 7.9 illustrates a broader range of junction geometries to show how these basic types can be developed to create distinctive places. Mini-roundabouts and shared surface squares can be incorporated within some of the depicted arrangements.

7.3.2 Junctions are generally places of high accessibility and good natural surveillance. They are therefore ideal places for locating public buildings, shops and public transport stops, etc. Junctions are places of interaction among street users. Their design is therefore critical to achieving a proper balance between their place and movement functions.

7.3.3 The basic junction forms should be determined at the masterplanning stage. At the street design stage, they will have to be considered in more detail in order to determine how they are going to work in practice. Masterplanning and detailed design will cover issues such as traffic priority arrangements, the need, or otherwise, for signs, markings and kerbs, and how property and building lines are related.
7.3.4 The resulting spaces and townscape should ideally be represented in three dimensions – see box.

7.3.5 Often, the key to a well-designed junction is the way in which buildings are placed around it and how they enclose the space in which the junction sits. Building placement should therefore be decided upon first, with the junction then designed to suit the available space.

7.3.6 Junction design should facilitate direct pedestrian desire lines, and this will often mean using small corner radii. The use of swept path analysis will ensure that the junctions are negotiable by vehicles (Fig. 7.11).

**Drawing in three dimensions**

Presenting design layouts in three dimensions is an important way of looking at aspects of engineering and urban design together (Fig. 7.10). It enables street furniture, lighting, utility equipment and landscaping to be clearly shown. Three-dimensional layouts are also useful in consultation with the public.

Street cross-sections and plans should be developed initially. Perspective or axonometric drawings can then be produced to add clarity and to assist designers in visualising and refining their ideas. Such three-dimensional representation is fairly easy to achieve both by hand and using CAD software. For more complex schemes, a computer-generated ‘walk-through’ presentation can be used to demonstrate how the proposal will work in practice. It is also a powerful tool for resolving design issues.

![Figure 7.10 Example of three-dimensional presentations.](image)

![Figure 7.11 Quadrant kerbstones used instead of large radii at junctions reduce the dominance of the carriageway. This is reinforced by the placement and form of the adjacent buildings and the absence of road markings. However, note the lack of dropped kerbs and tactile paving.](image)
7.3.7 Junctions can be marked to indicate which arms have priority, but on quieter streets it may be acceptable to leave them unmarked. A lack of marked priority may encourage motorists to slow down to negotiate their way through, making the junction more comfortable for use by pedestrians. However, this approach requires careful consideration (see Chapter 9).

7.3.8 Crossroads are convenient for pedestrians, as they minimise diversion from desire lines when crossing the street. They also make it easier to create permeable and legible street networks.

7.3.9 Permeable layouts can also be achieved using T and Y junctions. Y junctions can increase flexibility in layout design.

7.3.10 Staggered junctions can reduce vehicle conflict compared with crossroads, but may reduce directness for pedestrians. If it is necessary to maintain a view point or vista, and if there is sufficient room between buildings, staggered junctions can be provided within continuous building lines. (Fig. 7.12).

**Case study**

**Hulme, Manchester: speed tables**

![Image of Hulme, Manchester: speed tables](image)

A distinctive feature of the Hulme development is the adherence to a linear grid form. Raised tables at junctions reduce speeds and facilitate pedestrian movement (Fig. 7.13).

7.3.11 Where designers are concerned about potential user conflict, they may consider placing the junction on a speed table (see Hulme, Manchester box). Another option might be to close one of the arms to motor traffic (while leaving it open for pedestrians and cyclists).

7.3.12 Conventional roundabouts are not generally appropriate for residential developments. Their capacity advantages are not usually relevant, they can have a negative impact on vulnerable road users, and they often do little for the street scene.

7.3.13 Larger roundabouts are inconvenient for pedestrians because they are deflected from their desire lines, and people waiting to cross one of the arms may not be able to anticipate easily the movement of motor vehicles on the roundabout, or entering or leaving it.
7.3.14 Roundabouts can be hazardous for cyclists. Drivers entering at relatively high speed may not notice cyclists on the circulatory carriageway, and cyclists travelling past an arm are vulnerable to being hit by vehicles entering or leaving the junction.

