Design Manual for Urban Roads and Streets

An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

Comhshaol, Pobal agus Rialtas Áitiúil
Environment, Community and Local Government

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MINISTER'S INTRODUCTION

Ireland's major towns and cities are now linked by a network of high quality, well planned inter-urban roads. This achievement has resulted in a significant improvement in journey times and contributed to a welcome reduction in road fatalities and injuries as well as greater savings in fuel and lower carbon emissions.

The completion of the National Road network has delivered tangible economic, social and environmental benefits throughout Ireland. It is now timely to build on this progress by re-examining the role and function of streets within our urban areas, where vehicular traffic is most likely to interact with pedestrians and cyclists and where public transport can most effectively and efficiently be planned for and provided.

Better street design in urban areas will facilitate the implementation of policy on sustainable living by achieving a better balance between all modes of transport and road users. It will encourage more people to choose to walk, cycle or use public transport by making the experience safer and more pleasant. It will lower traffic speeds, reduce unnecessary car use and create a built environment that promotes healthy lifestyles and responds more sympathetically to the distinctive nature of individual communities and places.

Whether travelling to work, school or college or for shopping, social or leisure purposes, improved street design as envisaged in this document will enhance how we go about our business, how we interact with each other and have a positive impact on our enjoyment of the places to and through which we travel.

This Manual offers a holistic approach to the design of urban streets in cities, towns, suburbs and villages in Ireland for the first time and promotes a collaborative and consultative design process. It requires professionals of different disciplines to work together to achieve better street design. We welcome this Manual and look forward to the added value and improvements in quality of life that will be achieved through implementation of this integrated and progressive approach.

Leo Varadkar, TD
Minister for Transport, Tourism and Sport

Jan O'Sullivan, TD
Minister of State, Department of Environment, Community and Local Government with special responsibility for Housing and Planning

PREFACE

It is beyond doubt that the streets of our cities and towns, suburbs and villages, should be safe, attractive and comfortable for all users. As well as cars and other vehicles this encompasses pedestrians, cyclists, and those using public transport. It also includes people of all ages and abilities and is equally relevant to residents and visitors.

As Ireland follows the global trend towards increased urbanisation we must ensure our cities and towns are pleasant, safe and healthy places to live. Any form of movement within densely populated space entails risk. Perception of risk is an important part of road safety. Spaces that 'feel' safe for driving are often hazardous places to walk or cycle. These spaces sometimes induce a false sense of safety and a tendency to drive at inappropriate speed. Thus, well intended designers inadvertently transfer risk from motorists to more vulnerable road users.

The desire for safe, attractive and vibrant streets is reflected in a range of existing transport, planning and environmental policies and objectives. These policies and objectives address how neighbourhoods, villages and towns are created and protected. They relate not only to road safety and civil engineering, but also to town planning, urban design, architecture, landscape architecture and conservation.

More significantly, they bear directly on broad societal issues, ranging from economic development, employment, tourism and recreation, through health, crime and security and onto education, social inclusion, energy efficiency and climate change.

In other words, the design of safer, more attractive and vibrant streets will benefit everyone by generating and sustaining communities and neighbourhoods, with wide ranging economic, social and environmental consequences.

It is significant to note that the evolution of current policy extends back more than a generation. A paper given at a 'Streets for Living' Conference in Dublin in 1976 stated:

> 'We are expecting from our human settlements the characteristics of streets in order to humanise them, particularly in our residential areas, and yet we have set our designers the task of designing and building and indeed maintaining what are undoubtedly roads...traffic taken in isolation can be a totally destructive force in the formation of human settlements.'[1]

The above has remained more accurate than ever, but given the extent to which policy and legal frameworks have advanced in recent years, it is now possible to achieve change. Accordingly, this Manual does not seek to set out new policy. It gives effect to existing policy by providing guidance on how to approach the design of urban streets in a more balanced way.

1 Paper entitled *The Visual and Social Problems of the Design of Residential Areas Today*, Ruairi Quinn, *Streets for Living Conference*, Dublin 1976.

ABOUT THIS GUIDE

This Manual complements previous advice issued viz:

- *Traffic Management Guidelines* (2003).
- *Smarter Travel* (2009).
- *Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas (Cities, Towns and Villages)* (2009)
- *National Cycle Manual* (2011).
- *Draft Planning Guidelines: Local Area Plans* (2012).

DMURS provides guidance relating to the design of urban roads and streets. The Design Manual for Roads and Bridges (DMRB) shall not henceforth apply to urban roads and streets other than in exceptional circumstances. Where those circumstances arise, written approval shall be obtained from the relevant sanctioning authority (as set out in Section 1.3 Application of this Manual).

This document is designed to be universally accessible to all professionals associated with street design. It presents a series of principles, approaches and standards that are necessary to achieve balanced, best practice design outcomes with regard to street networks and individual streets. It does so by presenting these in a structured format, ranging from macro level to micro level considerations.

The principles, approaches and standards set out in this Manual are intended for use by suitably qualified and experienced designers who work within the built environment professions. Designers must exercise a duty of care when applying the Manual. Compliance with a standard does not in itself confer immunity from legal obligations.

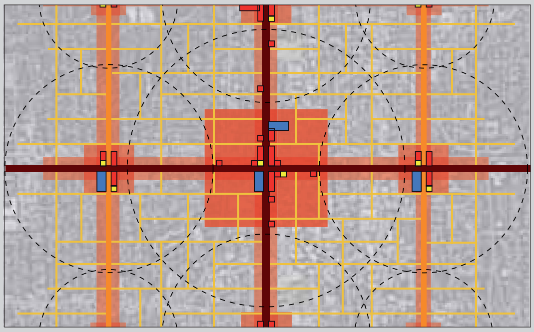
This Manual does not purport to account for every scenario that a designer will encounter, particularly when retrofitting existing streets. Nor can this Manual cover every technical detail. Many matters are left to the professional expertise and judgement of users, while others are covered elsewhere in relevant Irish, British or European standards, in codes of practice and guidelines, many of which are cross-referenced throughout this Manual.

CONTENTS

Chapter 1 introduces the goals of the Manual and demonstrates its context within the evolution of Government policy aimed at promoting more sustainable communities.

Chapter 2 makes the case for change and sets out the principles for a new direction that seeks to balance the needs of Place and Movement.

CHAPTER 3: STREET NETWORKS



Chapter 3 outlines the approaches to the design and management of street networks with the aim of creating better connected places.

CHAPTER 4: STREET DESIGN

Chapter 4 outlines the approaches and standards applicable to the design of individual streets with regard to context and the promotion of a self-regulating environment.

5. IMPLEMENTATION

Chapter 5 outlines a plan-led, multidisciplinary approach that will facilitate the implementation of the Manual.

APPENDICES

CHAPTER 1: INTRODUCTION

The desire for safe, attractive and vibrant streets is reflected in a range of existing environmental policies and objectives.

1. INTRODUCTION

1.1 A Different Perspective

This Manual seeks to address street design within urban areas (i.e. cities, towns and villages). It sets out an integrated design approach. What this means is that the design must be:

a) Influenced by the type of place in which the street is located, and

b) Balance the needs of all users.

A further aim of this Manual is to put well-designed streets at the heart of sustainable communities. Well designed streets can create connected physical, social and transport networks that promote real alternatives to car journeys, namely walking, cycling or public transport.

In preparing this Manual, it was instructive to examine and learn from experience in Ireland and elsewhere. This alternative requires a shift in thinking away from recently accepted practice approaches toward more sustainable approaches (see Figure 1.1). For example, in the UK, practice has evolved through several iterations of street design guidance in recent decades.

In many communities throughout Ireland it is perceived that some or all vehicular traffic is travelling too fast and should be directed elsewhere. The impacts are seen as a threat to the safety of the community and a negative element that detracts from the attractiveness of the road or street and the comfort of those using it. In response, it is sometimes possible to install a traffic-calming ramp. Such a 'retrofit' solution may slow traffic, but only very locally. It doesn't address the broader issue of what elements of the road design or street network encourage speeding.

In order to address the overall issue, it is necessary to start with the design of the street environment and street network as a whole. This 'holistic', design-led approach has been applied successfully in the UK, much of Europe and further afield. Although there are some good individual examples of street design in Ireland (see Figure 1.2), there is a need for agreed national street design standards specific to 'urban' areas.

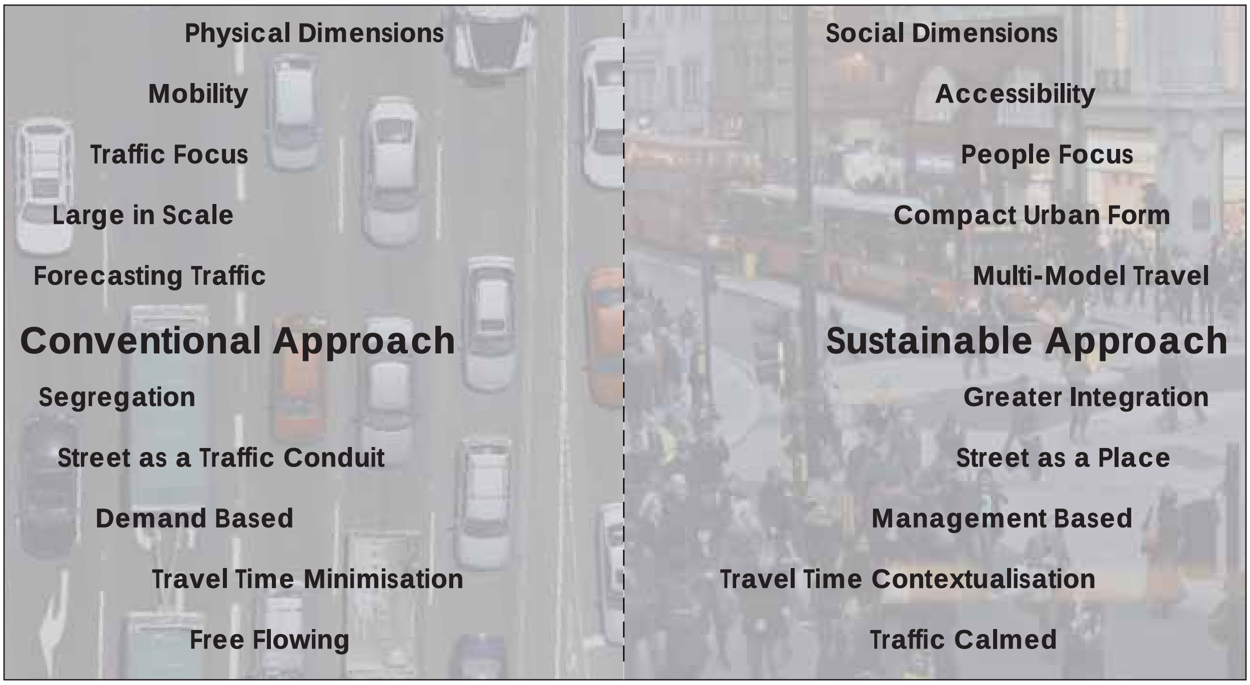


Figure 1.1: This guide will focus on shifting the emphasis of designers, as appropriate, from more conventional approaches that are concerned with the movement of traffic to more sustainable approaches concerned with multi-modal movement and streets as places.

Street design can be more effective in cost and efficiency, slowing traffic speeds, through understanding and addressing driver behaviour. Careful place-making will protect heritage and tourism potential whilst facilitating growth and new uses. Better quality public realm will promote civic confidence and can attract stakeholder investment, thus creating jobs. Encouraging walking and cycling, linked to easier access for a broad range of ages and abilities, will ensure liveliness and interaction on streets, thereby increasing vibrancy and improving commercial and retail activity.

The cumulative economic, social and environmental impacts of transport choices on the design of the built environment are often overlooked. A focus on improved street design will contribute to better value for money, social inclusion and reduced carbon emissions.

The sustainable urban neighbourhood is diverse, focused on identifiable centres, and walkable. Streets and roads should join rather than separate places and communities. The sustainable urban neighbourhood provides the principle building block of a viable community whether at the scale of village, town or city.

This Manual recognises the importance of assigning higher priority to pedestrians and cyclists, without unduly compromising vehicle movement, in order to create secure, connected places that work for all members of the community. Walking and cycling will improve health and well-being and will provide greater opportunities for interaction which promote neighbourliness and community growth.

This Manual focuses on streets as attractive places, whether new or existing. It seeks to encourage designs appropriate to context, character and location that can be used safely and enjoyably by the public.

This Manual is primarily intended for those built environment professions (both private and pubic sectors) concerned with the design of roads or streets in cities, towns and villages. It is also relevant to politicians, policymakers and community groups. Particular emphasis is placed on the importance of collaborative working and co-ordinated decision-making.

Figure 1.2: Ballina, Co. Mayo (top), Drogheda, Co. Louth (middle) and Adamstown, Co. Dublin (bottom). This Manual will build upon the many examples of streets which create positive places that serve communities in an inclusive way.

1.2 Policy Background

National planning and transport strategy seeks to achieve a hierarchy of towns, linked by efficient transport networks, underpinned by economic activity and investment. It also aims to minimise overall travel demand, reduce carbon emissions and reliance on fossil fuels. Central to this is the alignment of spatial planning and transport policy to contain suburban sprawl, linking employment to transport and encouraging modal shift to more sustainable modes of travel

To support these objectives, street layouts in cities, towns and villages will be interconnected to encourage walking and cycling and offer easy access to public transport. Compact, denser, more interconnected layouts, particularly where served by good quality bus or rail services, will help to consolidate cities, towns and villages making them viable for reliable public transport.

These objectives should be underpinned by Local Area Plans, Strategic Development Zone Planning Schemes and Land Use and Transportation Strategies. The importance of retrofitting existing streets and communities is also emphasised.

A further aim is to ensure compact, connected neighbourhoods based on street patterns and forms of development that will make walking and cycling, especially for local trips, more attractive. The context for the preparation of this Manual is set by the following Government policy documents:

Traffic Management Guidelines (2003)

The *Traffic Management Guidelines* (TMG), jointly published by the Departments of the Environment and Transport and the Dublin Transportation Office (now part of the National Transport Authority or NTA), address a wide range of issues, in the urban context, relating to street design and parking.

In 'Balancing conflicting priorities and making the right choices', it is recognised that there are many different objectives, modes and users to be considered in managing the transport network. The TMG seek to promote more sustainable alternatives to the private car and acknowledge the role of streets in urban areas as living spaces that serve many functions in addition to traffic movement:

> 'It is only in the last few decades that the car has come to dominate every street. Streets are (or ought to be) living spaces, an integral part of the community and the focus of many activities that link together people's lives. The way in which streets are managed and used promotes or discourages a sense of community and makes them an attractive or unattractive place to live…This imbalance must be reversed if urban communities are to revive and prosper. Planners and engineers must take the lead in this process.'

In relation to the layout and design of residential and commercial areas, the TMG further acknowledge deficiencies in the design process:

> '...layouts have been dictated by road hierarchy considerations based around the movement and parking requirements of motor vehicles. Design consideration for motor vehicles has come to dominate the shape and layout of developments. This has often been to the detriment of other road users and there are many examples where the road design and speed of traffic has discouraged pedestrian and cycle movement because of concerns over safety. It has also led to the creation of areas that are too similar and lack their own sense of local identity.'

The Guidelines recommend that new developments should address these issues, through the development plan and development control processes and they include some useful suggestions in relation to specific matters such as permeability and access to public transport.

Significantly, the TMG suggest that local authorities publish guidance on how new housing and/or commercial developments are to be designed, including 'guidance on general layout and design of residential/ commercial roads and footways/cycleways'.[1] A number of relevant UK design guides are referenced that 'could form the basis for such guidance. They would need some modification to reflect local and national differences in layout and design of housing, use of materials, local parking and garage use etc. to achieve a sense of local identity.'

1 To date, with the exception of the *Adamstown Street Design Guide* (2010) prepared by South Dublin County Council, no such local guidance manuals have been published.

Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas (Cities, Towns & Villages) (2009).

This guidance document was published by the Department of the Environment and is accompanied by the Urban Design Manual. It replaced the Residential Density Guidelines (1999) and focuses on sustainable residential development, including the promotion of layouts that:

- Prioritise walking, cycling and public transport, and minimise the need to use cars;
- Are easy to access for all users and to find one's way around;
- Promote the efficient use of land and of energy, and minimise greenhouse gas emissions;
- Provide a mix of land uses to minimise transport demand.

Specifically, in relation to the design of residential streets, the Guidelines reference the UK *Manual for Streets* (2007) and detail principles that should influence the layout and design of streets in residential areas. These principles include:

- Connectivity and permeability;
- Sustainability: Priority should be given to the needs of walking, cycling and public transport, and the need for car-borne trips should be minimised;
- Safety: Streets, paths and cycle routes should provide for safe access by users of all ages and degrees of personal mobility;
- Legibility: It should be easy for both residents and visitors to find their way in the area; and
- Sense of Place: Streets should contribute to the creation of attractive and lively mixed-use places.

The Guidelines also include recommendations in relation to streets, 'Frontage-free streets (such as distributor roads) are not recommended, as they can be unsafe for pedestrians (especially after dark) and can result in a hostile environment.' The Guidelines further recognise that 'most residential streets can successfully combine low to medium traffic movements with a pleasant residential setting, including on-street parking and the design of such streets from the outset should limit traffic speeds within the range of 30-50 km/h, without the need to resort to the use of remedial measures such as speed ramps.'

The Guidelines also make recommendations in relation to cul-de-sacs (they should not dominate residential layouts); shared priority 'homezones' and pedestrian and traffic safety. There is also a useful series of urban design checklists that include the following in relation to street design:

- Does the design of residential streets strike the right balance between the different functions of the street, including a 'sense of place'.
- Will the development:
    - prioritise public transport, cycling and walking, and dissuade the use of cars?
    - ensure accessibility for everyone, including people with disabilities?
    - include measures to ensure satisfactory standards of personal safety and traffic safety within the neighbourhood?
- Will the plan ensure a compact and easily walkable forms of development that will make walking and cycling, especially for local trips, more attractive than using the car?
- Has the design sought, where possible, to create child and pedestrian-friendly car-free areas, especially in higher density schemes, through the careful location of access streets and parking areas?

Smarter Travel - A Sustainable Transport Future
A New Transport Policy for Ireland 2009-2020

This document was published by the Department of Transport. It sets out five key goals as follows:

(i) to reduce overall travel demand;

(ii) to maximise the efficiency of the transport network;

(iii) to reduce reliance on fossil fuels;

(iv) to reduce transport emissions; and

(v) to improve accessibility to public transport.

To achieve these goals, key targets include objectives that future population and employment growth will predominantly take place in sustainable compact forms, which reduce the need to travel for employment and services and alternatives such as walking, cycling and public transport will be supported and provided to the extent that these will rise to 55% of total commuter journeys to work.

Further to outlining actions to reduce travel demand, it is targeted that in Ireland around 200,000 people will switch to cycling and walking by 2020.

The document specifically identifies the preparation of a 'Design Manual for Streets', 'which will outline practical design measures to support and encourage more sustainable travel patterns in urban areas', as key actions to encourage smarter travel.

The document details a range of 'Actions' in relation to the integration of land use planning and transport policy. It is recognised that this cannot be achieved solely in relation to new development and the significance of retrofitting is highlighted:

> 'We will require local authorities to prepare plans to retrofit areas towards creating sustainable neighbourhoods so that walking and cycling can be the best options for local trips, for example to reach local facilities such as shops and schools'.

The document includes a vision to create a strong cycling culture in Ireland and ensure that all cities, towns and villages will be cycling-friendly and that cycling will be a preferred way to get about, especially for short trips. There is also a commitment to creating a culture in Ireland that encourages people to walk as a matter of routine. Measures to ensure this include:

- Reprioritising traffic signals to favour pedestrians, instead of vehicles;
- Reducing waiting times and crossing distances at junctions;
- Ensuring that 30 km/h zones are designated in central urban areas which also continue to accommodate motorised traffic;
- Widening footpaths where there are high pedestrian flows, particularly close to public transport nodes;
- Clearing footpaths of unnecessary street furniture, e.g. rationalisation of signage poles etc.;
- Improving the surface quality of footpaths;
- Providing appropriately designed safe, well-lit, direct, continuous routes.

Draft Planning Guidelines: Local Area Plans 2012

This guidance document and its companion guide, the *Draft Manual for Local Area Plans* (2012), was published by the Department of the Environment in June 2012.

The LAP guidelines set out the range of requirements for the making of LAPs, including their content. Many of these requirements are concerned with placemaking and the design of streets and street networks, including:

Within existing areas

> 'promoting compact, walkable communities and neighbourhoods where local people can continue to enjoy access to established community facilities by the utilisation of undeveloped brownfield sites and/or derelict lands in preference to peripheral car-dependent development'.

> 'promoting smarter travel by encouraging/promoting development along existing public transport corridors and improving the pedestrian and cycling environment through better infrastructure and, in particular, creating shorter routes to educational, retail, employment or other facilities'.

> 'improving the public domain by providing active frontage to all public spaces and routes, thus promoting streets which encourage pedestrian activity and are safer by benefiting from passive surveillance'.

Within new areas

> 'providing compact, walkable neighbourhoods incorporating a variety of house types with mixed tenure'.

> 'designing in active streets and designing out anti-social behaviour through urban masterplanning, encouraging good mixture of uses and adaptability of buildings'.

> 'measures to encourage local people to adopt healthier, smarter ways to travel around their local communities, especially walking and cycling'

The *Draft Manual for Local Area Plans* provides more detailed measures to achieve these goals. In relation to street design, this includes:

> 'Create or enhance a distinctive hierarchy of streets, spaces and landscapes within an integrated structure'.

> 'Ensure priority for pedestrians, cyclists and public transport'.

> 'Set out the nature and hierarchies of public transport'.

> 'Optimise areas of high accessibility to public transport in terms of density and intensity of use'.

> 'Promote shared, safe movement routes for all users and avoid duplication or separation of main movement routes'.

> 'Set out the general movement function of routes and spaces within the route hierarchy'.

1.3 Application of this Manual

The principles, approaches and standards set out in this Manual apply to the design of all urban roads and streets (that is streets and roads with a speed limit of 60 km/h or less), except:

(a) Motorways.

(b) In exceptional circumstances, certain urban roads and streets with the written consent of Sanctioning Authorities.[2]

This Manual cannot account for every scenario (particularly when retrofitting existing streets) that a designer may face, the application of principles, approaches and standards contained herein requires a degree of flexibility. This is provided to designers, within a limited framework, via the use of the following terminology:

For the purposes of this Manual:

- **'Shall' or 'must'** indicates that a particular requirement is mandatory;
- **'Should'** indicates a recommendation. Where designers fail to meet a recommendation, they must clearly document the reasons as to why and propose a series of mitigation or compensation measures.
- **'May'** indicates a clarification, option or alternative course of action.