7.3.15 Mini-roundabouts may be more suitable in residential areas, as they cause less deviation for pedestrians and are easier for cyclists to use. In addition, they do not occupy as much land. Practitioners should refer to Mini-roundabouts: Good Practice Guidelines.

7.3.16 Continental-style roundabouts are also suitable for consideration. They sit between conventional roundabouts and mini-roundabouts in terms of land take. They retain a conventional central island, but differ in other respects — there is minimal flare at entry and exit, and they have a single-lane circulatory carriageway. In addition, the circulatory carriageway has negative camber, so water drains away from the centre, which simplifies drainage arrangements. Their geometry is effective in reducing entry, circulatory and exit speeds. They are safer for cyclists because of the reduced speeds, together with the fact that drivers cannot overtake on the circulatory carriageway. Their use is described in Traffic Advisory Leaflet 9/97.

Spacing of junctions

7.3.17 The spacing of junctions should be determined by the type and size of urban blocks appropriate for the development. Block size should be based on the need for permeability, and generally tends to become smaller as density and pedestrian activity increases.

7.3.18 Smaller blocks create the need for more frequent junctions. This improves permeability for pedestrians and cyclists, and the impact of motor traffic is dispersed over a wider area. Research in the preparation of MFS demonstrated that more frequent (and hence less busy) junctions need not lead to higher numbers of accidents.

7.3.19 Junctions do not always need to cater for all types of traffic. Some of the arms of a junction may be limited to pedestrian and cycle movement only.

7.4 Achieving appropriate traffic speeds

7.4.1 Conflict among various user groups can be minimised or avoided by reducing the speed and flow of motor vehicles. Ideally, designers should aim to create streets that control vehicle speeds naturally rather than having to rely on unsympathetic traffic-calming measures (Fig. 7.14). In general, providing a separate pedestrian and/or cycle route away from motor traffic should only be considered as a last resort (see the hierarchy of provision in Chapter 4).
7.4.2 For residential streets, a maximum design speed of 20 mph should normally be an objective. The severity of injuries and the likelihood of death resulting from a collision at 20 mph are considerably less than can be expected at 30 mph. In addition, vehicle noise and the intimidation of pedestrians and cyclists are likely to be significantly lower.

7.4.3 Evidence from traffic-calming schemes suggests that speed-controlling features are required at intervals of no more than 70 m in order to achieve speeds of 20 mph or less.12 Straight and uninterrupted links should therefore be limited to around 70 m to help ensure that the arrangement has a natural traffic-calming effect.

7.4.4 A continuous link can be broken up by introducing features along it to slow traffic. The range of traffic-calming measures available act in different ways, with varying degrees of effectiveness:

- **Physical features** – involving vertical or horizontal deflection – can be very effective in reducing speed. It is preferable to use other means of controlling speeds, if practicable, but there will be situations where physical features represent the optimum solution. Additional sources of advice on traffic calming can be found in Traffic Advisory Leaflet 2/05.13

- **Changes in priority** – at roundabouts and other junctions. This can be used to disrupt flow and therefore bring overall speeds down.

- **Street dimensions** – can have a significant influence on speeds. Keeping lengths of street between junctions short is particularly effective. Street width also has an effect on speed (see box).

- **Reduced visibility** – research carried out in preparation of MFS found that reductions in forward visibility are associated with reduced driving speeds (see box).

- **Psychology and perception** – street features and human activity can have an influence on the speed at which people choose to drive. Research14 suggests that features likely to be effective include the following:
  - edge markings that visually narrow the road – speed reduction is likely to be greatest where the edging is textured to appear unsuitable for driving on;
  - the close proximity of buildings to the road;
  - reduced carriageway width;
  - obstructions in the carriageway (Fig. 7.15);
  - features associated with potential activity in, or close to, the carriageway, such as pedestrian refuges;
  - on-street parking, particularly when the vehicles are parked in echelon formation or perpendicular to the carriageway;
  - the types of land use associated with greater numbers of people, for example shops; and
  - pedestrian activity.