The Manual introduces a set of principles, approaches and standards necessary to achieve best practice in urban roads and street design. Implementation of the principles approaches and standards will be achieved through actions at national and local level.

At the national level:

1. The Department of Transport Tourism and Sport (DTTS) and the Department of Environment, Community and Local Government has introduced this Manual (DECLG) as a key step in implementing the policies on promoting the use of more sustainable transportation proposed in *Smarter Travel* (2009) and the policies on sustainable living contained in the *Guidelines on Sustainable Residential Development in Urban Areas* (2009).

2. DTTS and DECLG will work with local authorities in assisting with technical aspects of the implementation of the Manual on an on-going basis, learning from experience within Ireland and internationally.

At city and county level:

1. Local authorities shall facilitate the implementation of the principles, approaches and standards to road and street design set out in the Manual in carrying out their development planning functions under the Planning Code.

2. City and County development plans shall reference this Manual in order to facilitate the implementation of the policies for sustainable living contained in the *Guidelines on Sustainable Residential Development in Urban Areas* (2009). Local Area Plans and also other non-statutory plans should also reference the principles, approaches and standards within this Manual, where appropriate.

3. Local authorities should facilitate the adoption of the multidisciplinary approach to consultation where appropriate and shall use the relevant standards in the Manual when assessing planning applications which relate to or impact on urban roads and streets.

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2 Sanctioning Authorities include:

(i) The National Roads Authority in respect of urban national roads. The NRA shall consult with the NTA in respect of such roads which lie within the Greater Dublin Area

(ii) The National Transport Authority in respect of urban non-national roads within the Greater Dublin Area.

(iii) The Department of Transport, Tourism and Sport in respect of urban non-national roads.

4. In the case of applications for planning permission and development consents to planning authorities and An Bord Pleanála, applicants and their agents shall:

    - Utilise, as appropriate, the multidisciplinary design teams advised in this Manual.

    - Carefully examine their development proposals which relate to or impact on urban roads and streets to ensure that they are consistent as far as is practical with the principles, approaches and design standards of this Manual.

    - Engage with planning authorities at an early stage, utilising the arrangements for pre-planning application consultation with regard to any issue that may arise in relation to the application of design approaches set out in the Manual.

5. In the case of local authority own development in relation to the design of urban roads, streets or networks,[3] local authorities shall:

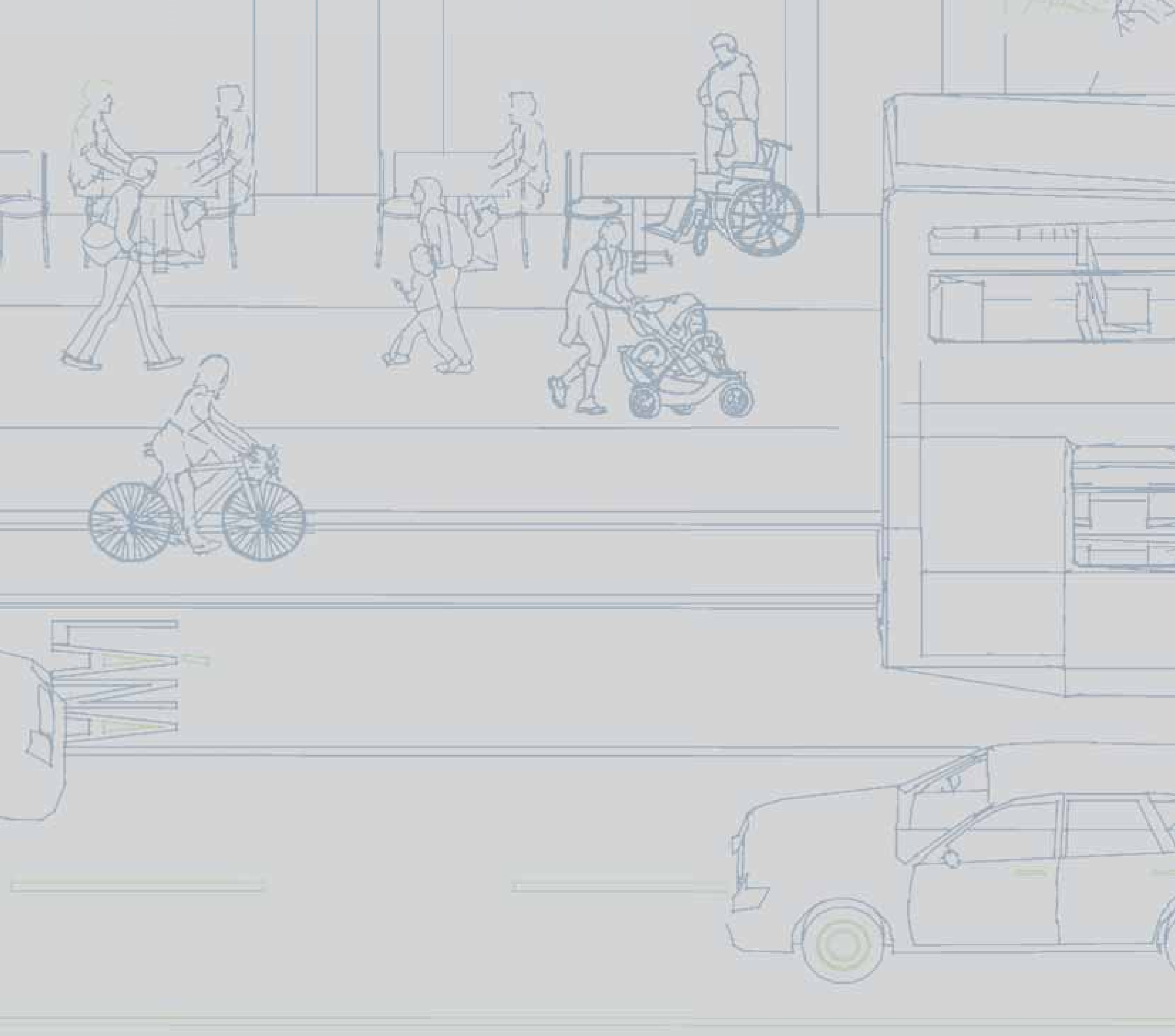
    - Facilitate as appropriate the multidisciplinary design teams advised in the Manual.

    - Ensure that the principles, approaches and standards of this Manual are applied as appropriate.

3 Including development made under Part 8 of the Planning and Development Regulations, 2001.

CHAPTER 2: RE-EXAMINING THE STREET

The creation of walkable, cycleable and public transport orientated communities require that designers re-examine the way streets are designed in order to meet the needs of all users.



2. RE-EXAMINING THE STREET

2.1 The Need for Change

Smarter Travel (2009) demonstrates that if travel trends within Ireland are not changed, congestion will increase, transport emissions will grow, economic competitiveness deteriorate, and the overall quality of life decline. Targets are set out to be achieved by 2020.[1] These include:

- The total share of car commuting to be reduced to 45%;
- Walking, cycling and public transport to achieve a 55% share of journeys to work, with cycling comprising 10%;
- Total kilometres travelled by the car fleet in 2020 not to increase significantly from 2009 levels.

Table 2.1 illustrates how people within Ireland travel to work. This table serves to highlight the scale of the challenge ahead. Ireland is highly car dependent when compared with our European neighbours.

There have been significant changes throughout Europe in recognition of the influence the design of streets and street networks have on travel patterns. *Smarter Travel* (2009) recognises that unless streets are designed to better facilitate and prioritise alternative modes of transport (to the car), the targets contained therein will not be met.

Section 2.1.1 below examines the relationship between the place and movement functions of a street, provides a review of conventional design practices and sets out an alternative, more sustainable approach.

1 Refer to Chapter 3 - *Smarter Travel* (2009).

Location/ Travel Mode	Ireland (state)	Dublin city and suburbs	Cork city and suburbs	Limerick city and suburbs	Galway city and suburbs	Waterford city and suburbs	All other urban areas	All urban areas	All rural areas
Vehicle	72%	55%	72%	72%	68%	76%	75%	66%	81%
On Foot	10%	14%	14%	15%	14%	14%	12%	13%	4%
Bicycle	2%	6%	2%	2%	5%	2%	1%	3%	0.5%
Bus, mini bus or coach	5%	13%	7%	4%	6%	3%	3%	8%	1%
Train, Dart or LUAS	3%	7%	0.4%	0.2%	0.4%	0.2%	3%	4%	0.5%

Table 2.1: Mode of travel to work within the State broken down by urban area (source Census 2011). Note: vehicle includes car, van, lorry or motorcycle as driver or passenger.

2.1.1 The Impact of the Car

The car has a significant impact on how street networks and streets are designed and how people interact with them. The relationship between cars and people can be illustrated via four distinct models (see Figure 2.1):

- The first model is where traffic and people are segregated and the car is dominant.
- The second model is where the car and people are segregated from each other.
- The third model is where traffic and people mix, although on a more equitable basis.
- The fourth model is where the car is excluded altogether.

Conventional design approaches in Ireland are largely based on the application of the first and second models. Pedestrian and vehicular movement are segregated from each other on the basis that a higher quality of service could be delivered for each mode.

Conventional design approaches within Ireland are heavily influenced by the UK publication *Traffic in Towns* (1963) or the *Buchanan Report*, as it became widely known. Utilising the Radburn principles of segregation, the *Buchanan Report* envisaged the creation of a highly ordered and structured street network that separated different modes of travel (see Figure 2.2).

The *Buchanan Report* was advanced in the UK by the publication of *Roads in Urban Areas* (1966). The Document proclaimed that 'segregation should be the keynote of modern road design' and 'should be applied as far as practical or necessary'. It recommended:

- The segregation of motor vehicles on the basis of purpose, destination or type.
- The segregation of motor vehicles from vulnerable road users (e.g. pedestrians and cyclists).

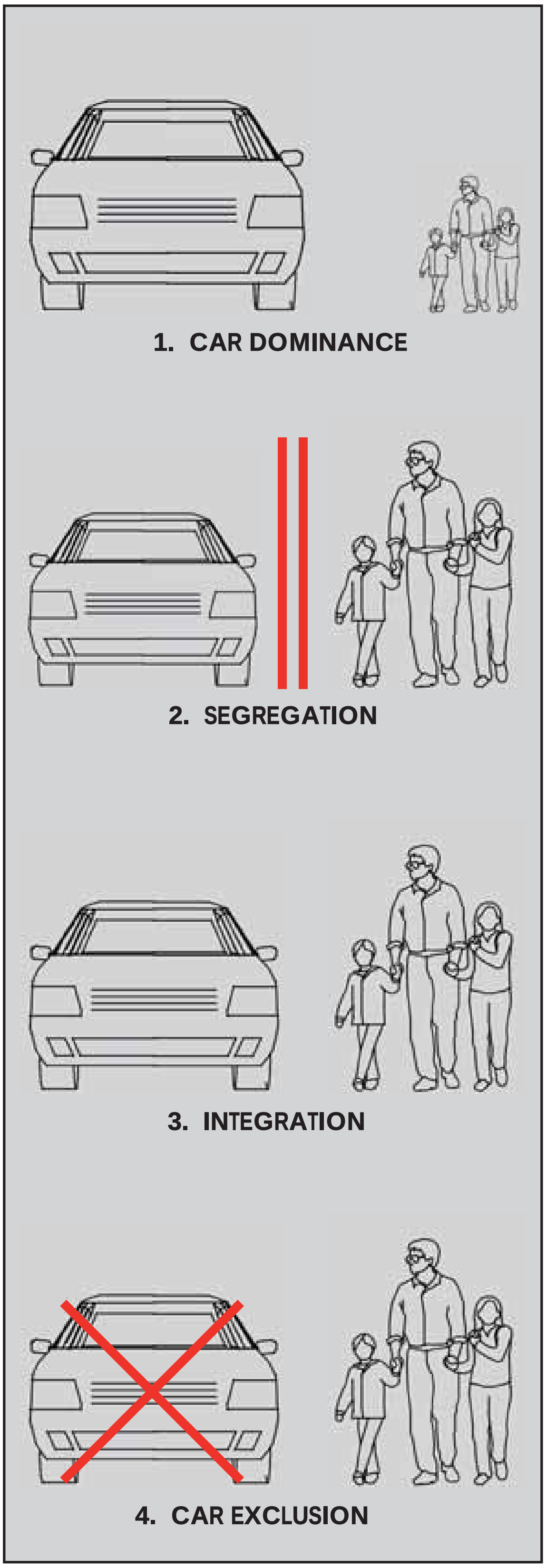


Figure 2.1: Four models of road design, adapted from Jan Gehl within Life Between Buildings (1971), illustrating the relationship between cars and people within a road or street.

- The provision of 'distributor roads' for 'the free flow of traffic at reasonable speed' along which access and frontage development was fully or partially restricted.

- The creation of 'neighbourhood cells' that restrict the movement of through traffic.

- The segregation of moving vehicles from parked vehicles primarily through restrictions on on-street parking.

These recommendations had a major influence in Ireland as designers became increasingly focused on traffic flow and capacity. One of the most expansive examples of this influence can be seen in the *Dublin Transportation Strategy* (1971) which sought to reshape inner Dublin into a functional system of one-way street systems, ring roads and motorways in order to relieve congestion (see Figure 2.3). Whilst such a grand scheme was never realised, many streets were incrementally changed over time (including conversion to one-way systems) to increase capacity and reduce congestion.

Figure 2.3: Dublin Transport Strategy (1971). Although the scale of vision was never realised many aspects such as one-way traffic systems were implemented.

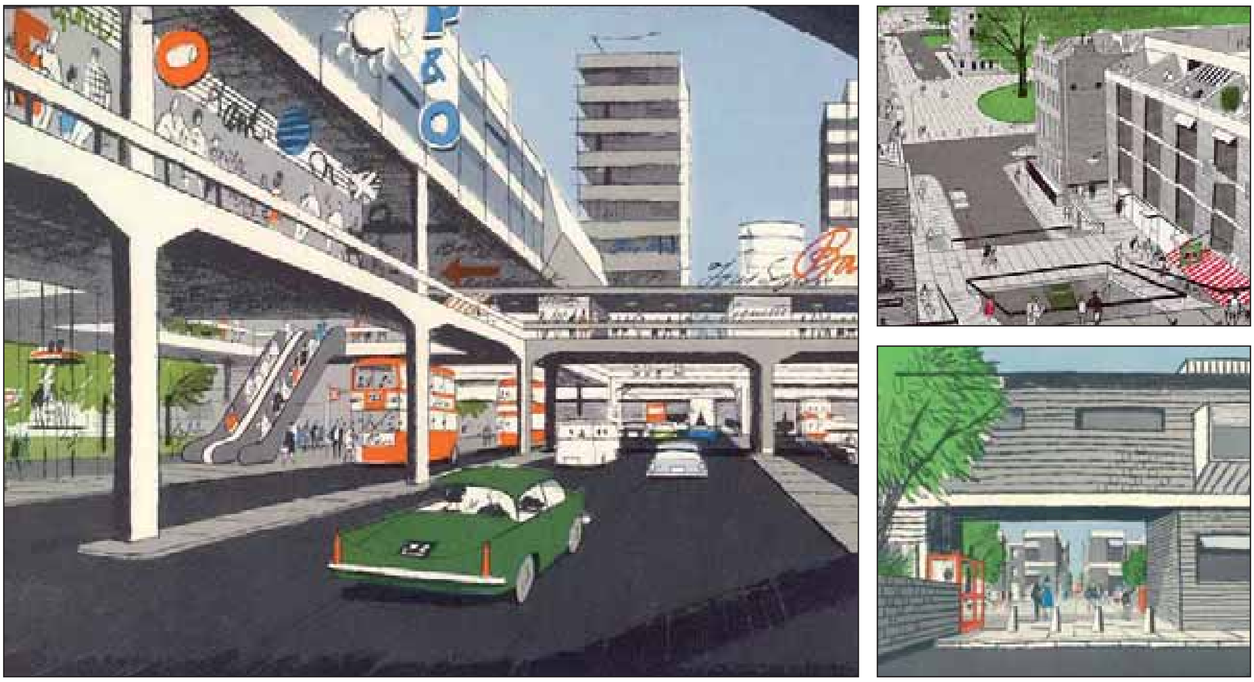


Figure 2.2: Images from the highly influential Traffic in Towns which drew upon the modernist vision of a highly ordered and efficient road network where users were vertically segregated by type (image source: Traffic in Towns (1963)).

The influence of *Traffic in Towns* (1963) is particularly evident in the design of new residential areas developed from the 1960s (see Figure 2.4):

- Through traffic is channelled along a series of distributor roads that are designed with minimal interruption to the flow of traffic (i.e. frontage free, restricted points of access, no parking).

- Access to the neighbourhood cell, and movement within it, is highly restricted. This is enforced by dendritic street networks that consist of a large proportion of cul-de-sacs.

Some segregated street networks may have benefits with regard to:

- Separating slower and faster modes of transport.

- The widespread application of cul-de-sacs may be popular because of their perceived safety and relatively traffic free environment (if short in length).

- Large car free areas may shelter pedestrians and cyclists from traffic.

However, segregated design solutions (particularly where the car is dominant) have tended to fail as places, increase car dependency and reduce pedestrians and cyclist activity.

The following review of conventional design outcomes has a particular focus on the pedestrian environment as well as the street as a place. Many of the scenarios depicted are also of relevance to cyclists, with many similar issues highlighted throughout the *National Cycle Manual* (2011).

Figure 2.4: Example of a residential community designed according to the keynote principles of segregated street networks. 1) Distributor roads are designed to facilitate free flowing traffic and provide access to 2) neighbourhood cells. Movement through the cell enforced via a dendritic street layout of 3) cul-de-sacs that spread out like the branches of a tree (base image source: Google Maps).

2.1.2 The Pedestrian Perspective

Connectivity

A core objective of a segregated approach to street design is the creation of a highly functional traffic network. This approach has left many communities disconnected and has placed significant limitations on sustainable forms of transportation. The connectivity (and legibility) problems which arise from dendritic street layouts are illustrated in Figure 2.5, where walking distances are increased, route choice is highly limited and users have to navigate a complicated street network. Research has shown, that a lack of connectivity is one of the key factors that discourage people from walking.[2]

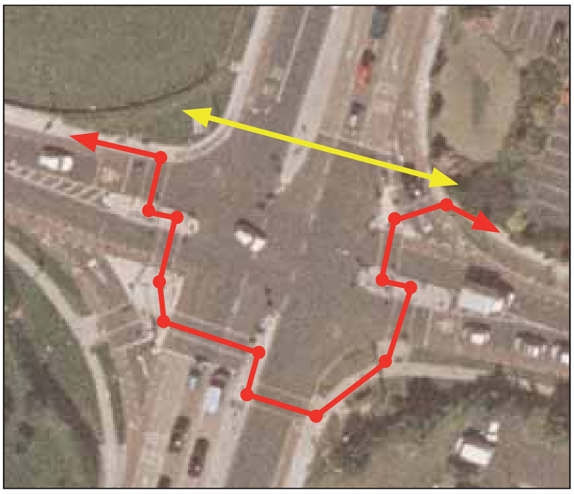
The highly segregated design of distributor roads also presents a major barrier that creates severance between adjoining communities (see Figure 2.6). This occurs because physical restrictions in access are enforced by continuous walls and fences put in place to prevent pedestrian access. Where access is proposed, safety concerns are often raised because of the fast moving/free flowing nature of these roads, even where there may be major benefits in terms of access to services (see Figure 2.7).

2 Refer to *Understanding Walking and Cycling* (2011).

Figure 2.5: A typical example of a residential area constructed in accordance with the principles of segregation. Walking and cycling permeability is restricted to the point that the two neighbouring houses shown back to back are up to 4km walking distance apart.

Figure 2.6: Distributor Road which creates severance between communities. The road is designed to minimise any disruption to vehicle movement by restricting the number of junctions and pedestrian access (through the use of walls and fences). The road is also frontage free, eliminating the need for driveway access to individual properties.

Connectivity and legibility issues also occur at a more localised scale where the movement of traffic is given priority over that of pedestrians. Pedestrians often have to walk long distances to designated crossing points. Larger junctions can also be difficult to navigate and significantly delay journey times. Many large junctions corral pedestrian movement (and in some cases cyclists) away from desire lines, using guardrails, increasing the amount of time it takes to cross as users navigate a number of individually signalised crossings (see Figure 2.8).



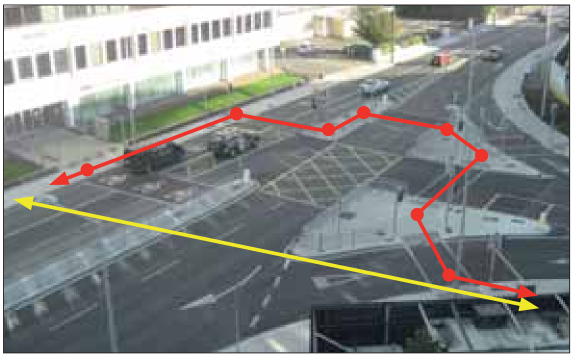


Figure 2.8: Examples of a junctions designed to minimise vehicle delays which significantly increase crossing times for pedestrians. Pedestrian desire lines (represented by the yellow line) are diverted through a series of separate crossings (represented by the red line). The top example can take pedestrians as long as 5 minutes to navigate.

Figure 2.7: Example of a 'neighbourhood cell' located within a 'distributor road' network. A long fence separates the Cell from the Distributor Road. A number of openings in the fence were initially planned to provide access to bus stops. These were removed at the request of residents due to safety concerns, significantly increasing walking distances to bus stops (base image source: www.bing.com/maps).

Comfort

Pedestrians are sometimes marginalised along the street edges so that greater space can be provided within the street reserve to facilitate vehicle movement. This occurs in a number of ways:

- Narrow footpaths squeeze pedestrians together and do not leave sufficient room for people to pass.
- Footpaths become cluttered with poles and guardrails that obstruct and constrain pedestrian movement and create visual clutter.
- Footpaths are lined with blank walls and fences that restrict passive surveillance and make pedestrians feel isolated and vulnerable.

These elements can combine to obstruct vulnerable users and at times it is necessary for them move onto out onto cycle paths/ lanes and/or vehicular carriageways in order to progress along the street (see Figures 2.9 - 2.11). A lack of on-street parking facilities can also contribute to the obstruction of footpaths and cycle paths/lanes. Where demand for on-street parking exists and is not catered for, drivers routinely kerb mount and park on footpaths and cycle lanes (see Figure 2.12).

Figure 2.9: Footpath widths are inadequate, forcing pedestrians on to the carriageway, however, the width of the vehicular lane is in excess of what is generally required.

Figure 2.10: Guardrails can create a hazard for cyclists, reduce footpath widths and give rise to feelings of constraint and restriction to pedestrians.

Figure 2.11: Pedestrians have been marginalised along the street edge and have their path obstructed in order to provide additional width to the vehicular carriageway and space for signage.

As recognised by the *Guidelines for Sustainable Residential Development in Urban Areas* (2009), the design of roads often results in an environment that is hostile for pedestrians (especially after dark).[3] Blank walls and fences restrict surveillance and movement. If pedestrians feel isolated within a street because of its characteristics, they are unlikely to use it, are unlikely to avail of the services within it and consequently will become more car dependent (see Figure 2.13). Research has shown that a lack of activity and surveillance on streets is one of the key factors that discourage people from walking.[4]

Safety

Many of the examples in Figures 2.5 to 2.13 are designed to eliminate risk, promote free-flowing conditions for traffic and make streets safer. By limiting elements such as junctions and on-street car parking, the number of potential vehicular traffic conflicts/stoppages is reduced. Clearer sightlines and wide carriageways also allow for greater driver reaction time/error correction. Whilst this approach is sensible on isolated roads, within urban areas it can be counter productive as it may transfer risk to more vulnerable users. Research has found that:[5]

- The speed at which drivers travel is principally influenced by the characteristics of the street environment (see Figure 2.14).

3 Refer to Section 3.18 of the *Guidelines for Sustainable Residential Development in Urban Areas* (2009).
4 Refer to *Understanding Cycling and Walking* (2011).
5 Refer to *Designs for Life: Learning from Best Practice Streetscape Design* (2007).

Figure 2.12: If on-street parking is not provided, particularly for visitors, it can lead to poor parking behaviour from drivers who kerb mount and park on footpaths/cycle lanes.

Figure 2.13: Example of a street that is hostile to pedestrians and cyclists (especially after dark). The unwillingness of people to interact with this type of environment will serve to undermine the viability of public transport services.

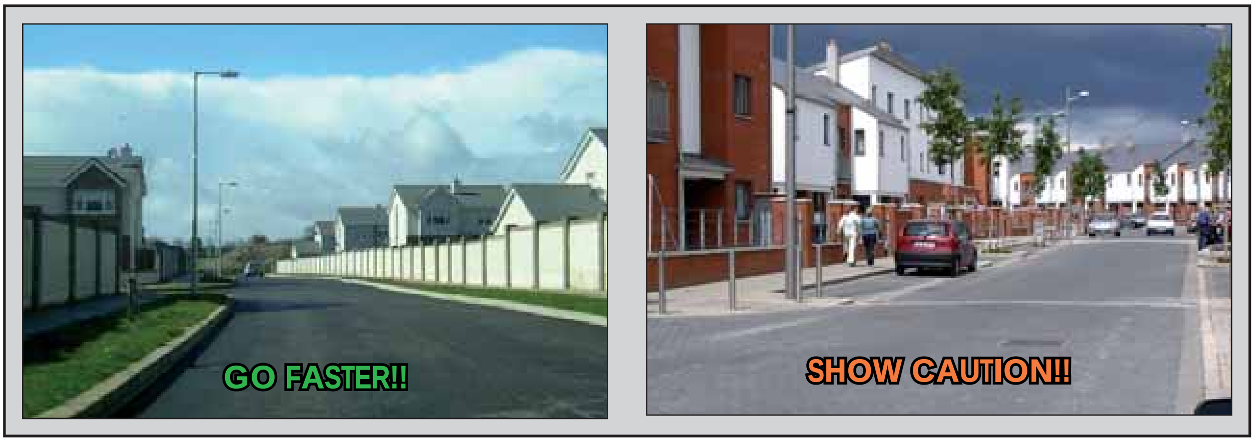


Figure 2.14. The elimination of access and frontage along roads (top) was introduced to reduce risk, but it serves to encourage speeding.

- If the design of a street creates the perception that it is safe to travel at higher speeds drivers will do so, even if this conflicts with the posted speed limit.

By eliminating risk and promoting free-flowing conditions, drivers feel more inclined to drive at higher speeds. Furthermore if speed limits are perceived as not being appropriate to the environment, it can undermine the speed limit system as a whole.[6] The extent to which speeding in urban areas is a problem has been identified in successive surveys carried out by the Road Safety Authority, with 3 out of 5 drivers on urban streets driving in excess of the posted speed limit.[7]

The Buchanan Report concluded that pedestrians and vehicles were 'fundamentally incompatible' and that segregation would lead to a safer road environment for all users. However, the envisaged segregation of the motor vehicle and pedestrian is not feasible in an urban environment. It is inevitable that pedestrians and vehicles will interact in urban environments. By creating larger, free-flowing roads which prioritise vehicle movement, where this interaction occurs it is likely to happen at a much higher speed, thus increasing the severity of an accident (see Figure 2.15).

Pedestrians have little tolerance for delay and studies have found that significant numbers of pedestrians will not comply with the detour/delay created by diversions, such as those enforced by guardrails.[8] Pedestrians tend to follow desire lines (i.e. take the shortest route), even if this conflicts with the location of formal crossings and pedestrian control measures (see Figure 2.16). The use of guardrails may be counter productive as:[9]

- It may increase vehicle speeds and aggressive driver behaviour.

6 Refer to *Circular RST 02/2011 Guidelines for the Setting of Special Speed Limits* (2010).
7 Refer to the *RSA Free Speed Survey* (2008), (2009) and (2011).
8 Refer to the UK Parliament Inquiry into *Walking in Towns and Cities* presented to the European Transport Conference (2011).
9 There are several publications that further discuss the use of guardrails, including Section 4.4 of the *National Cycle Manual* (2011); UK Department for Transport Local Transport Note 2/09 *Pedestrian Guardrails* (2008); *Guidance on the Assessment of Pedestrian Guardrail* (2012) and Section 12.4 of the *Manual for Streets 2* (2010).

Figure 2.15: Large freer flowing roads and junctions may result in pedestrians taking greater risks in front of faster moving traffic.

Figure 2.16: Measures which divert and/or delay pedestrians may reduce safety as pedestrians walk/cross in locations which vehicles may not anticipate.

- Create a false sense of safety for both drivers and pedestrians (guardrails will only stop vehicles travelling at very low speeds).
- Block intervisibility between drivers and children.
- Result in pedestrians/cyclists being trapped on the carriageway or found in locations that are not anticipated by drivers.
- Reduce the width and capacity of footways and crossings.
- Create a collision hazard for cyclists where built in close proximity to cycle lanes.[10]

Updesigning

Many of the issues highlighted above have been exacerbated by a process of 'updesigning', where roads are designed to standards in excess of their movement function. This often occurs due to:

- The inappropriate application of the *National Roads Authority Design Manual for Roads and Bridges* (NRA DMRB) on streets and roads in urban areas.[11]
- Catering for the ease of movement of large vehicles, which only occasionally frequent a road/street.
- Enabling greater capacity and vehicle flow based on excessive demand forecasts and/or the assumption that private vehicle usage will increase unabated.

The continued assumption of growth in private vehicle usage is not sustainable and is contrary to the targets contained within *Smarter Travel* (2009). Updesigning also places a significant financial burden (both capital and maintenance) on local authorities (see Figure 2.17). These outcomes represent poor value for money and a simpler, more integrated approach can achieve advantages in terms of sustainability, placemaking and traffic movement.

Figure 2.17: Examples of updesigning which provide little cost benefit. From top to bottom, large splayed junction, complex junctions, ramps on wide carriageways, noise walls and repetitive signage.

10 Refer to Section 4.4.1.3 of the *National Cycle Manual* (2011).

11 The NRA DMRB is primarily intended for use on roads of national/regional importance. Such roads generally carry significant volumes of traffic at higher speeds over longer distances (Refer to Section 1.5 of the NRA TD 9 of the NRA DMRB).

2.2 The Way Forward

Government policies (refer to Section 1.2 Policy Background) require a shift away from conventional design solutions toward those which prioritise sustainable modes of transport, safeguard vulnerable users and promote a sense of place. The approach required to achieve these outcomes will be principally based the application of a more integrated model of street design, where real and perceived barriers to movement are removed to promote more equitable interaction between users in a safe and traffic calmed environment.

Integrated approaches incorporate elements of urban design and landscaping that instinctively alter behaviour, thus reducing the necessity for more conventional measures (such as physical barriers and the road geometry) alone to manage behaviour. The attraction of this approach is that it creates a new dynamic and a 'win-win' scenario where:

- Street networks are simpler in structure (more legible) with higher levels of connectivity (more permeable) thus reducing travels distances.
- Higher quality street environments attract pedestrians and cyclists, promoting the use of more sustainable forms of transport.
- Self-regulating streets manage driver behaviour and calm traffic, promoting safer streets.
- Streets and junctions are more compact, providing better value for money.

There are those measures associated with segregation that will remain a key component of street design. The key to best practice street design is to promote the street as a place that appropriately balances the level of segregation and integration that occur within it (see Figure 2.18). Sections 2.2.1-2.2.3 outline the defining factors for achieving best practice street design, including four design principles fundamental to the implementation of a more sustainable approach.

Figure 2.18: Examples of busy streets and junctions with a high place value where the degree of segregation decreases/integration increases (from top to bottom) utilising a variety of design techniques that increase pedestrian/ cyclist mobility and slow vehicles.

2.2.1 'Place' as Part of the Design Equation

Designers must broaden the scope of issues that are considered throughout the design process. Whilst the movement of traffic is still a key issue, there are several others, including the 'sense of place', which are of core significance to the creation of safe and more integrated street designs (see Figure 2.19).[12]

The elements of place can be difficult to define as they often relate to the 'feel' of a particular area. More tangible elements of place can be measured and relate to connectivity, the quality of the built environment, how buildings and spaces interact with each other and the levels of pedestrian activity that occur. These tangible or quantifiable elements of a street highlight four interlinked characteristics that influence the sense of place within a street (see Figure 2.20):

Connectivity

The creation of vibrant and active places requires pedestrian activity. This in turn requires walkable street networks that can be easily navigated and are well connected.[13]

Enclosure

A sense of enclosure spatially defines streets and creates a more intimate and supervised environment. A sense of enclosure is achieved by orientating buildings toward the street and placing them along its edge. The use of street trees can also enhance the feeling of enclosure.

Active Edge

An active frontage enlivens the edge of the street creating a more interesting and engaging environment. An active frontage is achieved with frequent entrances and openings that ensure the street is overlooked and generate pedestrian activity as people come and go from buildings.

12 Refer also to Section 2.2.1 of the UK *Manual for Streets* (2007).
13 Refer also to the Section 01 of the *Urban Design Manual* (2009), which notes that successful places tend to be those that are the most well connected.

Figure 2.19: The most fundamental aspect of the creation of a sustainable street network is that designers clearly recognise that streets have both a place and movement function, so that streets are connected, enclosed, fronted onto and promote pedestrian and cyclist activity

Pedestrian Activity/Facilities

The sense of intimacy, interest and overlooking that is created by a street that is enclosed and lined with active frontages enhances a pedestrian's feeling of security and well-being. Good pedestrian facilities (such as wide footpaths and well designed crossings) also make walking a more convenient and pleasurable experience that will further encourage pedestrian activity.

These four characteristics represent the basic measures that should be established in order to create people friendly streets that facilitate more sustainable neighbourhoods.

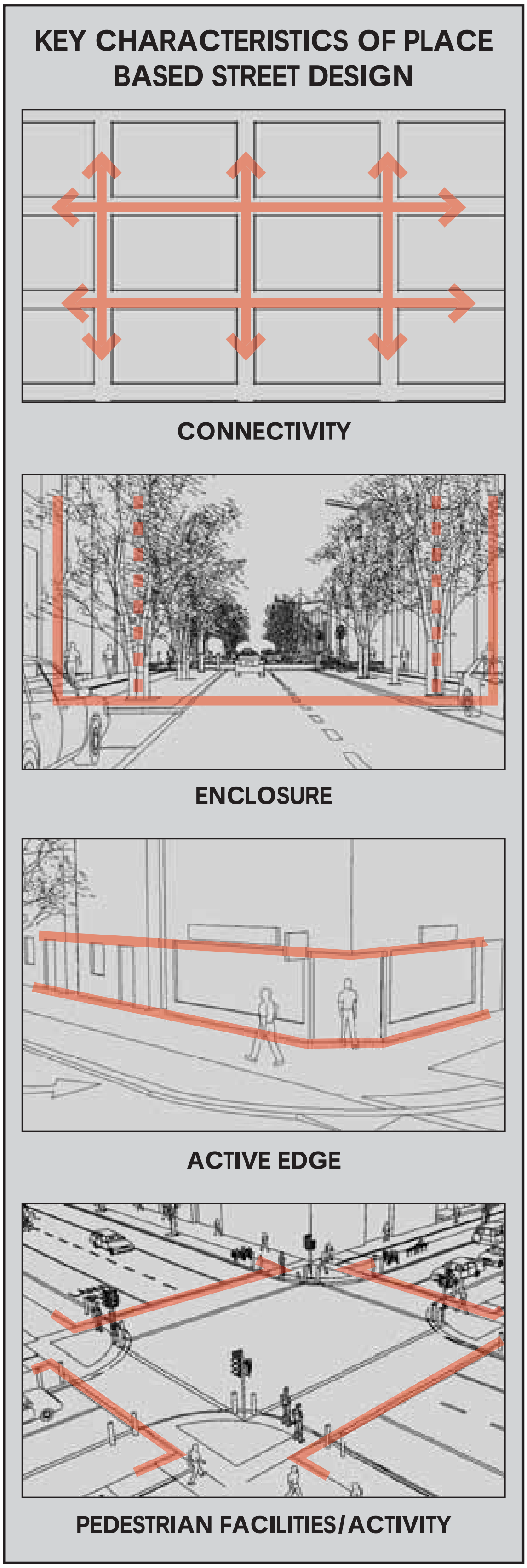


Figure 2.20: The key characteristics of the street that influence its sense of place. A safe, attractive and comfortable pedestrian environment requires all of these elements.

2.2.2 User Priorities

To encourage more sustainable travel patterns and safer streets, designers must place pedestrians at the top of the user hierarchy (see Figure 2.21). Walking is the most sustainable form of transport. Furthermore, all journeys begin and end on foot. By prioritising design for pedestrians first, the number of short journeys taken by car can be reduced and public transport made more accessible. The need for more walkable communities is also an issue of social equity as it is the poorest and most vulnerable in society, including children, the elderly and the disabled for whom car travel is less of an option. Research from the UK has shown that it is these groups who are disproportionately affected by the threat of accident, community severance and the loss of social cohesion.[14]

Designing for cyclists must also be given a high priority. Trips by bicycle have the potential to replace motor vehicles as an alternative means of transport for short to medium range trips (and in some cases longer range trips). Cycling also promotes a healthy lifestyle. Advances have been made in this regard with the publication of the *National Cycle Manual* (2011).

Within Ireland it is the bus that primarily caters for medium to long range journeys for those who don't drive though necessity or convenience. As noted by *Smarter Travel* (2009), commuters will only begin to consider a shift from car to bus transport when the advantages of the bus are greater than those of the car. The movement of buses should be prioritised over other motorised vehicles.

Placing private motor vehicles at the bottom of the user hierarchy should not be interpreted as an anti-car stance. People will always be attracted to cars where they are a convenient and flexible option and for many users it is currently their only viable option for medium to longer distance journeys. The key issue is one of balance, and the needs of the car should no longer take priority over the needs of other users or the value of place.

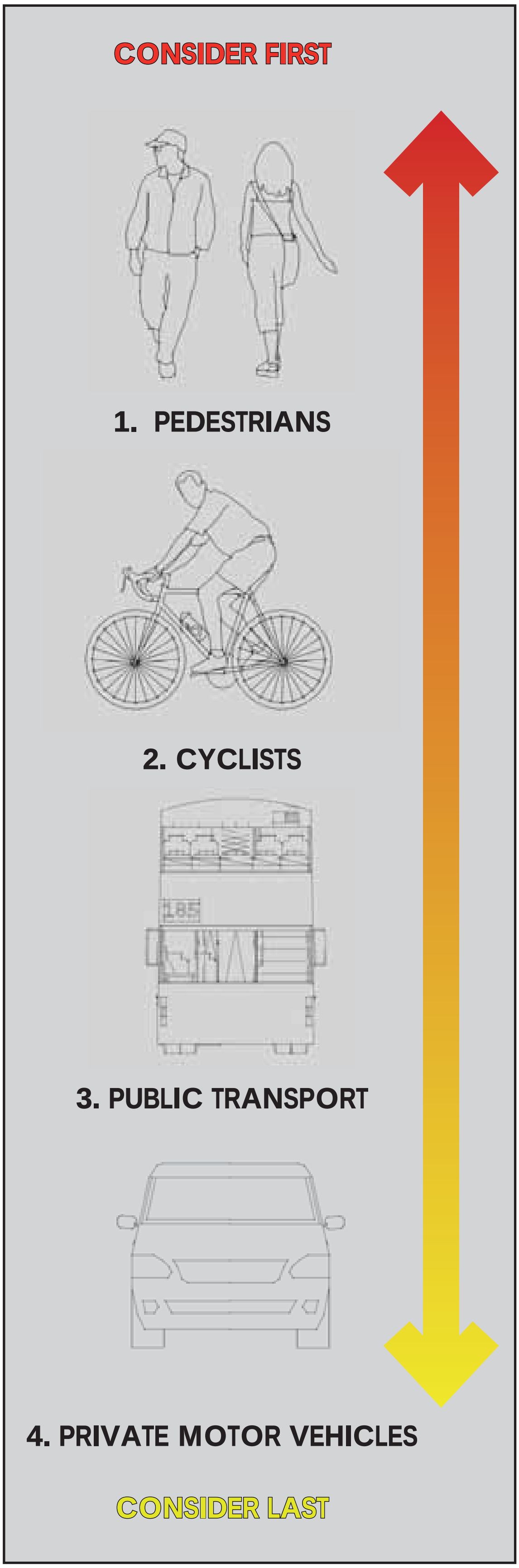


Table 2.21: User hierarchy that promotes and prioritises sustainable forms of transportation

14 Refer also to UK *Fairness in Transport: Finding an alternative to car dependency* (2011).

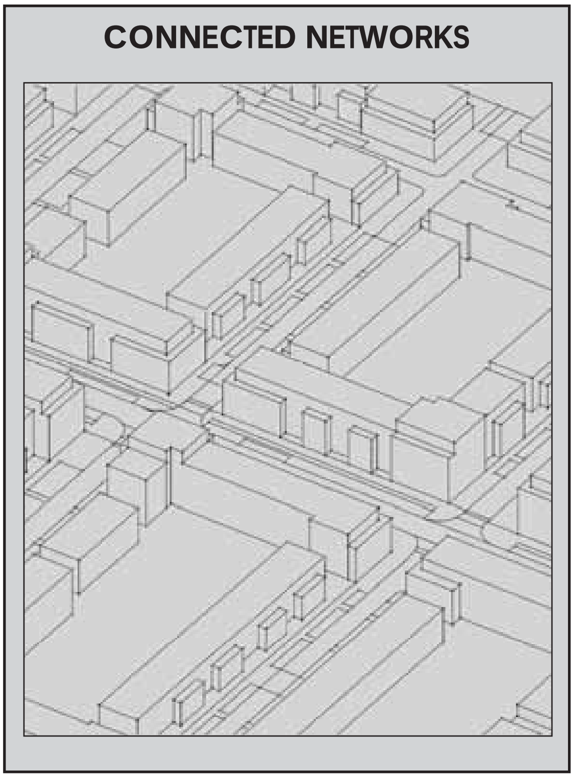
2.2.3 A Balanced Approach (Key Design Principles)

To guide a more place-based/integrated approach to road and street design, designers must have regard to the four core principles presented below:

Design Principle 1:

To support the creation of integrated street networks which promote higher levels of permeability and legibility for all users, and in particular more sustainable forms of transport.

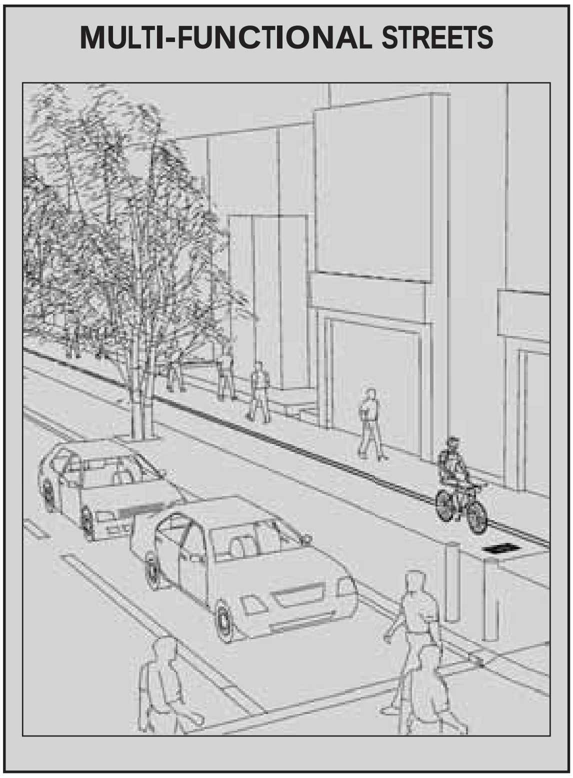
Chapter 3 of this Manual is concerned with the creation and management of permeable and legible street networks.



Design Principle 2:

The promotion of multi-functional, place-based streets that balance the needs of all users within a self-regulating environment.

Chapter 4 of this Manual is concerned with the creation of self-regulating streets that cater for the various place and movement functions of a street.



Design Principle 3:

The quality of the street is measured by the quality of the pedestrian environment.