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Influence of geometry on speed

Research carried out in the preparation of MfS considered the influence of geometry on vehicle speed and casualties in 20 residential and mixed-use areas in the UK. Two highway geometric factors stand out as influencing driving speed, all other things being equal. They are:

• forward visibility; and
• carriageway width.

Improved visibility and/or increased carriageway width were found to correlate with increased vehicle speeds. Increased width for a given visibility, or vice versa, were found to increase speed. These data are summarised in Fig. 7.16.

The relationship between visibility, highway width and driver speed identified on links was also found to apply at junctions. A full description of the research findings is available in TRL Report 661.15

Figure 7.16 Correlation between visibility and carriageway width and vehicle speeds (a) average speeds and (b) 85th percentile speeds. These graphs can be used to give an indication of the speed at which traffic will travel for a given carriageway width/forward visibility combination.


7.4.5 Speed limits for residential areas are normally 30 mph, but 20 mph limits are becoming more common. If the road is lit, a 30 mph limit is signed only where it begins – repeater signs are not used here. All other speed limits have to be signed where they start and be accompanied by repeater signs.
7.4.6 A street with a 20 mph limit is not the same as a 20 mph zone. To create a 20 mph zone, it is a legal requirement that traffic-calming measures are installed to ensure that low speeds are maintained throughout. In such cases, the limit is signed only on entering the zone, and no repeater signs are necessary.

7.4.7 Any speed limits below 30 mph, other than 20 mph limits or 20 mph zones, require individual consent from the Secretary of State for Transport. Designers should note that such approval is unlikely to be given.

7.4.8 A speed limit is not an indication of the appropriate speed to drive at. It is the responsibility of drivers to travel within the speed limit at a speed suited to the conditions. However, for new streets, or where existing streets are being modified, and the design speed is below the speed limit, it will be necessary to include measures that reduce traffic speeds accordingly.

7.4.9 Difficulties may be encountered where a new development connects to an existing road. If the junction geometry cannot be made to conform to the requirements for prevailing traffic speeds, the installation of traffic-calming measures on the approach will allow the use of a lower design speed to be used for the new junction.

7.5 Stopping sight distance

7.5.1 This section provides guidance on stopping sight distances (SSDs) for streets where 85th percentile speeds are up to 60 km/h. At speeds above this, the recommended SSDs in the Design Manual for Roads and Bridges may be more appropriate.

7.5.2 The stopping sight distance (SSD) is the distance within which drivers need to be able to see ahead and stop from a given speed. It is calculated from the speed of the vehicle, the time required for a driver to identify a hazard and then begin to brake (the perception–reaction time), and the vehicle’s rate of deceleration. For new streets, the design speed is set by the designer. For existing streets, the 85th percentile wet-weather speed is used.

7.5.3 The basic formula for calculating SSD (in metres) is:

$$SSD = vt + v^2/2d$$

where:

- \(v\) = speed (m/s)
- \(t\) = driver perception–reaction time (seconds)
- \(d\) = deceleration (m/s²)

7.5.4 The desirable minimum SSDs used in the Design Manual for Roads and Bridges are based on a driver perception–reaction time of 2 seconds and a deceleration rate of 2.45 m/s² (equivalent to 0.25g where \(g\) is acceleration due to gravity (9.81 m/s²)). Design Bulletin 32 adoption of these values.

7.5.5 Drivers are normally able to stop much more quickly than this in response to an emergency. The stopping distances given in the Highway Code assume a driver reaction time of 0.67 seconds, and a deceleration rate of 6.57 m/s².