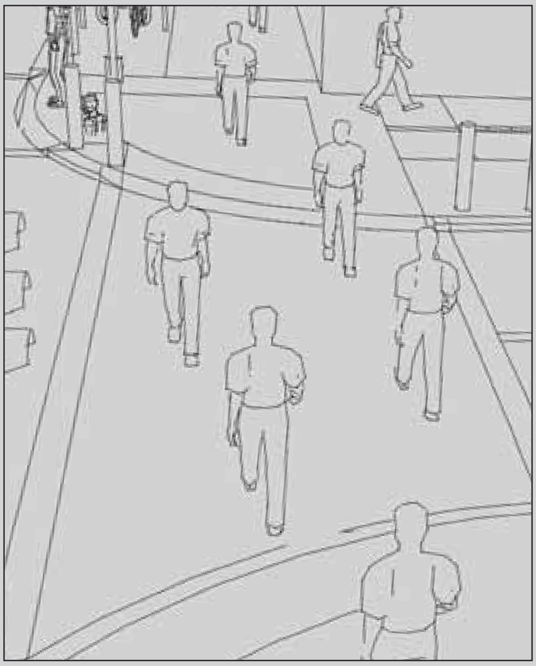
Chapter 4 of this Manual also provides design standards for the creation of a safe, comfortable and attractive pedestrian environment.

Design Principle 4:

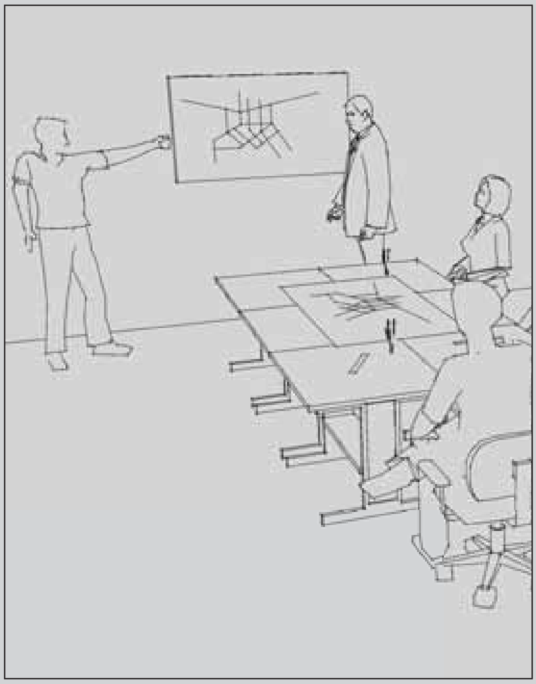
Greater communication and co-operation between design professionals through the promotion of a plan-led, multidisciplinary approach to design.

Chapter 5 of this Manual is concerned with the implementation of a more integrated approach to street design.

PEDESTRIAN FOCUS



MULTIDISCIPLINARY APPROACH



CHAPTER 3: STREET NETWORKS

Street Networks should be designed to maximise connectivity between destinations to promote higher levels of permeability and legibility for all users, in particular more sustainable forms of transport. This will allow people to move from place to place in a direct manner with greater route choice.

3.0 STREET NETWORKS

3.1 Integrated Street Networks

Sustainable neighbourhoods are areas where an efficient use of land, high quality urban design and effective integration in the provision of physical and social infrastructure such as public transport, schools, amenities and other facilities combine to create places people want to live in.

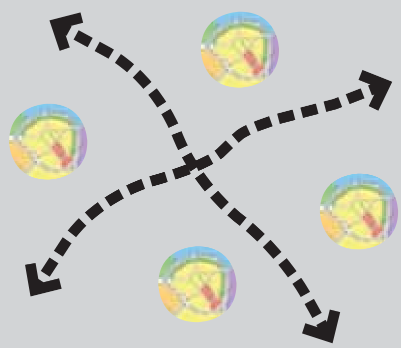
Additional features of sustainable neighbourhoods include:

- Compact and energy efficient development;
- Prioritising sustainable modes of transport;
- Provision of a good range of amenities and services within easy and safe walking distance of homes.

The implementation of the *Guidelines for Sustainable Residential Development in Urban Areas* (2009) and *Smarter Travel* (2009) strategy support an integrated urban structure where land uses are spatially organised around strategic connections and nodes. Strategic connections are the primary routes that connect places. Nodes form where these routes converge and intersect. Within Ireland there is a long established pattern of development evolving at nodes (such as cross roads and river crossings) as these tend to be the most connected places. It is this connectivity that allows the cities, towns and villages to grow and thrive (see Figure 3.1).

The integration of land use and transportation encourage the consolidation of development along strategic connections and around nodes (including city, town and village centres). The strategic connections are also the major routes for public transport, and the nodes their primary destination or interchange hub. This maximises accessibility to services and promotes the use of more sustainable forms of transportation, thus reducing car dependency.

Centres form the 'hub' of sustainable urban development through the formation of connected compact communities.



Positioning centres away from strategic routes deprives them of life and passing trade.

The answer is to create pedestrian and public transport orientated centres at the convergence of strategic links.

Figure 3.1: The creation of connected centres forms the backbone of integrated land use and transportation development. Base images from the UK Urban Design Compendium (2000) and UK Urban Design Taskforce.

Figure 3.2 illustrates an abstract model of an integrated land use and transportation settlement structure at a metropolitan scale, with an indicative street hierarchy. This settlement pattern has universal application and can be adapted according to the scale of a settlement. It may also be adapted according to accessibility by public transport. For example, as vehicular traffic (and in particular through traffic) converges on city, town and village centres, it may be diverted around the core area, allowing more efficient service by public transport routes.

This structure should be supported by a permeable and legible street network that offers route choice and flexibility for managing movement within it. These approaches are discussed in the ensuing sections with regard to the design and management of street networks.

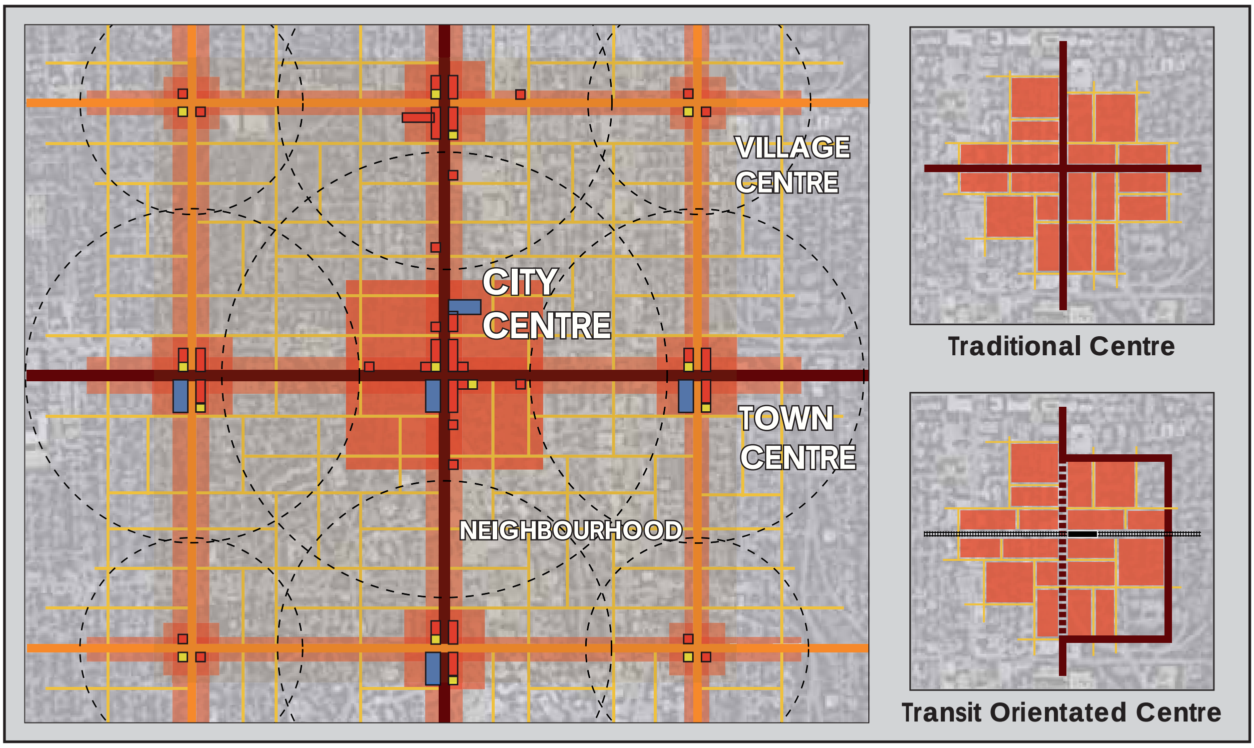


Figure 3.2: At a larger scale land use and transport integration occurs where more intensively developed areas are spatially organised around strategic links and centres/nodes.

3.2 Movement and Place

3.2.1 Movement Function

The movement function of a street is generally described using a classification system, such as a street hierarchy. This guide refers to street hierarchy as follows (see Figure 3.3):

- *Arterial Streets*
- *Link Streets*
- *Local Streets*

Table 3.1 illustrates how street/road hierarchies contained within other relevant documents are cross-referenced with the above.

The nature of this street hierarchy is well understood. In general, greater levels of connectivity are required between significant destinations, particularly those generating or attracting large volumes of traffic.

Designers must consider the *Function* of a street/street network. In general, as the movement function increases the street, designers:

- Should optimise the movement of public transport.
- Should cater for greater numbers of pedestrians and cyclists.
- May need to cater for higher volumes of traffic.

This approach should have regard to settlement size. For example an *Arterial Street* through a city may have to cater for much larger volumes of traffic than that in a village.

DMURS Description	Roads Act/NRA DMRB	Traffic Management Guidelines	National Cycle Manual
Arterial	National	Primary Distributor Roads	Distributor
Link	Regional (see note 1)	District Distributor Local Collector (see Notes 1 and 2)	Local Collector
Local	Local	Access	Access

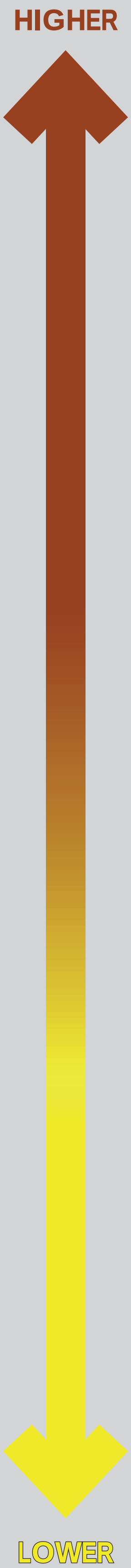
Notes

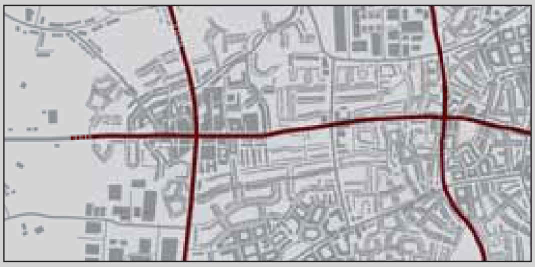
Note 1: Larger Regional/District Distributors may fall into the category of *Arterial* where they are the main links between major centres (i.e. towns) or have an orbital function.

Note 2: Local Distributors may fall into the category of *Local* street where they are relatively short in length and simply link a neighbourhood to the broader street network.

Table 3.1: Terminology used within this Manual compared with other key publications.

Figure 3.3: FUNCTION AND THE IMPORTANCE OF MOVEMENT





ARTERIAL STREETS

These are the major routes via which major centres/nodes are connected. They may also include orbital or cross metropolitan routes within cites and larger towns.

LINK STREETS

These provide the links to *Arterial* streets, or between *Centres*, *Neighbourhoods*, and/or *Suburbs*.

LOCAL STREETS

These are the streets that provide access within communities and to *Arterial* and *Link* streets.

3.2.2 Place Context

One of the criticisms of the classification led approach is that the same set of standards are applied along the entire route, regardless of *Context*. Urban roads and streets can traverse many areas with very different characteristics, such as industrial areas, residential areas, mixed use neighbourhoods and city, town and village centres (see Figure 3.4). This clearly requires different design solutions within each of these different contexts.

The Irish urban landscape contains an array of places that have their own unique set of characteristics. Where there are collective similarities between the characteristics of place they can be defined as a particular *Context*. For the purposes of this guide, *Context* is classified as:

- Centre;
- Neighbourhood;
- Suburb; and
- Business Park/Industrial Estate;

In general, place status will be elevated where densities and land use intensity is greater, resulting in higher activity levels (in particular pedestrian activity).

Designers must consider the *Context* of a street/street network. In general, as the place value of a street increases:

- Greater levels of connectivity will be required as accessibility demands will be higher.
- Higher quality design solutions should be implemented that highlight and promote the importance of place.
- Higher levels of pedestrian movement should be catered for and promoted to support vibrant and sustainable places.
- Higher levels of integration between users will be required to calm traffic and increase ease of movement for more vulnerable users.

Figure 3.5 summarises the relationship between place status and context.

In most circumstances the characteristics of a place enable the classification of its *Context* to be readily identifiable. There are places where context will be more ambiguous. In such cases designers should undertake a process of analysis which identifies the characteristics of a place.[1]

1 Further guidance to assist designers in identifying context will be published as downloadable content to accompany this Manual.

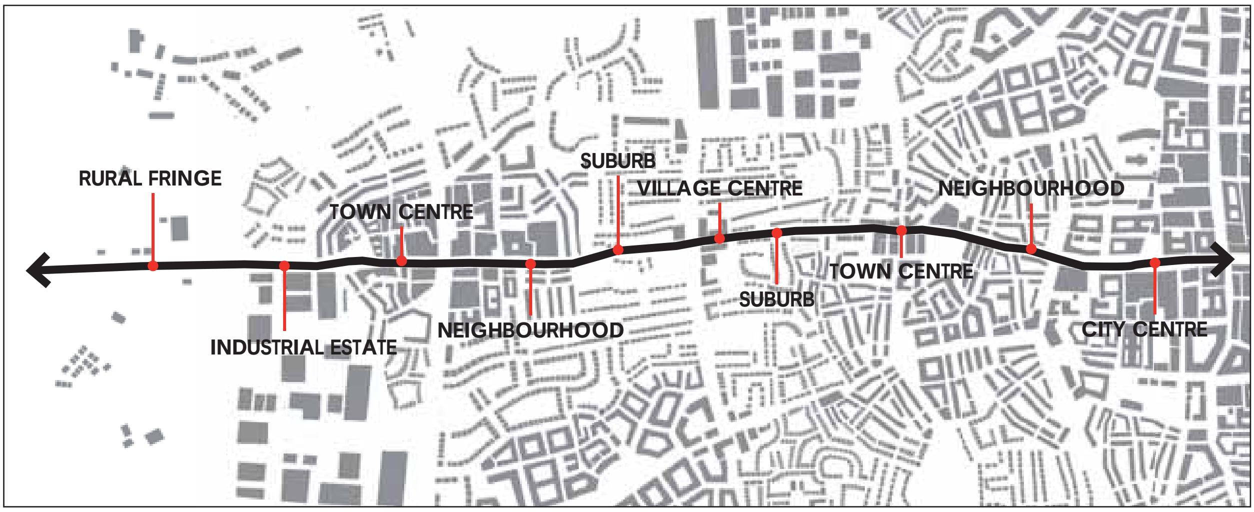
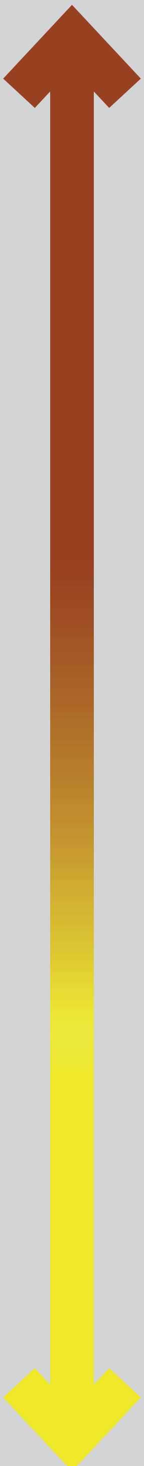


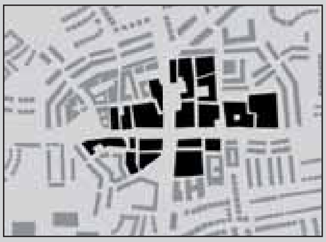
Figure 3.4: A street or road may pass through a number of different contexts along its route. As context changes, the design of streets and roads will need to change accordingly.

Figure 3.5: CONTEXT AND THE PLACE VALUE OF STREETS

HIGHER

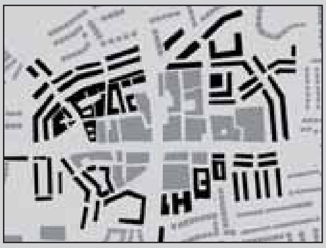


LOWER



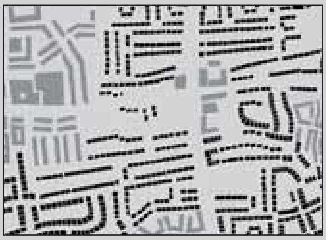
CENTRES

Centres include areas that are the focus of economic and cultural activity. Many cities, towns and villages are defined by the image of streets within their *Centres*. Place status is at its highest. Larger City and Town centres may occupy a number of blocks whilst smaller Village centres may only occupy a single street. Pedestrian activity is high as this is where most people are travelling to and once there, will most likely travel on foot. Pedestrian activity is highest in *Centre* streets that contain a concentration of retail and commercial frontages that directly open onto the street.



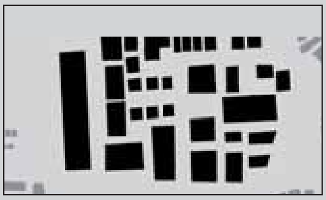
NEIGHBOURHOODS

Neighbourhoods include new and existing areas which are intensively developed with medium to higher density housing and/or contain a broad mix of uses. These areas generally include older areas that represent the first stages of urban expansions and more recently developed compact communities located towards the peripheries of cities and towns (i.e. those in excess of 35 dwellings per ha). Pedestrian activity ranges from higher to more moderate levels. The highest levels of pedestrian activity occur along major streets which connect destinations, where public transport services run. Such streets may also contain dispersed retail and commercial frontages.



SUBURBS

Suburbs predominantly consist of existing lower density housing developed over expansive areas. The place status of streets is harder to define within Suburbs. Many of these areas are attractive living places which are highly valued by residents for their green qualities and sense of tranquillity. However, many areas are criticised for their ‘placelessness’, due to a lack of connectivity and a high frequency of streets and ‘distributor roads’ that are devoid of development. Many of these characteristics contribute to lower levels of pedestrian activity.



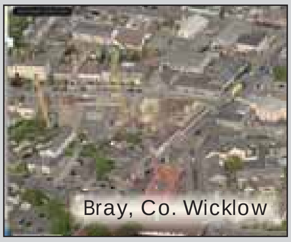
BUSINESS PARKS/ INDUSTRIAL ESTATES

Business Parks/Industrial Estates are areas that are primarily focused on (and often purpose built for) providing areas of commercial and industrial activity outside of *Centres*. Streets within these areas generally have a low place status as buildings have little street presence and they are largely devoid of pedestrian activity. Many of these areas are in a state of transition toward more intensive commercial and residential uses replacing older industrial ones. As this transition occurs, the status of these places will rise. Place status in existing campus style *Business Parks* also tends to be higher and pedestrians can be highly active in these areas during business hours.

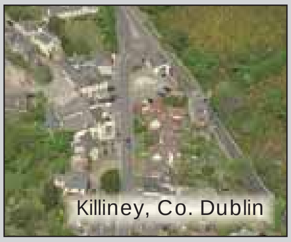
NOTE: 1. This refers to existing *Shopping Centres* developed to service lower density areas. These generally do not display the characteristics associated with highly valued places due to their inward looking nature and focus on vehicle movement (including extensive areas of surface parking). Their importance as destinations gives them a high place value that needs to be better responded to should these centres undergo significant redevelopment.

birds eye images from
www.bing.com/maps/

CITY CENTRE

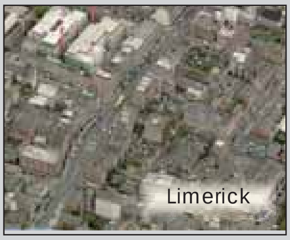


TOWN CENTRE

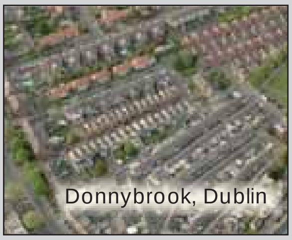


VILLAGE CENTRE

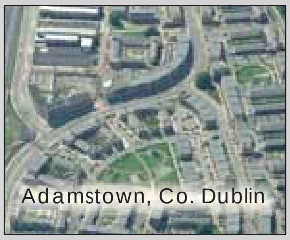
SHOPPING CENTRE [1]



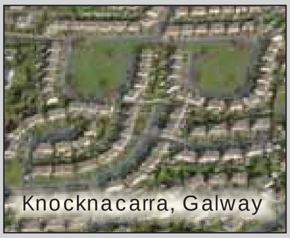
MIXED USE CORE



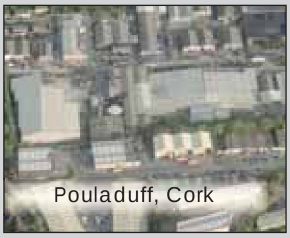
EARLY RESIDENTIAL [2]



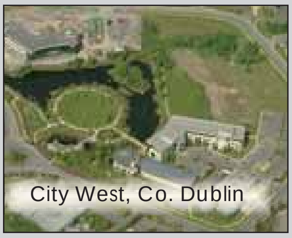
MEDIUM/HIGHER DENSITY



LOW DENSITY RESIDENTIAL [3]



INDUSTRIAL ESTATE



BUSINESS PARK [3]

NOTE: 2. Some areas may have densities below 35 dwellings per hectare where sites are long and narrow. From a street design perspective they are compact neighbourhoods due to their narrow frontages (i.e. fine grain) and proximity of dwellings to the street/continuity of the built form (i.e. strong sense of enclosure).

NOTE: 3. The examples listed above are illustrative of existing contexts. Future development or retrofit schemes in any of the contexts indicated above must be subject to national policy on sustainable development as set out in relevant policy documents and to the principles, approaches and standards contained within this Manual.

Transition Areas

There are also those *Contexts* where designers should provide a transition from those roads built to NRA DMRB led standards to those roads and streets described by this Manual. These include (and as further detailed in Section 3.3.4 Wayfinding):

- In *Business Parks/Industrial Estates* undergoing a period of transition toward more intensive forms of commercial and residential development, designers should cater for increased levels of pedestrian activity (see Figure 3.6).
- In the *Rural Fringe* when moving between rural areas and cities, towns and villages (see Figure 3.7).

Managing transitions within *Business Parks/Industrial Estates* presents a series of challenges to designers. As development within these areas intensifies, designers are encouraged to move toward standards that are better suited to densely populated urban areas (i.e. *Centres* and/or *Neighbourhoods*). However, the implementation of standards which seek to slow vehicular movement and increase pedestrian mobility (such as narrower carriageways or tighter corner radii), may be more difficult to implement due to the manoeuvrability requirements of larger vehicles. Under such circumstances designers may consider additional mitigation measures (as further detailed in Chapters 4 and 5).

Many *Rural Fringe* areas act as transitional *Gateways* between the rural and more urban/suburban forms of development. These areas may be treated as a *Transition Zone* (see Section 3.3.4 Wayfinding). In such circumstances, designers should implement a series of measures aimed at highlighting this transition and slowing drivers. Further advice in this regard is also contained throughout Chapters 4 and 5.

Figure 3.6: Sandyford Industrial Estate, Co. Dublin, is undergoing a process of significant change from an industrial estate to a mixed use area of centre/urban qualities. The new crossing in the foreground in one example of how designers are responding to its rising place value and the needs of pedestrian users.

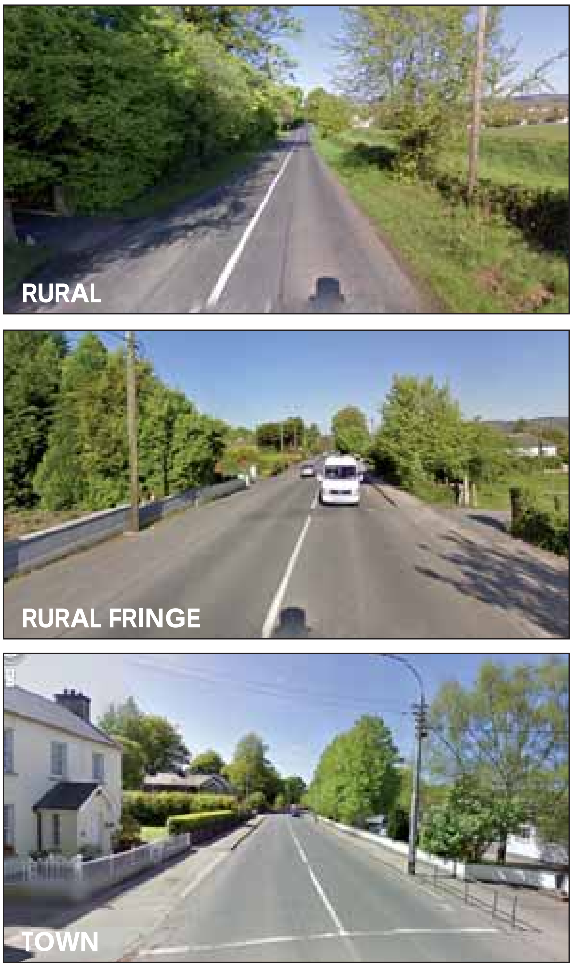


Figure 3.7: Example of a road that goes through a period of transition between a rural area (top) to that of a town/urbanised area (bottom) (image source: Google Street View).

3.3 Permeability and Legibility

3.3.1 Street Layouts

The movement towards more integrated and sustainable forms of development will result in a shift away from dendritic street layouts to highly connected networks which maximise permeability, particularly for pedestrians and cyclists. When designing new street networks designers should implement solutions that support the development of sustainable communities. In general, such networks should:

- be based on layouts where all streets lead to other streets, limiting the use of cul-de-sacs that provide no through access.
- maximise the number of walkable/cycleable routes between destinations.

Maximising the connections within a site will allow the street network to also evolve over time to meet local accessibility needs. This will limit the use of cul-de-sacs that do not allow through accessibility for all users. These streets should be limited to areas where mid-block penetration is desirable (see Section 3.3.2 Block Sizes). Figure 3.8 illustrates three network typologies that can be adapted to the needs of place.

Street networks that are orthogonal (see Figure 3.8a) in nature are the most effective in terms of permeability (and legibility). Within the Irish context orthogonal or grid layouts are often found within the *Centres* and *Neighbourhoods* developed between the Georgian and Edwardian periods (e.g. Limerick City Centre). More recent successful examples include Dublin Docklands and Belmayne, Co. Dublin.

Street networks that are curvilinear (see Figure 3.8b) may also be highly effective. Within the Irish context, these types of grids are often found within *Suburbs* developed from the 1920s onwards (e.g. Marino and Cabra, Dublin). More recently designers have successfully used similar geometric patterns in higher density developments to draw people toward spaces, highlighting *Focal Points* (see Section 3.3.4 Wayfinding) and creating attractive curvilinear streetscapes. More recent successful examples include Clongriffin, Co. Dublin.

Figure 3.8: Permeable street layouts may be formed via a number of different configurations including examples of the more rigid orthogonal, curvilinear and/or organic.

Street networks that are organic (see Figure 3.8c) have usually developed over time in a haphazard manner, but can be highly connected. As noted in the *Urban Design Manual* (2009) the more organic layout of some small villages can be very different from orthogonal grids, but perform a similar function. These types of layouts can be found within many Medieval or Early Modern Centres (such as Lusk, Co. Dublin). Organic layouts introduce place benefits by introducing variety and intrigue. An example where designers have recreated these qualities within a recently developed area can be found in Poundbury, Dorchester, in the UK.

The creation of a permeable network is a multi-layered process. The process should begin with a site analysis that identifies any constraints to the development of a particular network (such as environmentally sensitive areas, topography, existing structure etc). The process then should move into a design phase. This should outline:

- Points of access.
- The major destinations (such as *Centres* and nodes).
- The main strategic connections between destinations.

This process will identify the basic framework for the application of a more detailed street hierarchy. Figure 3.9 outlines how this process can evolve in four simplified stages of design. This process should also be expanded to take account of:

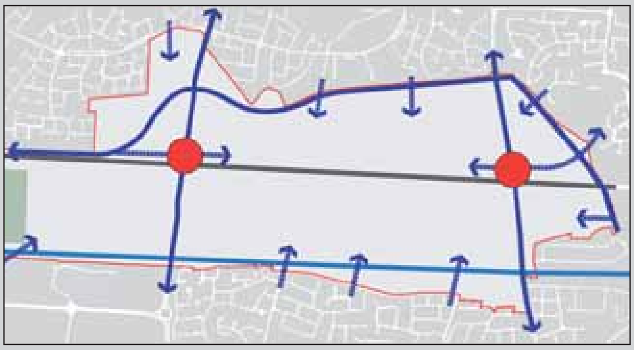
- The likely number of trips generated by each destination. This may result in additional *Link Streets* that are designed to cater for larger volumes of traffic (and in particular buses).
- Movement prioritisation measures for buses, particularly along *Arterial* and *Link* streets and within *Centres* (see Section 3.4.3 - Bus Services).
- The creation of a cycle network.[2]
- Possible restrictions on the movement of private vehicles (see Section 3.4.1 Vehicular Permeability).

Designers may refer to Appendix 1 of the *Urban Design Manual* (2009) which provides several examples of an analysis process and the subsequent design outcomes. This includes a number of extensions to existing areas. Understanding the historical context of a place will give a greater appreciation of the way it evolved and the street patterns that exist. This is particularly important for extensions to existing towns and villages and should help avoid the imposition of incongruous street layouts.

2 Chapter 3 of the *National Cycle Manual* (2011) outlines a 7 step process for Network Planning.

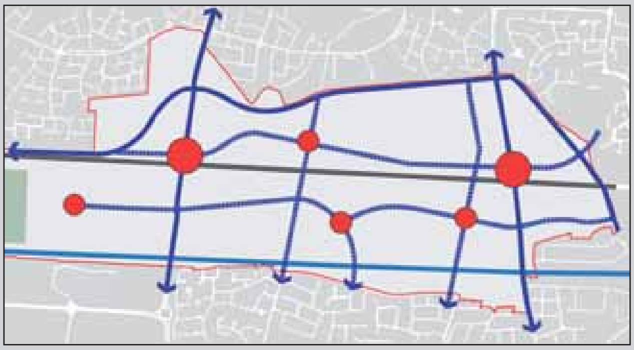
Figure 3.9: Illustrations of the creation of a structured and permeable grid network as a multi-layered process.

The site analysis should identify the connection opportunities (1) within a site including the major destinations (such as *Centres* and nodes) within it and access from the surrounding area.



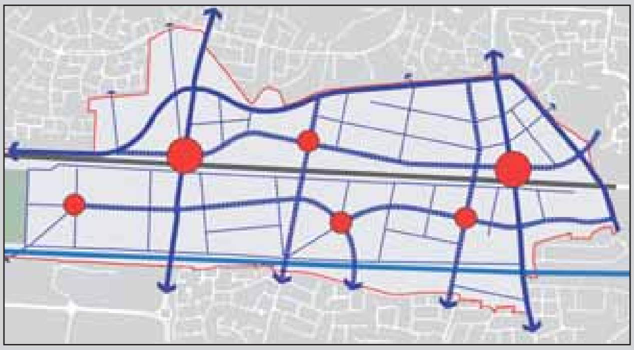
1. CONNECTION OPPORTUNITIES

The connection options form the basis for the main *Strategic links* (2) into and through the site. These routes will form the principle corridors for the movement of pedestrians, cyclists, public transport and vehicles within and through the site. They should be as direct and as continuous as is possible within the constraints of any site.



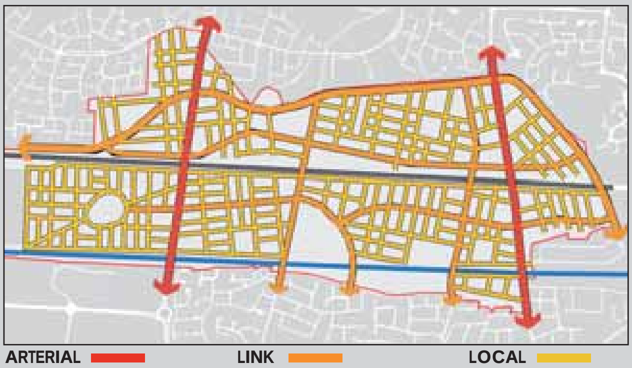
2. MAIN STRATEGIC LINKS

Further links and connections will be needed to allow for permeability within a network. The creation of routes for (3) access and circulation ensure all parts of the site are accessible from a number of different directions.



3. ACCESS AND CIRCULATION

As the process moves into (4) detailed design, designers will need to address further structural issues, including block layouts, mobility levels for different users and the street hierarchy.



4. DETAILED DESIGN

3.3.2 Block Sizes

Designers must also have regard to size of blocks within a street network and how they impact on permeability. Smaller, more compact blocks should be focused around *Centres* to optimise connectivity. Larger block sizes may occur away from *Centres*, through less intensively developed areas (see Figure 3.10). With regard to block dimensions:[3]

- A block dimension of 60-80m is optimal for pedestrian movement and will sustain a variety of building types. This range of dimensions should be considered for use within intensively developed areas, such as *Centres,* to maximise accessibility.
- Larger blocks within *Centres* and *Business Parks/Industrial Estates* may be required to cater for larger commercial or civic developments. In such cases mid-block pedestrian links should be provided.
- A block dimension of up to 100m will enable a reasonable level of permeability for pedestrians and may also be used in *Neighbourhoods* and *Suburbs*.

Within a development there may be sections of a site where accessibility requirements are low or where the site constraints may not facilitate a more permeable block pattern. Where this occurs designers may need to apply larger block dimensions. However, all efforts should be made to ensure the maximum block dimension does not exceed 120m. On larger and/or irregular blocks short cul-de-sacs may also be used for mid-block penetration to serve a small number of dwellings and to enable more compact/efficient forms of development (see Figure 3.11).

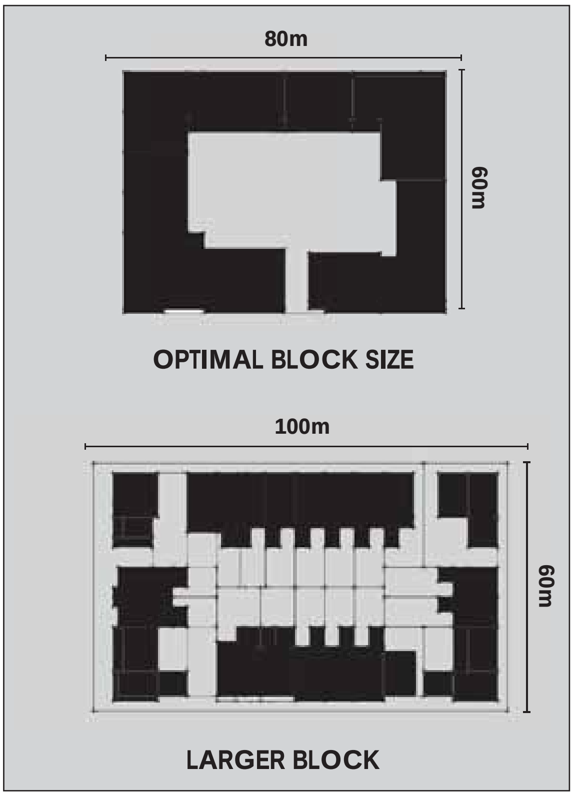


Figure 3.10: Optimal block dimensions in varying contexts that will promote a walkable neighbourhood.

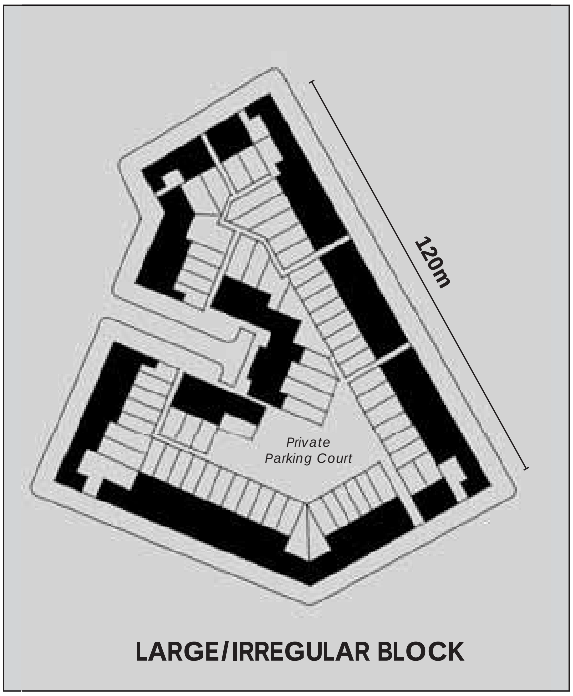


Figure 3.11: An example of a short cul-de-sac which is used to penetrate an irregular/larger block and serves a small number of dwellings.

3 Designers may also refer to Section 3.7.2 of the UK *Urban Design Compendium* (2000) for further guidance on block sizes and permeability.

3.3.3 Retrofitting

Smarter Travel (2009) recognises that sustainable travel can be supported through retrofitting and requires that local authorities prepare plans to retrofit areas in order to create more sustainable neighbourhoods.[4] The retrospective application of a permeable network to increase connectivity levels within more segregated street patterns can be problematic. The dendritic nature of some of these street patterns often means that connection opportunities are very limited.

Well placed links can lead to substantial benefits for the local community in terms of reducing walking distances to essential services. Research has found that increased local movement is also beneficial to security as it can increase levels of passive surveillance.[5] Designers should seek to engage closely with local communities to highlight such benefits.

Figure 3.12 illustrates two recently constructed pedestrian and cyclist connections made in Dublin. Both examples significantly reduced walking times to public transport (top) and local shops (bottom). The bottom example included consultation sessions and a survey of residents prior to the formal planning process. This survey indicated that 86% of the local community (located within a 10 minute walking catchment) supported the link. Post construction monitoring has also found up to 500 people a day using the link.[6]

There are also a number of processes and design principles that may also assist in gaining greater community support:

- Focus on the provision of pedestrian/cyclist only links.

4 Refer to Action 4 of *Smarter Travel* (2009).
5 Refer to *An Evidence Based Approach to Crime and Urban Design* (2009).
6 Source: South Dublin County Council.

Figure 3.12: An example of two local permeability projects in Dublin which have significantly improved local access to the LUAS (top) and local shops (bottom) for pedestrians and cyclists. These links formalised routes that were used by locals which previously involved walking across unlit fields, muddy patches and/or climbing over/through fences.

- Rather than seeking to retrofit a fully permeable network (i.e. maximising all connections), focus on key desire lines where the maximum gain can be achieved through the minimum amount of intervention.
- Ensure any plan clearly highlights reductions in journey times, walking distances etc. (see Figure 3.13).
- Identify potential reductions in private vehicle use or increases in cycling and walking.
- Ensure links are short, overlooked, have clear sight lines and are well lit to mitigate anti-social behaviour. Longer links should be limited to those which go through areas of open space.
- Implement a package of landscape improvements that will directly add to the attractiveness of an area.
- Implement parking management plans (such as pay and display/controlled parking permits) to mitigate any possible influx of vehicles seeking to 'park and ride' on neighbouring streets.
- Where possible, focus on formalising routes which are currently used by more able pedestrians but due to barriers are not suitable for use by the mobility Impaired and disabled.

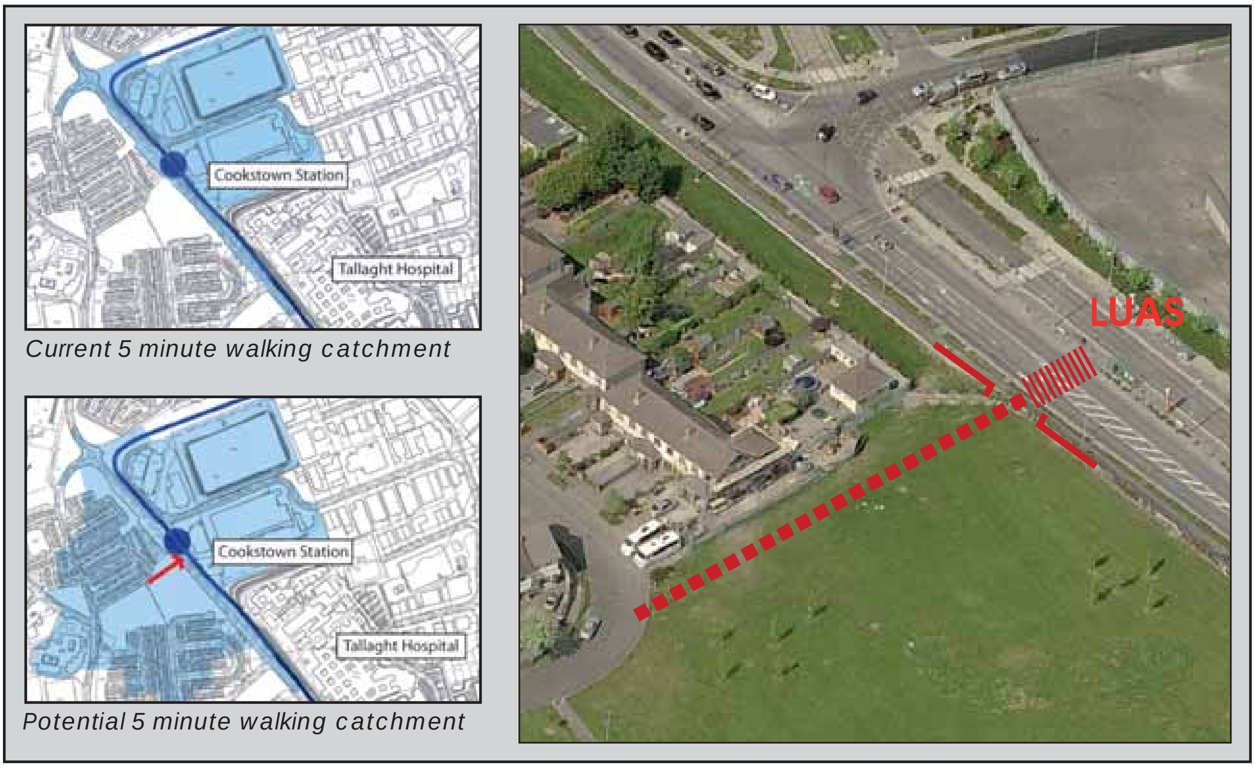


Figure 3.13: Connectivity study undertaken for the Tallaght Town Centre LAP identified how a short link intervention through an area of open space (achieved by providing a path, crossing and partial removal of a fence) could significantly increase the number of households within the 400m walking catchment to the LUAS station (base map source:www.bing.com/maps).

3.3.4 Wayfinding

Wayfinding, or legibility, relates to how people can find their way around an area. For pedestrians and cyclists this is of particular importance as they are more likely to move through an area if the route is clear. There are many tools that designers can use to provide a series of design cues by which people can orientate themselves. For example, changes in building height and form, materials and finishes and landscape features. From a broader perspective designers should ensure that journeys through the network are relatively straightforward. In general:

- The more the orthogonal street layout the more legible it will be (as well as being the most connected).
- The network should be structured to draw people towards *Focal Points* such as *Landmarks*, *Gateways* and other civic buildings and spaces.

Figures 3.14 and 3.15 illustrate how legibility can be achieved with street networks by drawing people toward key destinations or *Focal Points*.

Figure 3.14: Poundbury, Dorchester, UK. The network of interconnecting streets directs people toward a central location, whilst also allowing for route choice (base map source: Google Earth).

Figure 3.15: The Newcastle LAP (South Dublin County Council) illustrates how movement within the village is structured by connecting major Focal Points, which are also used to slow/discourage through traffic.

To Increase effectiveness the streets around *Focal Points* require a more individualised design response that highlights their high place value. These are further discussed below in relation to their implications for street design.

Landmarks and civic buildings and spaces

Landmarks are features that stand out from their surrounds and are valued by the broader community for their aesthetic and/or historic qualities. Examples include a tall or historic building, archaeological site or landscape feature. Civic buildings and spaces generally include local facilities such as areas of open space and buildings of civic importance. Areas of open space include parks, squares or plazas. Buildings of civic importance include a wide range of places such as schools, churches, hospitals and other institutions.

Designers should highlight these *Focal Points* by (see Figure 3.16):

- Ensuring that pedestrian facilities are adequate to cater for large number of visitors.
- Traffic is calmed using surface treatments and other elements that further highlight the importance of the place.

Gateways

Gateways are used to demarcate a point of arrival from one place to another. They are important placemaking tools as they form the 'first impression' of a place. *Gateways* are also an important traffic-calming tool as they can be used to inform drivers of a change in driving conditions ahead. Common forms of gateways in Ireland occur at the entrances to residential estates and on National Roads at approaches to villages.

To create an effective gateway that adds value to place designers should:

- Use elements of place such as landscape and built form to create a strong sense of enclosure (see Figure 3.17).
- Use material changes and street furniture as supplementary measures (see Figure 3.18).