7.5.6 While it is not appropriate to design street geometry based on braking in an emergency, there is scope for using lower SSDs than those used in Design Bulletin 32. This is based upon the following:

- A review of practice in other countries has shown that Design Bulletin 32 values are much more conservative than those used elsewhere.
- Research which shows that the 90th percentile reaction time for drivers confronted with a side-road hazard in a driving simulator is 0.9 seconds (see TRL Report 332);
- Carriageway surfaces are normally able to develop a skidding resistance of at least 0.45g in wet weather conditions. Deceleration rates of 0.25g (the previously assumed value) are more typically associated with snow-covered roads; and
- Of the sites studied in the preparation of this manual, no relationship was found between SSDs and casualties, regardless of whether the sites complied with Design Bulletin 32 or not.
7.5.7 The SSD values used in MfS are based on a perception–reaction time of 1.5 seconds and a deceleration rate of 0.45g (4.41 m/s²). Table 7.1 uses these values to show the effect of speed on SSD.

7.5.8 Below around 20 m, shorter SSDs themselves will not achieve low vehicle speeds: speed-reducing features will be needed. For higher speed roads, i.e. with an 85th percentile speed over 60 km/h, it may be appropriate to use longer SSDs, as set out in the Design Manual for Roads and Bridges.

7.5.9 Gradients affect stopping distances. The deceleration rate of 0.45g used to calculate the figures in Table 7.1 is for a level road. A 10% gradient will increase (or decrease) the rate by around 0.1g.

7.6 Visibility requirements

7.6.1 Visibility should be checked at junctions and along the street. Visibility is measured horizontally and vertically.

7.6.2 Using plan views of proposed layouts, checks for visibility in the horizontal plane ensure that views are not obscured by vertical obstructions.

7.6.3 Checking visibility in the vertical plane is then carried out to ensure that views in the horizontal plane are not compromised by obstructions such as the crest of a hill, or a bridge at a dip in the road ahead. It also takes into account the variation in driver eye height and the height range of obstructions. Eye height is assumed to range from 1.05 m (for car drivers) to 2 m (for lorry drivers). Drivers need to be able to see obstructions 2 m high down to a point 600 mm above the carriageway. The latter dimension is used to ensure small children can be seen (Fig. 7.17).

7.6.4 The SSD figure relates to the position of the driver. However, the distance between the driver and the front of the vehicle is typically up to 2.4 m, which is a significant proportion of shorter stopping distances. It is therefore recommended that an allowance is made by adding 2.4 m to the SSD.

Table 7.1 Derived SSDs for streets (figures rounded).

<table>
<thead>
<tr>
<th>Speed</th>
<th>Kilometres per hour</th>
<th>16</th>
<th>20</th>
<th>24</th>
<th>25</th>
<th>30</th>
<th>32</th>
<th>40</th>
<th>45</th>
<th>48</th>
<th>50</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSD (metres)</td>
<td>9</td>
<td>12</td>
<td>15</td>
<td>16</td>
<td>19</td>
<td>20</td>
<td>25</td>
<td>28</td>
<td>30</td>
<td>31</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td>SSD adjusted for bonnet length. See 7.6.4</td>
<td>11</td>
<td>14</td>
<td>17</td>
<td>18</td>
<td>23</td>
<td>25</td>
<td>33</td>
<td>39</td>
<td>40</td>
<td>43</td>
<td>45</td>
<td>59</td>
</tr>
</tbody>
</table>

Additional features will be needed to achieve low speeds
7.7 Visibility splays at junctions

7.7.1 The visibility splay at a junction ensures there is adequate inter-visibility between vehicles on the major and minor arms (Fig. 7.18).

7.7.2 The distance back along the minor arm from which visibility is measured is known as the X distance. It is generally measured back from the ‘give way’ line (or an imaginary ‘give way’ line if no such markings are provided). This distance is normally measured along the centreline of the minor arm for simplicity, but in some circumstances (for example where there is a wide splitter island on the minor arm) it will be more appropriate to measure it from the actual position of the driver.

7.7.3 The Y distance represents the distance that a driver who is about to exit from the minor arm can see to his left and right along the main alignment. For simplicity it is measured along the nearside kerb line of the main arm, although vehicles will normally be travelling a distance from the kerb line. The measurement is taken from the point where this line intersects the centreline of the minor arm (unless, as above, there is a splitter island in the minor arm).