Figure 3.16: Illustration of surface treatments in Dundalk, Co. Louth. These treatments enhance the sense of place by expanding the square into the adjacent streets and are an effective way of improving pedestrian mobility and calming traffic.

Figure 3.17: Example of a Gateway from Adamstown, Co. Dublin, where changes to the built form and landscaping treatments add to the sense of enclosure and create a formal entry point.

Transition Zones

A *Transition Zone* refers to an area that may be needed for slowing vehicles when entering an urban area from a faster moving road, such as from a rural road into a city, town or village or from a motorway into an integrated street network (see Figure 3.19). Designers should emphasise *Transitions Zones* by:

- Introducing measures that provide enclosure, such as large trees.
- Applying transitional geometric measures, such as the narrowing of carriageways.
- Applying changes to carriageway surfacing materials.

The length of a *Transition Zone* will largely be influenced by the required reduction in speed. Designers should also take into account how visible/prominent any subsequent *Gateway* is. If a *Gateway* is highly visible from a distance, a *Transition Zone* may not be necessary as drivers will instinctively be inclined to slow.

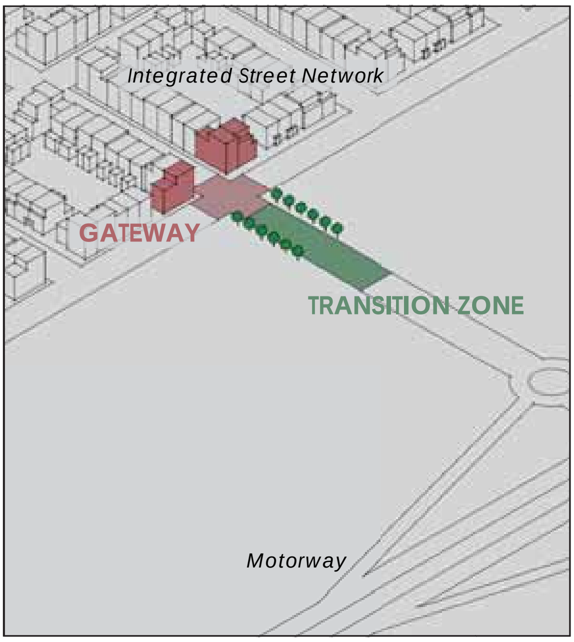


Figure 3.19: Illustration of a Gateway and Transition Zone that reinforces a large speed reduction when entering an integrated street network.

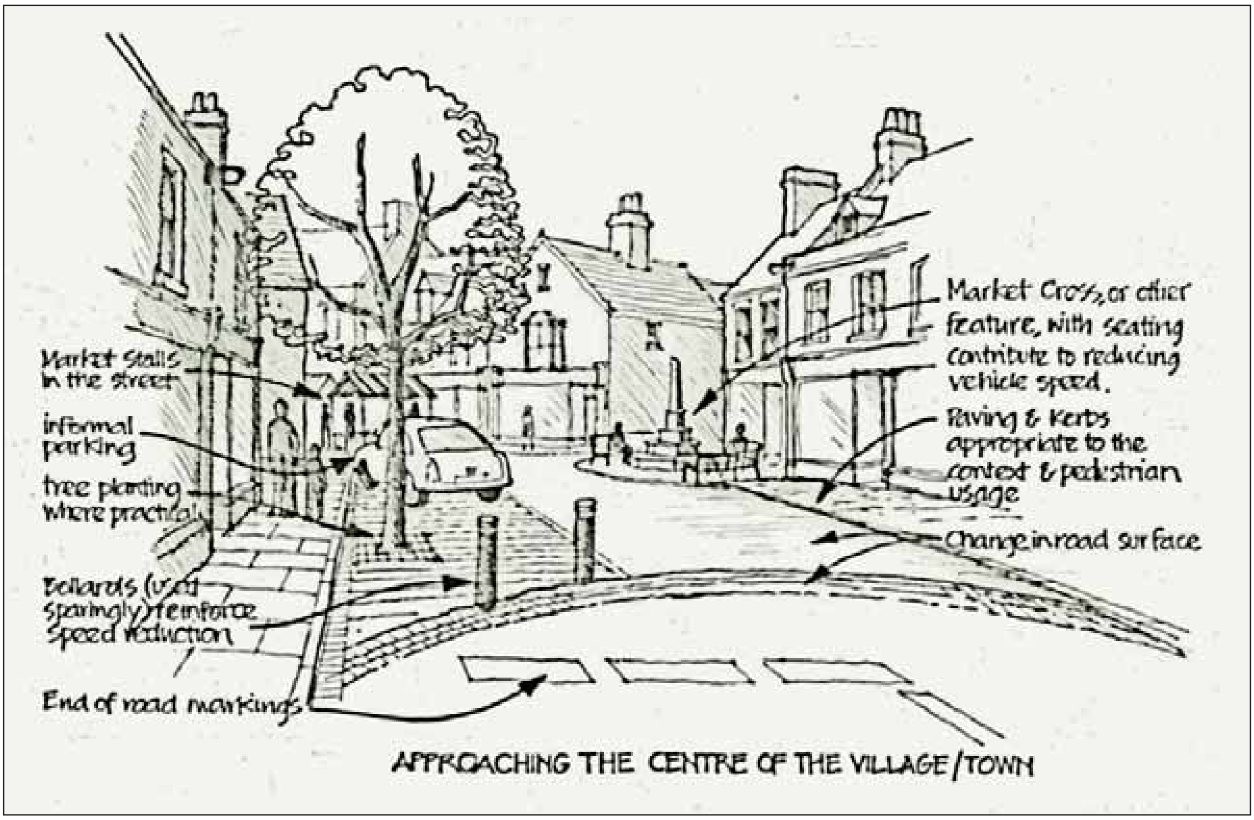


Figure 3.18: Image from Traffic in Villages (2011) showing a various number of gateway treatments designed to enhance the character of the village and calm traffic.

3.4 Management

3.4.1 Vehicle Permeability

Integrated networks do not require the same degree of restrictions to be placed on the movement of vehicles as is applied to more conventional/segregated networks. A network of integrated/self-regulating streets provides the framework for higher levels of accessibility for slow modes (including motor vehicles at slow speed) and strategic continuity for cross-network modes at more moderate speeds (such as public transport) as (see Figure 3.20):

- The slower nature of *Local* streets (i.e. 10-30 km/h) will result in them being less attractive to through traffic. Although trips through *Local* streets may be more direct (and therefore legible), the traffic-calmed nature of these streets may not necessarily result in significant advantages in overall journey times.

- Through traffic will be attracted to *Arterial/Link* streets where trips are more direct and are designed to cater for more moderate speeds (i.e. up to 50km/h).

- Public transport along *Arterial/Link* streets can be prioritised by measures such as *Quality Bus Corridors* and *Bus Lanes* (see Section 3.4.3 Bus Services).

There are a number of advantages to more permeable networks in regard to the management of traffic and vehicle speeds such as:

- Drivers are more likely to maintain lower speeds over shorter distances than over longer ones. As drivers are able to access individual properties more directly from *Access/Link* streets (where speeds are more moderate) they are more likely to comply with lower speed limits on *Local* streets (see Figure 3.21).

- Permeable layouts provide more frequent junctions which have a traffic-calming effect as drivers slow and show greater levels of caution.[7]

Figure 3.20: Examples from Adamstown, Co. Dublin. Through routes (top) are designed to cater for more moderate speeds and to prioritise public transport movement. Local streets (bottom) are slower moving, thus discouraging use by through traffic.

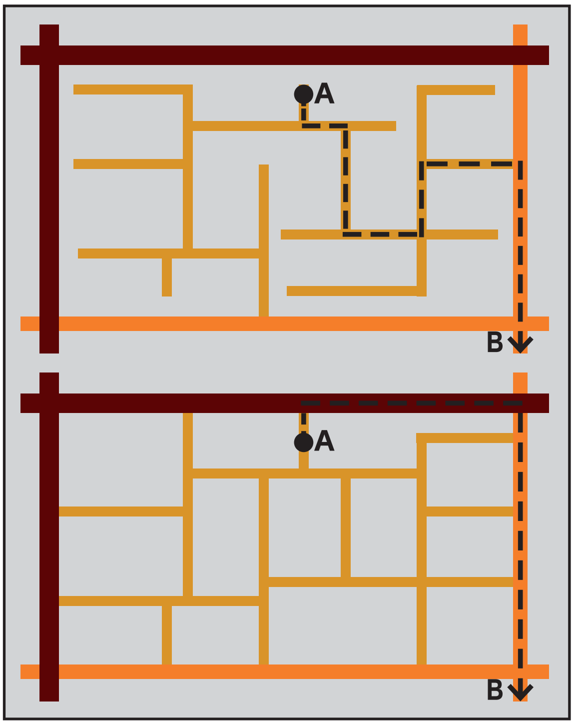


Figure 3.21: Drivers are more likely to comply with posted speed limits where less time is spent on streets with a low design speed (as per the bottom example)

7 Refer to *Whose Street is it Anyway? Redefining Residential Street Design* (2006).

- Increasing access to neighbourhood cells can result in the more equitable distribution of traffic and the impacts of congestion as it is no longer concentrated on a few select junctions or local access streets (see Section 3.4.2 Traffic Congestion) and noise and air pollution (see Section 3.4.5 Noise and Air Pollution).

- The value of place can also be improved as slower moving traffic has less impact on the surrounding environment (see Section 3.4.5 Noise and Air Pollution).

- Frequent entrances to a neighbourhood cell can reduce the size of individual junctions and streets. This will reduce the potential for severance between communities and increase pedestrian/cyclist mobility as streets/junctions are more compact and easier to navigate.

Designers may be concerned that more permeable street layouts will result in a higher rate of collisions. However, research has shown that there is no significant difference in the collision risk attributable to more permeable street layouts in urban areas and that more frequent and less busy junctions need not lead to higher numbers of accidents.[8]

The degree to which permeability is provided for different transport modes can be categorised into four types (see Figure 3.22):

- *Dendritic Networks* which place significant restrictions on movement for all users.

- *Open Networks* which allow full permeability for all users.

- *3 way Off-Set Networks* which contain a large proportion of 3 way junctions.

- *Filtered Permeability* networks which allow full permeability to some users whilst placing greater restrictions on others.

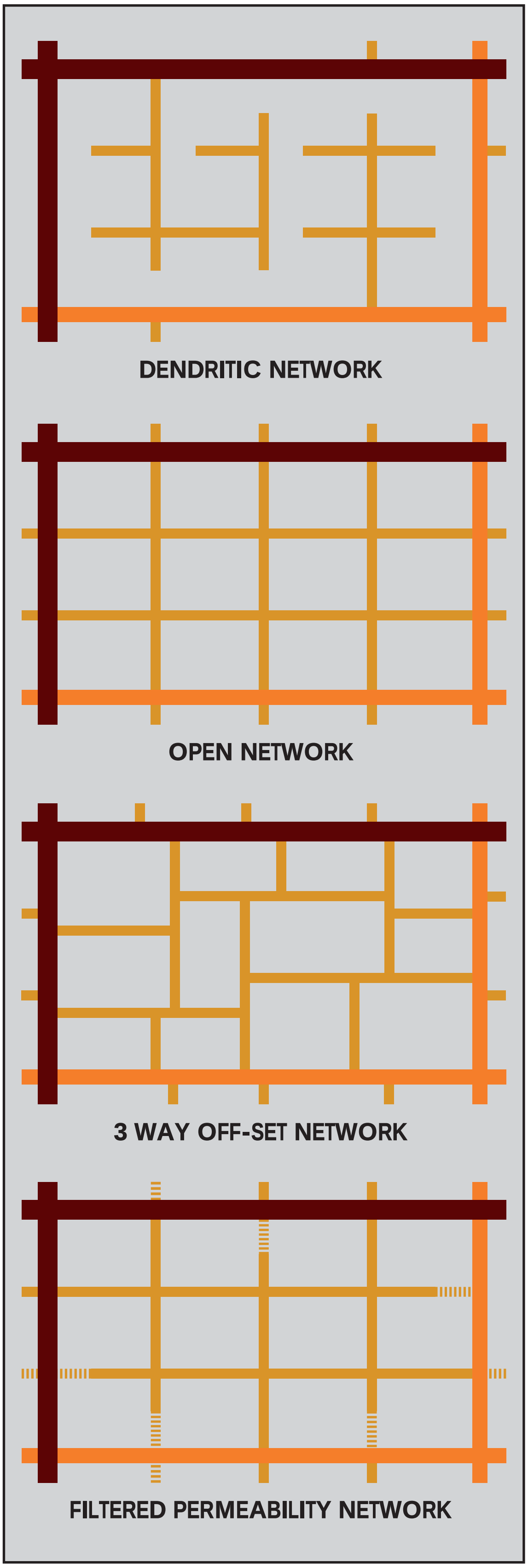


Figure 3.22: Types of Street Network identified within Road Safety Planning: New tools for Sustainable Road Safety and Community Development (2007).

8 Refer to *Whose Street is it Anyway? Redefining Residential Street Design* (2006) and 'Safenet' analysis *Manual for Streets: Evidence and research* (2007).

Designers should avoid the creation of *Dendritic* networks which place heavy restrictions on movement. The use of cul-de-sacs that do not allow through access for users should be restricted throughout any network (see Section 3.3.2 Block Sizes).

Open Networks place few restrictions on the permeability of users. They are best suited to contexts where maximum accessibility is desirable for all users such as within *Centres*. *Open Networks* may also be desirable in *Business Parks/Industrial Areas* to allow more efficient access for commercial vehicles.

3 Way Off-Set Networks allow through movement for all modes, however, they discourage faster modes by requiring vehicles to slow, stop and/or change direction repeatedly when travelling along *Local* streets. Such networks are suitable to all contexts, but there are limitations to their overall effectiveness. The use of multiple junctions off-sets can reduce legibility. This can discourage walking/cycling as the network is difficult to navigate and the route unclear (as well as increasing journey times). It can also result in driver frustration, as noted above.

Filtered Permeability Networks, which restrict universal permeability, may be applied where designers are seeking to prioritise the movement of more sustainable modes (i.e. pedestrians, cyclists and public transport) over private vehicles. For example bus gates and other measures, may also be used to prioritise bus movements, particularly in *Centres* (see Section 3.4.3 Bus Services). The limited use of vehicular cul-de-sacs may be considered in *Neighbourhoods* and *Suburbs* where there is a particular concern regarding through traffic.

The use of vehicular cul-de-sacs to enforce *Filtered Permeability* networks should be approached with caution. Their overuse can result in many of the negatives associated with Dendritic networks being replicated. Additional design measures should be applied to ensure that pedestrian and cycle links are not perceived as 'anti social spaces'. Links should maintain clear sight lines and be overlooked by development (see Figure 3.23).

Figure 3.23: Examples of vehicular cul-de-sacs in Adamstown, Co. Dublin, which allows for through pedestrian and cyclist access only and has incorporated design measures to ensure that it is safe (i.e. clear sightlines and passive surveillance).

Within existing networks, pressure is often applied from local communities to create vehicular cul-de-sacs. Designers should approach such requests with caution, as street closures will often simply shift the problem elsewhere.

One-way streets have also been widely implemented, retrospectively, in order to filter vehicle permeability and relieve traffic congestion. The use of one-way systems for traffic management should also be approached with caution by designers as they:

- Promote faster speeds as drivers are likely to drive faster when no risk is perceived from oncoming traffic.
- Will result in longer vehicular journeys, including those for cyclists and public transport.
- Can be confusing for users when they deflect people away from destinations.
- Require additional signage.

Conversion to one-way systems may be beneficial on narrow carriageways where the street reserve is limited in order to provide additional space for pedestrians, cyclists and other public realm improvements. Counter flow cycle lanes should also be considered in order to maintain permeability for cyclists Examples include Centres where the implementation of a one-way system has direct placemaking benefits as it allows for additional footpath width and/or on-street parking (see Figure 3.24).

The key to network design is balance. An optimal approach to network design is to start from the position of an *Open Network.* This will provide for the development of a robust network that can evolve over time to meet the changing needs of a place. Parts of the network may then be refined by incorporating elements of *Filtered Permeability Networks* and *3 Way-Off Set Networks* according to local conditions and where there are clear benefits in terms of prioritising more sustainable modes of transport, improving safety and reducing energy consumption.

Figure 3.24: Example from Drogheda, Co. Louth, of narrow street that was converted from a two-way system to a one way system to facilitate a series of improvements within the town centre that calm traffic, expand the pedestrian domain and strengthen the sense of place.

3.4.2 Traffic Congestion

A primary function of all transport policies has been to reduce the waste of resources caused by congestion. National and regional transport policies and plans have recognised that it is not feasible or sustainable to accommodate continued demand for car use. In contrast, sustainable modes (walking, cycling and public transport) can cater for very high volumes of movement in a far more efficient manner (see Figure 3.25). Policies and plans, therefore, promote sustainable modes of travel and acknowledge that, in the absence of demand management, a certain level of car congestion is inevitable.

One of the outcomes of a more connected, traffic-calmed network will be reduced car dependency and increased use of more sustainable modes of transport. This is the most balanced way of addressing traffic congestion. Higher levels of connectivity for all users will also enable greater vehicular permeability, albeit at slower speeds. The benefits of this approach include:

- Slower vehicle speeds are often perceived to be a cause of congestion but can lead to increased traffic capacity (see Figure 3.26).
- More frequent minor junctions with fewer vehicle movements calm traffic and are easier for pedestrians and cyclists to navigate.

Within urban networks, delay and congestion overwhelmingly occur at junctions. Segregated networks channel traffic towards fewer junctions and this can locally concentrate the negative impacts of traffic, resulting in large junctions where bottlenecks occur (see Figure 3.27). The design of junctions has traditionally prioritised the minimisation of vehicular queuing and delay. As a result pedestrians can face significant delays. This is also evident in the various computer programs used to analyse junction design, which have the calculation and minimisation of vehicular queuing and delay as their primary outputs. Designers will often seek to provide junctions that operate below 90% capacity as measured by the ratio of flow to capacity (RFC).

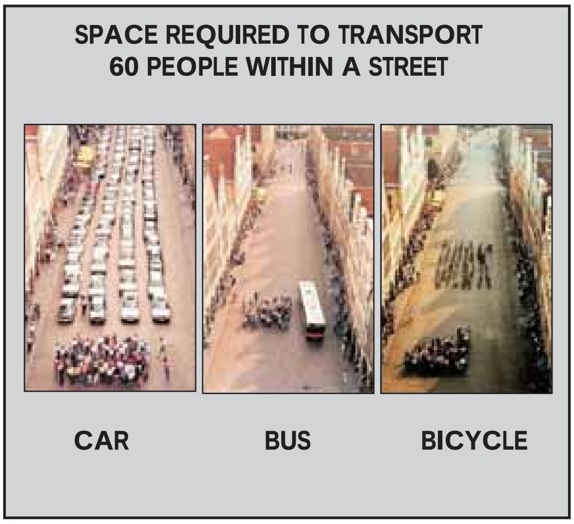


Figure 3.25: Illustration of the amount of space required to transport the same number of people via different modes of transport (image source: Munster Planning Office, Germany)

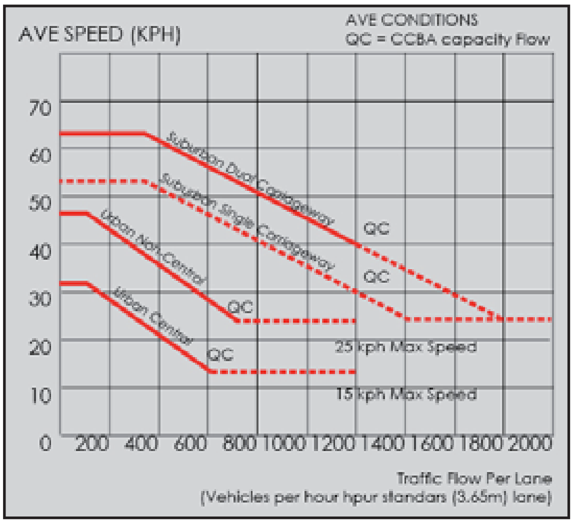


Figure 3.26: Extract from the Traffic Management Guidelines (2003) showing Traffic flow capacity increasing as speed reduces.

Smarter Travel (2009) requires greater priority to be given to the movement of pedestrians in order to facilitate more sustainable travel patterns. This includes the reprioritisation of traffic signal timings (both new and existing) to favour pedestrians and cyclist instead of vehicles and to reduce pedestrian crossing distances[9] (see Section 4.3.2 Pedestrian Crossings and 4.4.3 Junction Design).

The creation of more compact junctions that minimise pedestrian and cyclist waiting times, will place additional pressures on junction performance. In areas where pedestrian activity is high (such as in *Neighbourhoods* and *Centres*) junctions may have to operate at saturation levels for short periods (i.e. above 93% during peak periods). Where junctions operate at or near saturation levels and they are frequented by bus services, priority measures should ensure services are not unduly delayed (see Section 3.4.3 Bus Services). Where longer periods of saturation occur, pedestrian cycle times may be extended. This should be done in preference to the implementation of staged/staggered crossings (see Section 4.3.2 Pedestrian Crossings).

Figure 3.27: Highly segregated 'cell and distributor' networks channel faster moving traffic to large junctions where bottlenecks may occur (left). More permeable networks result in more frequent minor junctions with fewer vehicle movements (right) which calm traffic and are easier for pedestrians and cyclists to navigate.

9 *Refer to Action 16 of Smarter Travel (2009).*

3.4.3 Bus Services

Street networks underpin the efficiency and sustainability of public-transport and, consequently, the ability to facilitate higher development densities along public transport corridors in accordance with the objectives of *Smarter Travel* (2009). This includes an objective that all houses within urban areas are located within 800m of a bus route/stop.[10] Permeable networks which maximise connectivity will assist in achieving this objective. *Smarter Travel* (2009) also requires the implementation of bus priority measures,[11] such as *Quality Bus Corridors* and *Bus Lanes.* These ensure that buses can move through congested networks with minimal delays.

Designers must have regard to the location of bus services as a strategic network issue. In general:

- Bus services should primarily be directed along *Arterial* and *Link* streets as these will be the most direct routes with between destinations with the greatest number of connections.
- QBCs or *Green Routes* should be provided on streets which cater for higher frequency services[12] over longer distances (see Figure 3.28).
- On lower frequency routes, or in less congested networks, bus lanes that allow buses to move towards the front of queuing traffic at junctions may suffice. This approach may also be preferred on existing streets where the street reserve is constrained.
- The provision of public transport services on *Local* streets should be limited. The constrained nature of these streets will limit the delivery of efficient services. Conversely, designing *Local* streets to cater for buses would require wider streets, which will serve to increase vehicle speeds, undermining their place function.