7.7.4 When the main alignment is curved and the minor arm joins on the outside of a bend, another check is necessary to make sure that an approaching vehicle on the main arm is visible over the whole of the Y distance. This is done by drawing an additional sight line which meets the kerb line at a tangent.

7.7.5 Some circumstances make it unlikely that vehicles approaching from the left on the main arm will cross the centreline of the main arm – opposing flows may be physically segregated at that point, for example. If so, the visibility splay to the left can be measured to the centreline of the main arm.

X distance

7.7.6 An X distance of 2.4 m should normally be used in most built-up situations, as this represents a reasonable maximum distance between the front of the car and the driver’s eye.

7.7.7 A minimum figure of 2 m may be considered in some very lightly-traffic and slow-speed situations, but using this value will mean that the front of some vehicles will protrude slightly into the running carriageway of the major arm. The ability of drivers and cyclists to see this overhang from a reasonable distance, and to manoeuvre around it without undue difficulty, should be considered.

7.7.8 Using an X distance in excess of 2.4 m is not generally required in built-up areas.

7.7.9 Longer X distances enable drivers to look for gaps as they approach the junction. This increases junction capacity for the minor arm, and so may be justified in some circumstances, but it also increases the possibility that drivers on the minor approach will fail to take account of other road users, particularly pedestrians and cyclists. Longer X distances may also result in more shunt accidents on the minor arm. TRL Report No. 184 found that accident risk increased with greater minor-road sight distance.

Y distance

7.7.10 The Y distance should be based on values for SSD (Table 7.1).

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Figure 7.18 Measurement of junction visibility splays (a) on a straight road, (b) and (c) on bends.
7.8 Forward visibility

7.8.1 Forward visibility is the distance a driver needs to see ahead to stop safely for obstructions in the road. The minimum forward visibility required is equal to the minimum SSD. It is checked by measuring between points on a curve along the centreline of the inner traffic lane (see Fig. 7.19).

7.8.2 There will be situations where it is desirable to reduce forward visibility to control traffic speed – the Influence of geometry on speed box describes how forward visibility influences speed. An example is shown in Fig 7.20.

Visibility along the street edge

7.8.3 Vehicle exits at the back edge of the footway mean that emerging drivers will have to take account of people on the footway. The absence of wide visibility splays at private driveways will encourage drivers to emerge more cautiously. Consideration should be given to whether this will be appropriate, taking into account the following:
- the frequency of vehicle movements;
- the amount of pedestrian activity; and
- the width of the footway.

Obstacles to visibility

7.8.4 When it is judged that footway visibility splays are to be provided, consideration should be given to the best means of achieving this in a manner sympathetic to the visual appearance of the street (Fig. 7.21). This may include:
- the use of boundary railings rather than walls (Fig. 7.22); and
- the omission of boundary walls or fences at the exit location.

7.8.5 Parking in visibility splays in built-up areas is quite common, yet it does not appear to create significant problems in practice. Ideally, defined parking bays should be provided outside the visibility splay. However, in some circumstances, where speeds are low, some encroachment may be acceptable.

7.8.6 The impact of other obstacles, such as street trees and street lighting columns, should be assessed in terms of their impact on the overall envelope of visibility. In general, occasional obstacles to visibility that are not large enough to fully obscure a whole vehicle or a pedestrian, including a child or wheelchair user, will not have a significant impact on road safety.
7.9 Frontage access

7.9.1 One of the key differences between streets and roads is that streets normally provide direct access to buildings and public spaces. This helps to generate activity and a positive relationship between the street and its surroundings. Providing direct access to buildings is also efficient in land-use terms.

7.9.2 The provision of frontage vehicle access onto a street should be considered from the viewpoint of the people passing along the street, as well as those requiring access (Fig. 7.23). Factors to consider include:

- the speed and volume of traffic on the street;
- the possibility of the vehicles turning around within the property – where this is possible, then vehicles can exit travelling forward;
- the presence of gathered accesses – a single access point can serve a number of properties or a communal parking area, for example. This may be acceptable where a series of individual accesses would not be; and
- the distance between the property boundary and the carriageway – to provide adequate visibility for the emerging driver.

7.9.3 In the past, a relatively low limit on traffic flow (300 vehicles per peak hour or some 3,000 vehicles per day) has generally been used when deciding whether direct access was appropriate. This is equivalent to the traffic generated by around 400 houses. Above this level, many local-authority residential road guidelines required the provision of a ‘local distributor road’.

Figure 7.21 Beaulieu Park, Chelmsford – low vegetation provides subtle provision of visibility at private driveway.

Figure 7.22 Beaulieu Park, Chelmsford: the visibility splays are provided by railings rather than boundary walls, although the railings could have followed the property boundary.

Figure 7.23 Frontage access for individual dwellings onto a main street into Dorchester.
7.9.4 Such roads are often very unsuccessful in terms of placemaking and providing for pedestrians and cyclists. In many cases, buildings turn their backs onto local distributors, creating dead frontages and sterile environments. Separate service roads are another possible design response, but these are wasteful of land and reduce visual enclosure and quality.

7.9.5 It is recommended that the limit for providing direct access on roads with a 30 mph speed restriction is raised to at least 10,000 vehicles per day (see box).

Traffic flow and road safety for streets with direct frontage access

The relationship between traffic flow and road safety for streets with direct frontage access was researched for MfS. Data on recorded accidents and traffic flow for a total of 20 sites were obtained. All of the sites were similar in terms of land use (continuous houses with driveways), speed limit (30 mph) and geometry (single-carriageway roads with limited side-road junctions). Traffic flows at the sites varied from some 600 vehicles per day to some 23,000 vehicles per day, with an average traffic flow of some 4,000 vehicles per day.

It was found that very few accidents occurred involving vehicles turning into and out of driveways, even on heavily-trafficked roads.

Links with direct frontage access can be designed for significantly higher traffic flows than have been used in the past, and there is good evidence to raise this figure to 10,000 vehicles per day. It could be increased further, and it is suggested that local authorities review their standards with reference to their own traffic flows and personal injury accident records. The research indicated that a link carrying this volume of traffic, with characteristics similar to those studied, would experience around one driveway-related accident every five years per kilometre. Fewer accidents would be expected on links where the speed of traffic is limited to 20 mph or less, which should be the aim in residential areas.

7.10 Turning areas

7.10.1 Connected street networks will generally eliminate the need for drivers to make three-point turns.

7.10.2 Where it is necessary to provide for three-point turns (e.g. in a cul-de-sac), a tracking assessment should be made to indicate the types of vehicles that may be making this manoeuvre and how they can be accommodated. The turning space provided should relate to its environment, not specifically to vehicle movement (see Fig. 7.24), as this can result in a space with no use other than for turning vehicles. To be effective and usable, the turning head must be kept clear of parked vehicles. Therefore it is essential that adequate parking is provided for residents in suitable locations.

7.10.3 Routeing for waste vehicles should be determined at the concept masterplan or scheme design stage (see paragraph 6.8.4). Wherever possible, routing should be configured so that the refuse collection can be made without the need for the vehicle having to reverse, as turning heads may be obstructed by parked vehicles and reversing refuse vehicles create a risk to other street users.

Figure 7.24 Different turning spaces and usable turning heads.
7.11 Overrun areas

7.11.1 Overrun areas are used at bends and junctions (including roundabouts). They are areas of carriageway with a surface texture and/or appearance intended to deter overrunning by cars and other light vehicles. Their purpose is to allow the passage of large vehicles, such as buses and refuse vehicles, while maintaining ‘tight’ carriageway dimensions that deter smaller vehicles from speeding.

7.11.2 Overrun areas should generally be avoided in residential and mixed-use streets. They can:
- be visually intrusive;
- interfere with pedestrian desire lines (Fig. 7.25); and
- pose a hazard for cyclists.
However, they can help to overcome problems with access for larger vehicles and so may represent the best solution.

Figure 7.25 The overrun area at this junction is hazardous for pedestrians and/or requires them to divert from their desire line. Notice also the unsightly placing of inspection covers. The layout is particularly hazardous for blind and partially-sighted pedestrians.