Designers should consult with bus operators regarding the need for dedicated lanes. Under-used or unnecessary lanes can serve only to increase the width of carriageways (encouraging greater vehicle speeds) and consume space that could otherwise be dedicated to placemaking/traffic-calming measures such as planted verges, wider footpaths, cycle tracks or lanes and on-street parking.

Designers should also consider the use of bus gates (see Figure 3.29) and selective bus detection technology that prioritise buses to improve journey times by restricting other motorised vehicles. These should be strategically placed throughout a network, and in particular within *Centres*, to filter permeability and ensure more rapid movement for buses.

10 Refer also to Action 13 of *Smarter Travel* (2009).
11 Refer to Action 12 of *Smarter Travel* (2009).
12 Refer to Section 10.2.2 of the *Greater Dublin Area Draft Transport Strategy 2011-2030* for further information on service frequency.

Figure 3.28: QBCs and Bus lanes should be considered on all Strategic Routes where the high frequency services occur or where their future need has been established.

Figure 3.29: Example of a 'bus gate' in Tallaght, Co. Dublin, which filters permeability to allow for the free passage of buses whilst excluding other vehicles.

3.4.4 Relief Roads

The focus of this Manual is the creation of place-based/sustainable street networks, which balance pedestrian and vehicle movement. However, it is recognised that there are some roads which are required to cater for the efficient movement of larger volumes of motorised traffic at faster speeds over longer distances. These are generally referred as *Inner Relief Roads* and *Urban Relief Roads*.[13]

Inner Relief Roads are generally used to divert traffic within an urban area, away from a *Centre* or *Node*. The design of these routes needs careful consideration. Chapter 2 highlights the issues associated with the provision of higher speed/highly segregated routes though cities, towns and villages. Authorities in many urban areas have attempted to overcome issues of severance by vertically separating these routes into a series of tunnels, cuttings or elevated carriageways. Such solutions, however, tend to be reserved for major national projects and can have significant negative impacts on place (see Figure 3.30).

It is more likely that *Inner Relief Roads* through urban areas will need to occur at moderate speeds (50 km/h). The route should be integrated within the urban fabric so that a sense of place is maintained and to prevent severance between adjoining areas. There are many examples in Ireland of streets that carry significant volumes of through traffic at moderate speeds and retain a high place value/levels of connectivity (see Figure 3.31). Successful solutions tend to be designed as boulevards with well planted medians and verges that provide a buffer between the heavily-trafficked carriageway and the surrounding pedestrian environment. Boulevards may also be designed as a 'multiway' boulevard with a central carriageway for through traffic and access carriageways at the side (see Section 3.4.5 Noise and Air Pollution).

Figure 3.30: Examples of major urban roads that move large volumes of traffic via vertical segregation. These require significant investment in infrastructure. As illustrated in the middle and bottom examples they can have negative impacts in terms of place and/or connectivity (image sources: Google Street View).

Figure 3.31: Dorset Street, Dublin, an example of a street that carries large volumes of traffic and where recent improvements have ensured it maintains an important place function.

13 Urban Relief Roads are defined by TD 9/12: Road Link Design, part of the NRA DMRB.

Urban Relief Roads are generally routed around urban areas and are commonly referred to as *By-Passes* or *Outer Ring Roads*. Designers may use these routes to direct longer distance traffic, and in particular Heavy Goods Vehicles (HGVs), away from cities, towns and villages provided they are clearly separated from the urban fabric (see Figure 3.32). Urban development should not extend to the edge of these routes without full integration into the surrounding street network. This is a strategic issue that should be resolved via a County Development Plan/Local Area Plan (see Figure 3.33) and may also require close consultation with the NRA, where the road is part of the national road network.[14] In the case of a motorway or national grade separated dual carriageway the future integration of the road would not be an option.

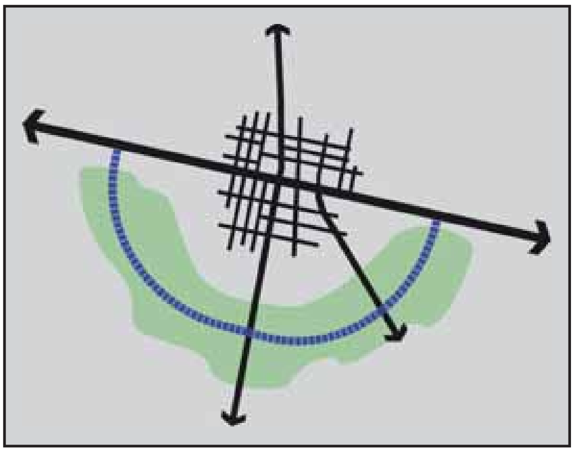


Figure 3.32 Outer Relief Roads can be used to direct long distance traffic away from cities, towns and villages

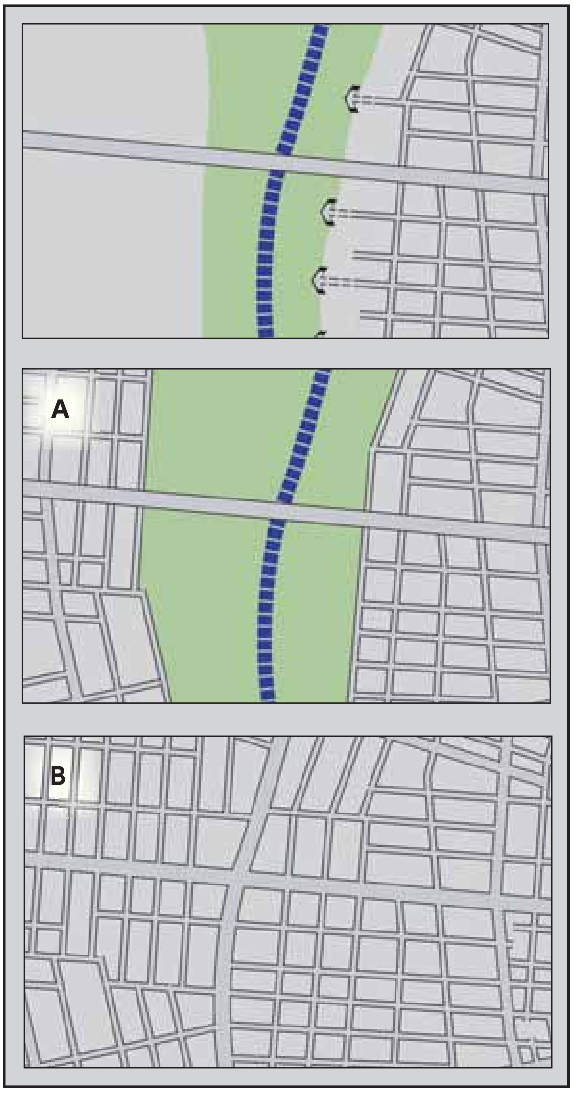


Figure 3.33: As urban expands toward an *Urban Relief Road (top) a strategic decision will need to be made as to either maintain segregation and 'leapfrog' leaving a green belt (middle), or moderate speed, retrofit and integrate route (bottom).*

14 Refer to *Spatial Planning and National Roads: Guidelines for Planning Authorities* (2012).

3.4.5 Noise and Air Pollution

The primary source of widespread environmental noise in Ireland is road traffic. Traffic is also the main source of air pollutants in cities, towns and villages. Whilst air pollutants generally have declined in recent years, those pollutants associated with traffic have not, principally because of an increase in traffic volumes and congestion.[15] Busy or congested roads can create pollution 'hot-spots' and can have a significant negative impact on adjacent street activities. Pollution can also seriously affect the attractiveness of walking and cycling along affected routes.

The main factors which determine the level of road noise and air pollution are traffic volume, speed, levels of congestion and the proportion of HGVs. Many of these issues may be substantially addressed by directing large volumes of traffic (and in particular HGVs) away from cities, towns and villages via *Urban Relief Routes* (see Section 3.4.4 Relief Roads) and by reducing speeds (see Table 3.2). The creation of a permeable street network which promotes walking, cycling and public transport will also lead to reductions in vehicular traffic and less concentration of traffic and consequently of noise and air pollution.

It is inevitable that some heavily-trafficked routes (such as *Arterial* streets) will pass through urban areas. Whilst traffic volume and noise have a significant impact on the value of place, there are many examples in Ireland of streets that carry significant volumes of through traffic at moderate speeds which retain a high place value (as per Figure 3.31 - Dorset Street). Whilst some mitigation measures can be provided through construction materials used on carriageway surfaces and within adjoining buildings, most integrated or place-based solutions should involve (see Figure 3.34):

- Apply boulevard typologies with well planted medians and verges that reduce pollution[16] and provide a buffer between the heavily-trafficked carriageway and the surrounding pedestrian environment.
- Consider the use of multiple carriageways that separate through traffic from access traffic and parking.

15 Refer to *Air Quality In Ireland* (2009).

16 Refer also to *Effectiveness of Green Infrastructure for Improvement of Air Quality in Urban Street Canyons* (2012).

SPEED AND NOISE REDUCTION

Speed Reduction	dB (A) Reduction
from 70-60 km/h	1.8
from 60-50km/h	2.1
from 50-40km/h	1.4

TRAFFIC AND NOISE REDUCTION

Traffic Volume Reduction	dB (A) Reduction
30%	1.6
40%	2.2
50%	3.0
75%	6.0

Table 3.2: Noise reduction effects of lowering traffic speeds and volumes

At a broader level, land uses should be distributed in a manner that takes into account sensitivity to traffic noise:

- Commercial or retail uses should be used to shield more sensitive receptors (i.e. residential uses). Such an approach complements the principle of integrated street design as it focuses commercial/ retail uses on *Arterial* and *Link* streets where public transport services are likely to be located.
- Where residential uses are provided on the upper floors of buildings, aspects of the upper floors may be orientated so that they are perpendicular (i.e. at right angles) to the roadway. This will ensure a degree of overlooking, whilst deflecting the impacts of pollution (see Figure 3.35).

Figure 3.35: Example of a development adjacent to a busy Arterial Street where residential development is provided over a commercial podium at street level.

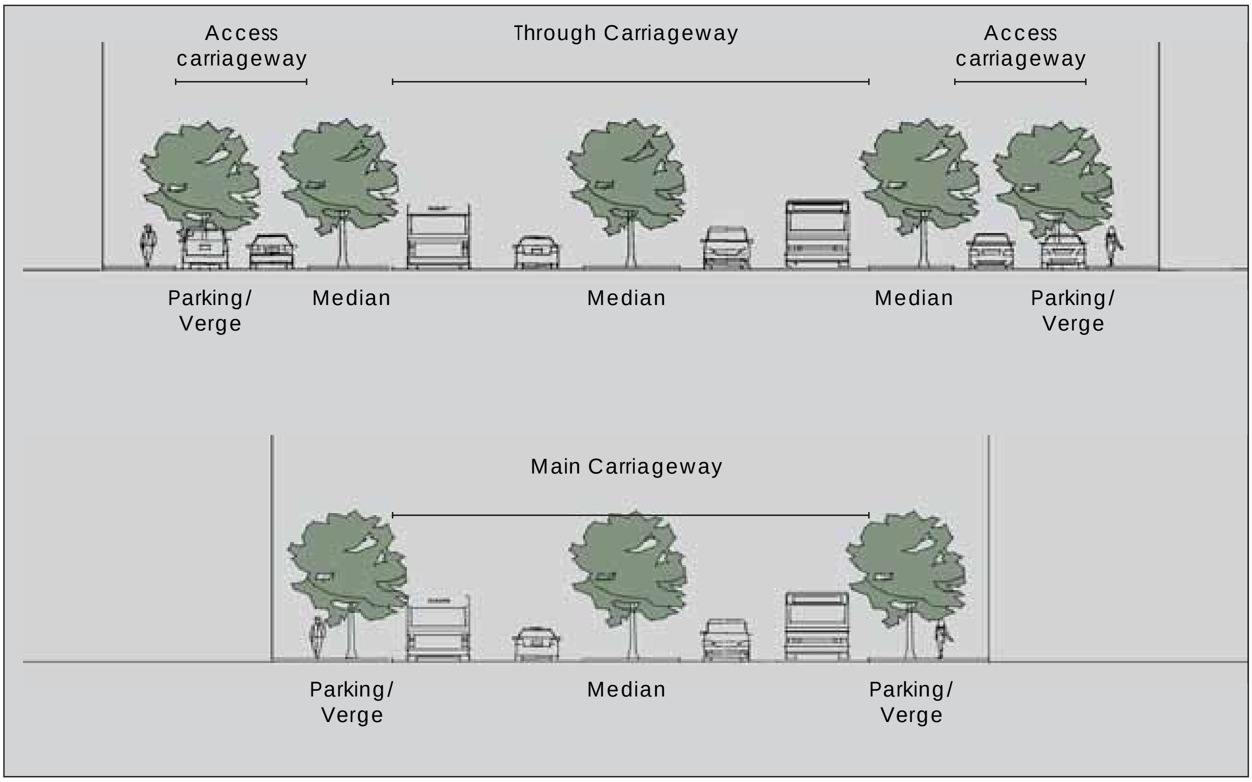
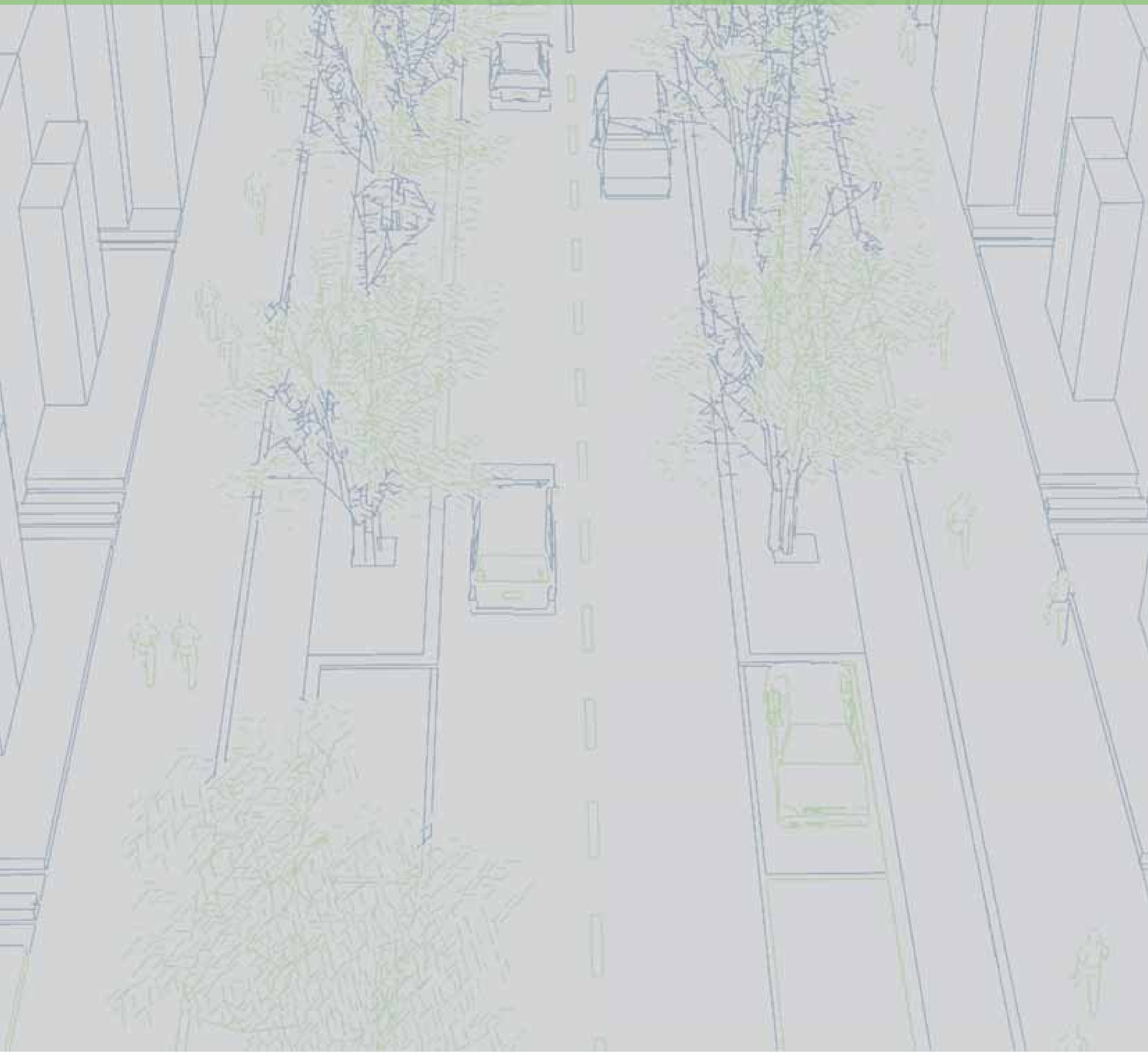


Figure 3.34: Examples of Urban Boulevard street typologies which mitigate the impacts of noise through place based design solutions.

CHAPTER 4 - STREET DESIGN

A more integrated approach to street design can create a 'win-win' scenario, where designers can enhance the value of place whilst calming traffic and improving pedestrian and cyclist comfort. To achieve this outcome, designers need to consider the multi-functional role of the street and apply a package of 'self-regulating' design measures.



4.0 Street Design

4.1 Movement, Place and Speed

4.1.1 A Balanced Approach to Speed

Balancing the priorities *Context* and *Function* creates a shifting dynamic in street design. The UK *Manual for Streets* (2007) illustrates this relationship as a simple graph depicting some well known scenarios (see Figure 4.1). Key to the successful implementation of responsive design solutions is the issue of speed, particularly so with regard to pedestrian and cyclist safety, comfort and convenience (see Figure 4.2). Expectations of appropriate speed will vary greatly from person to person and there is little relevant research on this subject. Intuitively one would expect motorists' tolerance of low-speed journeys to increase in intensively developed areas (i.e. from the *Centres*, to *Neighbourhoods* to *Suburbs*) and according to journey type (i.e. from *Local* to *Link* and to *Arterial* Streets.

Designer must balance speed management, the values of place and reasonable expectations of appropriate speed according to *Context* and *Function.*[1] In this regard:

- Within cites, towns and villages in Ireland a default speed limit of 50km/h is applied.
- Speed limits in excess of 50km/h should not be applied on streets where pedestrians are active due to their impact on place and pedestrian safety.
- Lower speed limits of 30km/h are a requirement of *Smarter Travel* (2009) within the central urban areas, where appropriate.[2]
- Where pedestrians and cyclists are present in larger numbers, such as in *Centres*, lower speed limits should be applied (30-40km/h).
- Where vehicle movement priorities are low, such as on *Local* streets, lower speed limits should be applied (30km/h).

Figure 4.1: Illustration from the Manual for Streets 2 (2010) depicting the relationship between place and movement in regard to some well know scenarios.

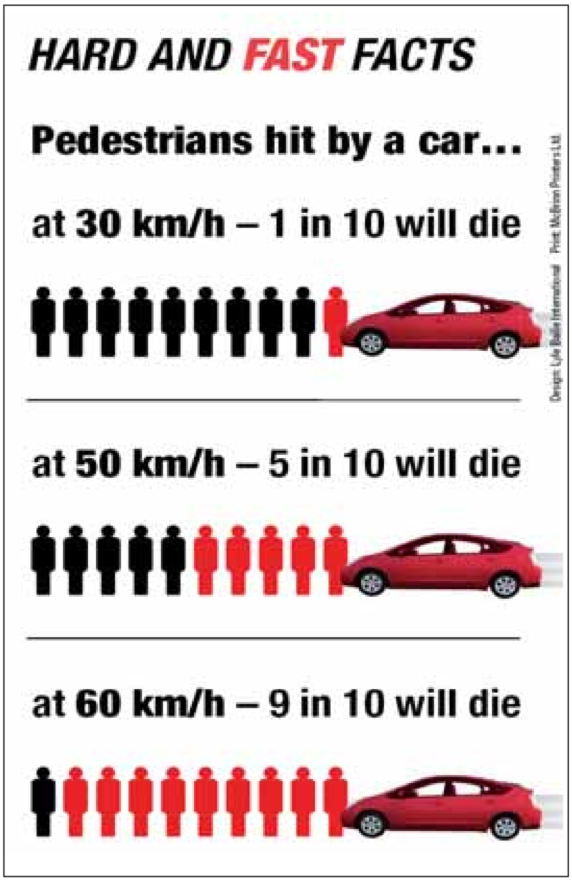


Figure 4.2: Illustration from the Road Safety Authority showing the impact of vehicle speeds on pedestrian fatalities. This is of primary consideration when considering appropriate speeds and levels of pedestrian activity.

1 Further guidance in regard to special speed limits is available from Section 9 of the *Road Traffic Act - Guidelines for the Application of Special Speed Limits (2011).*
2 Refer to Action 16 of *Smarter Travel (2009).*

- Local Authorities may introduce advisory speed limits of 10-20km/where it is proposed that vehicles, pedestrians and cyclists share the main carriageway.

Design speed is the maximum speed at which it is envisaged/intended that the majority of vehicles will travel under normal conditions. In this regard:

- In most cases the posted or intended speed limit should be aligned with the design speed.
- In some circumstances, such as where advisory speeds limits are posted, the design speed may be lower than the legal speed limit.
- The design speed of a road or street must not be 'updesigned' so that it is higher than the posted speed limit.

Table 4.1 illustrates the broader application of design speeds according to *Context* and *Function*. Designers should refer to this table when setting speed limits and designing urban streets and urban roads to align speed limits and design speeds.

When applying these limits designers must also consider how effectively they can be implemented, as the introduction of more moderate and/or lower speed limits out of context and/or without associated speed reduction measures may not succeed.

PEDESTRIAN PRIORITY — VEHICLE PRIORITY

FUNCTION \ CONTEXT	CENTRE	N'HOOD	SUBURBAN	BUSINESS/ INDUSTRIAL	RURAL FRINGE
ARTERIAL	30-40 KM/H	40-50 KM/H	40-50 KM/H	50-60 KM/H	60-80 KM/H
LINK	30 KM/H	30-50 KM/H	30-50 KM/H	50-60 KM/H	60-80 KM/H
LOCAL	10-30 KM/H	10-30 KM/H	10-30 KM/H	30-50 KM/H	60 KM/H

Table 4.1: Design speed selection matrix indicating the links between place, movement and speed that need to be taken into account in order to achieve effective and balanced design solutions.

4.1.2 Self-Regulating Streets

An appropriate design response can successfully balance the functional needs of different users, enhance the sense of place and manage speed in a manner that does not rely on extensive regulatory controls and physically intrusive measures for enforcement. In short, place can be used to manage movement. Such environments are referred to as being self-regulating. Within this self-regulating street environment the design response is closely aligned with the design speed (see Figure 4.3).

Within Ireland, the *Dublin Traffic Initiative: Environmental Traffic Planning* (1995) was, perhaps, the first strategic document in Ireland to recognise the link between the street environment and driver behaviour. It cited the use of narrow streets and on-street parking as traffic-calming tools. The *Adamstown Street Design Guide* (2010) draws upon research undertaken in regard to the UK *Manual for Streets* (2007) to advance this approach. It cited a combination of place-based psychological measures and integrated them with more traditional physical measures in order to create a self-regulating street environment (see Figure 4.4).[3]

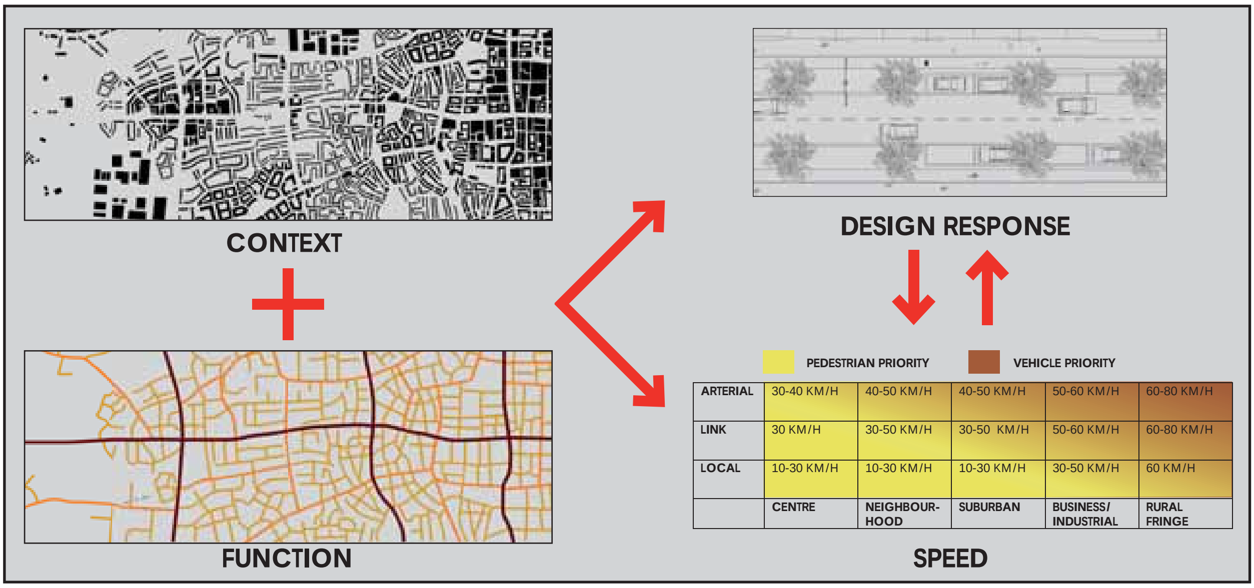
There is no set formula of how a package of psychological and physical measures should be applied. The design team must take into account that:

- Physical and psychological measures are most effective when used in combination.[4]
- The more frequently and intensely physical and psychological measures are applied, the lower the operating speed.

Analysis of the Road Safety Authority *Free Speed Survey* 2008, 2009 and 2011, inclusive showed that where there are few psychological and physical measures, average drivers regularly exceeded the posted speed limit. Conversely where these measures are more frequently and/or more intensely applied, driver speeds were lower and compliance with the posted speed limit was greater (see Figure 4.5).

3 Refer also to Section 2.2 'Safe Streets' of the *Adamstown Street Design Guide* (2010).

4 Refer to *Psychological Traffic Calming* (2005).



ARTERIAL	30-40 KM/H	40-50 KM/H	40-50 KM/H	50-60 KM/H	60-80 KM/H
LINK	30 KM/H	30-50 KM/H	30-50 KM/H	50-60 KM/H	60-80 KM/H
LOCAL	10-30 KM/H	10-30 KM/H	10-30 KM/H	30-50 KM/H	60 KM/H
	CENTRE	NEIGHBOUR-HOOD	SUBURBAN	BUSINESS/ INDUSTRIAL	RURAL FRINGE

Figures 4.3: Illustration of the links between place, movement and speed that need to be taken into account in order to achieve effective self-regulating street environments.

Figure 4.4: Extract from the Adamstown Street Design Guide.
Illustration of the psychological and physical, or 'hard' and 'soft', measures that influence driver speeds and may be used to enhance place and manage movement.

Close Proximity of Buildings (left)

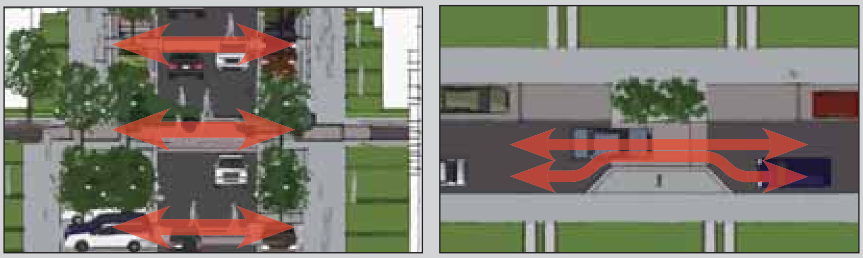
Continuous Street Wall (right)

Active Ground Floor Uses (left)

Pedestrian Activity (right)

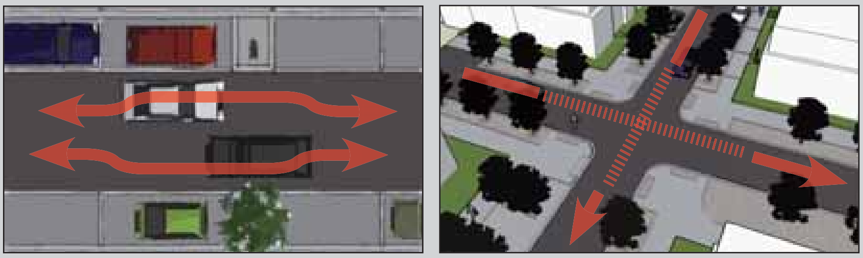
Frequent Crossing Points and Junctions (left)

Horizontal and Vertical Deflections (right)



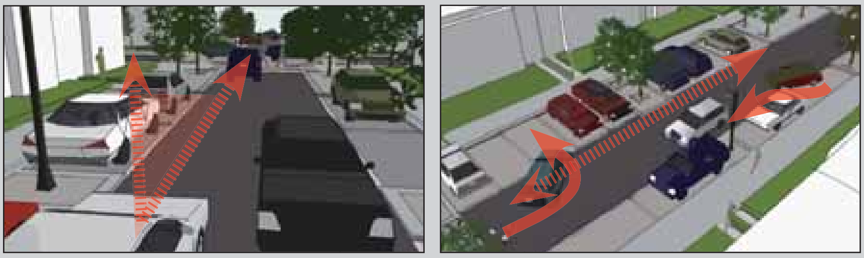
Narrow Carriageways (left)

Minimising signage and road markings (right)



Reduced Visibility Splays (left)

On-Street Parking (right)



Tighter Corner Radii (left)

Shared Surfaces (right)

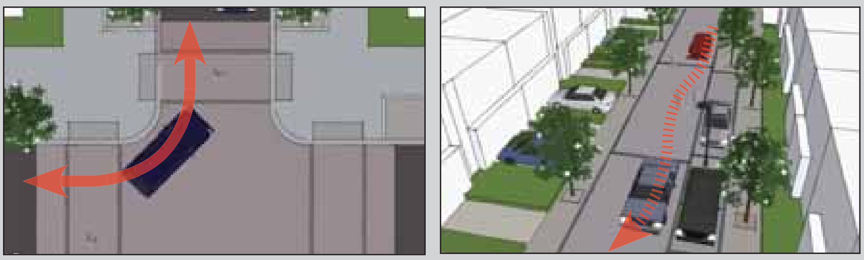


Figure 4.5: Road Safety Authority Free Speed Survey and Street Characteristics

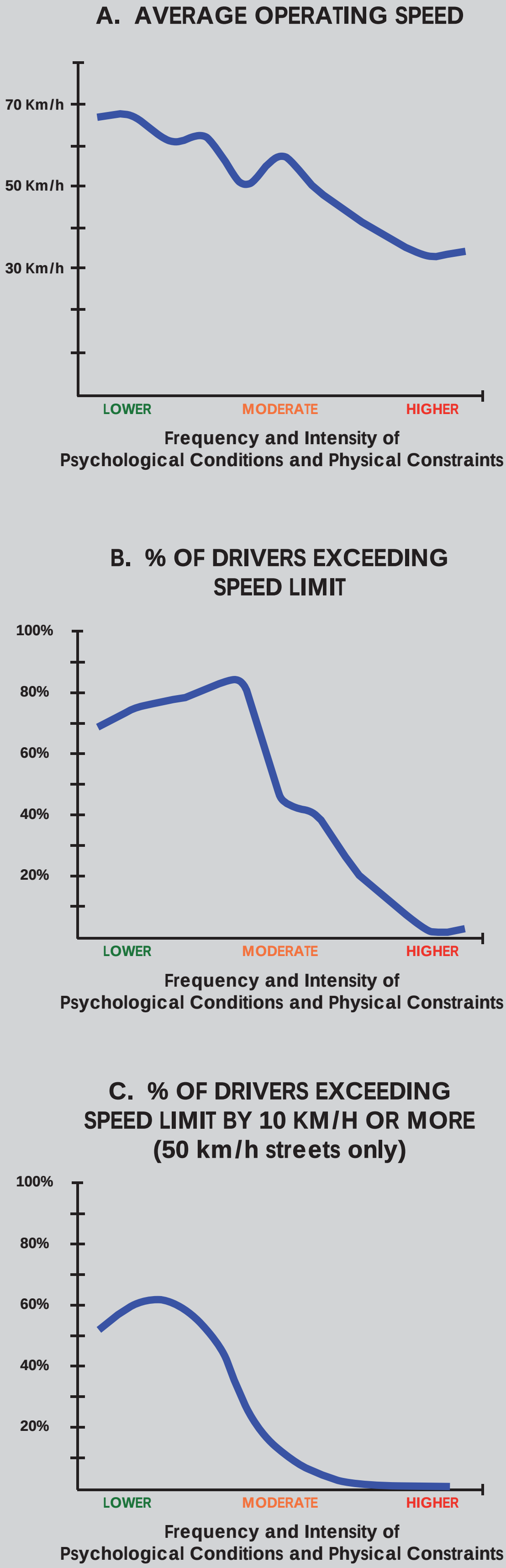
The Road Safety Authority periodically undertakes free speed surveys throughout urban and rural Ireland. In 2008, 2009 and 2011 the speeds of some 9,500 vehicles along 23 streets within metropolitan Dublin were recorded.

An analysis of the characteristics of the street environment at each of the 23 locations was carried out for the preparation of this Manual. This survey recorded the frequency and intensity of psychological and physical design measures that influence driver behaviour, such as those illustrated in Figure 4.4.

The survey results demonstrated that the individual effectiveness of these measures varied. For example, as would be generally expected, the presence of deflections (such as ramps) had a strong influence on reducing speed. Results also showed that other 'softer' measures, such as a sense of enclosure, surveillance and activity created by a continuous line of development fronting directly onto the street, have a strong influence on lowering speed.

Overall, the results demonstrated a strong trend whereby as the frequency and strength of the psychological and physical design measures increased, the lower the operating speed and the greater the level of compliance with the posted speed limit (see graphs A and B). This trend was generally consistent for all road types including those which did not have ramps.

Figure 4.2 illustrates that an increase in vehicle speeds from 50 km/h to 60 km/h nearly doubles the chance of a pedestrian fatality, should they be struck by a vehicle. Graph C is particularly significant in this regard as it illustrates that where there are limited psychological and physical design measures on streets with a speed limit of 50 km/h most drivers will exceed the speed limit by 10 km/h or more. Conversely where the frequency and strength of these measures are high full, or near full, compliance with the speed limit occurred. In many cases the average operating speed dropped below 40 km/h.



In retrofit scenarios, designers must carefully consider the characteristics of the existing street environment prior to implementing self-regulating measures as:

- The measures contained within this Manual should not be implemented in isolation as they may not fully address issues related to inappropriate driver behaviour on existing streets.

- Designers should carry out a detailed analysis to establish the levels of intervention and design measures required in any given scenario (see Figure 4.6).

For example, in many older *Centres* and *Neighbourhoods,* measures such as connectivity, enclosure, active street edges and pedestrian activity are generally strong. In these circumstances the design measures contained within this Manual may be readily applicable. The application of a holistic solution may be more challenging within a more conventional or highly segregated road environments. Under such circumstances a wider package of measures may need to be implemented.

This Manual cannot account for every scenario that a designer will encounter. In addition to those examples contained in the ensuing sections, to assist designers in the process of retrofitting it is intended that a series of 'best practice' case studies will be made available as downloadable content.

Figure 4.6: Examples from Youghal, Co. Cork (left), and Dorset Street, Dublin City (right), of retrofitted design responses that are appropriate according to Context and Function. The narrow, enclosed and lightly trafficked nature of the street within Youghal is highly suited to a shared carriageway. The heavily trafficked nature of Dorset Street makes it highly suited to a Boulevard type configuration.

4.2 Streetscape

4.2.1 Building Height and Street Width

Sense of enclosure is generally measured as a ratio where the height of a building (measured from front building line to front building line) is measured against the width of a street. Consideration needs to be given as to how consistently this ratio applies along the length of the street through the creation of a street wall. The street wall refers to how continuous the sense of enclosure is along the street.

Enclosing streets with buildings helps to define them as urban places, creates a greater sense of intimacy[5] and promotes them as pedestrian friendly spaces that are overlooked. This sense of intimacy has been found to have a traffic-calming effect as drivers become more aware of their surroundings.

Designers should seek to promote/maintain a sense of enclosure on all streets within cities, towns and villages (see Figure 4.7). In this regard.

- A strong sense of enclosure should be promoted in large *Centres*. The most effective way of achieving this is with a building height to street width ratio greater than 1:2 and street wall that is predominantly solid (allowing for intermittent gaps only).
- A good sense of enclosure can also be achieved with a building height to street width ratio of 1:3 and a street wall that is 75% solid, provided a continuous line of street trees are planted along the street. This approach may be more desirable in smaller *Centres* or *Neighbourhoods* where maintaining a more human scale is desirable.
- A strong sense of enclosure may be difficult to achieve where the total street width exceeds 30m wide, such as on *Boulevards*. In such circumstances design teams should emphasise the sense of enclosure with the planting of continuous rows of large closely planted street trees.

5 Refer to Section 07 of the *Urban Design Manual* (2010).

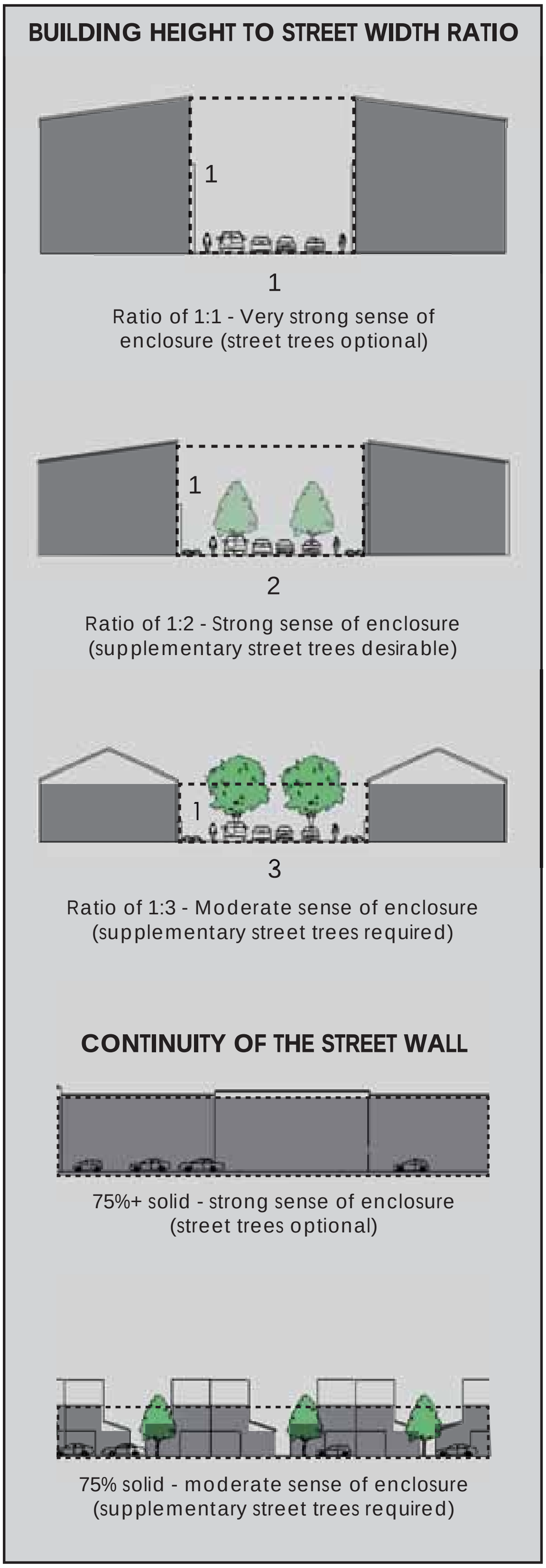


Figure 4.7: Measurements that indicate the sense of enclosure by way of building height to street width ratio and the percentage of the street wall that is solid.

- Within established areas creating a strong sense of enclosure may result in building heights that would conflict with those of the surrounding area. In such circumstances designers may emphasise enclosure though other design measures, such as the planting of street trees.
- The planting of street trees should also be considered as a retrospective traffic calming measure in existing contexts where levels of enclosure are traditionally weaker, such as in *Suburban* areas.
- The planting of street trees may also be desirable within *Transition Zones* (see Sections 3.4.1 Wayfinding and 3.4.4 Relief Roads), in advance of *Gateways* and within *Rural Fringe* areas as an advance warning to drivers of changing conditions ahead.

The measures illustrated in Figure 4.7 should not be strictly viewed as quantifiable. For example a moderate building height to street width ratio, in addition to a moderate continuity of street wall, does not equate to a strong sense of enclosure. Rather they should be viewed as complementary, i.e. a strong sense of enclosure is created where both elements are strong.

The relationship between building height and street width is also key to creating a strong urban structure, by increasing building heights in proportion to street widths. This will also promote greater levels of sustainability and legibility by placing more intensive development along wider/busier streets, such as *Arterial and Links* streets, to support public transport routes and highlight their importance as connecting routes, respectively (see Figure 4.8).

Additional building height may also be used at junctions to create a 'book end' effect (see Figure 4.9). This approach will assist in slowing vehicles as they approach junctions and will improve legibility by highlighting connecting routes throughout the network.

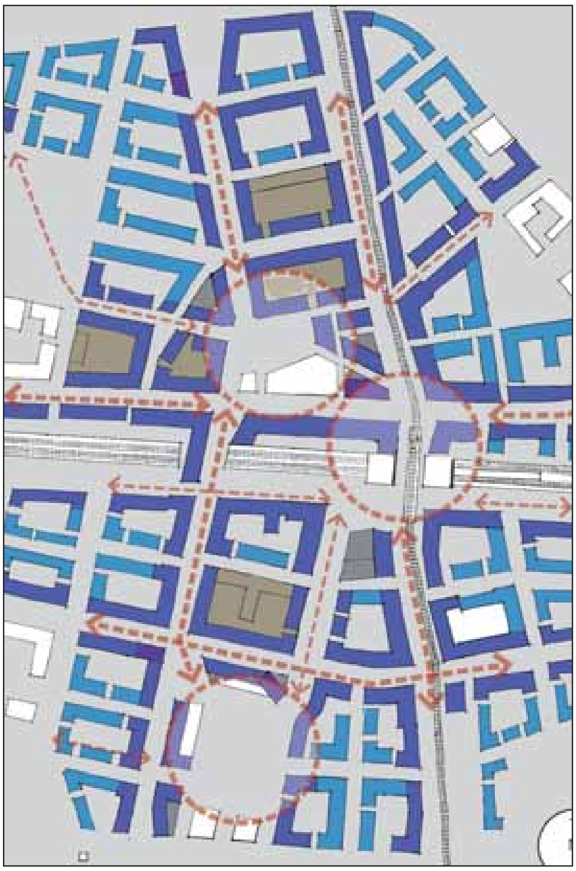


Figure 4.8: Plan illustrating how taller buildings (purple) are placed along busier routes (and around major spaces) to enclose streets and reinforce the structure of the area.

Figure 4.9: Reinforcing junctions with additional building height will assist in slowing vehicles as they approach junctions and will improve legibility by highlighting connecting routes throughout the network.

4.2.2 Street Trees

Street trees are an integral part of street design as they contribute to the sense of enclosure, act as a buffer to traffic noise/ pollution and enhance place. A traffic-calming effect can also be achieved, where trees are planted in continuous rows and their canopies overhang, at least in part, the vehicular carriageway. Street trees can also be used to enhance legibility by highlighting the importance of connecting routes and distinguishing one area from another through variations in size and species selection.

The planting of trees should be considered as an integral part of street design. In general, the size of the species selected should be proportionate to the width of the street reserve. For example (see Figure 4.10):

- Larger species, with a canopy spread greater than 6m will be best suited to wider streets, such as *Arterial* and *Link* streets.
- Smaller species with a canopy spread of 2-6m will be best suited to narrower streets such as *Local* streets.

Designers may seek to vary this approach in keeping with the characteristics of a place. For example:

- Sparse planting may be more appropriate in a *Centre*, enhancing its urban qualities.
- Smaller species may be more appropriate where buildings are located in close proximity to the street edge carriageway (i.e. to take account of overshadowing, growth restrictions).
- Larger species may be desirable within *Suburbs*, to enhance the greener character associated with these places.

To be effective, trees should be planted at intervals of 14-20m. This may be extended periodically to facilitate the installation of other street facilities, such as lighting. Designers should also consider the impact of root growth. Tree roots may need to be contained within individual tree pits, continuous soil planting strips or using other methods to restrict growth under pavements/toward services.

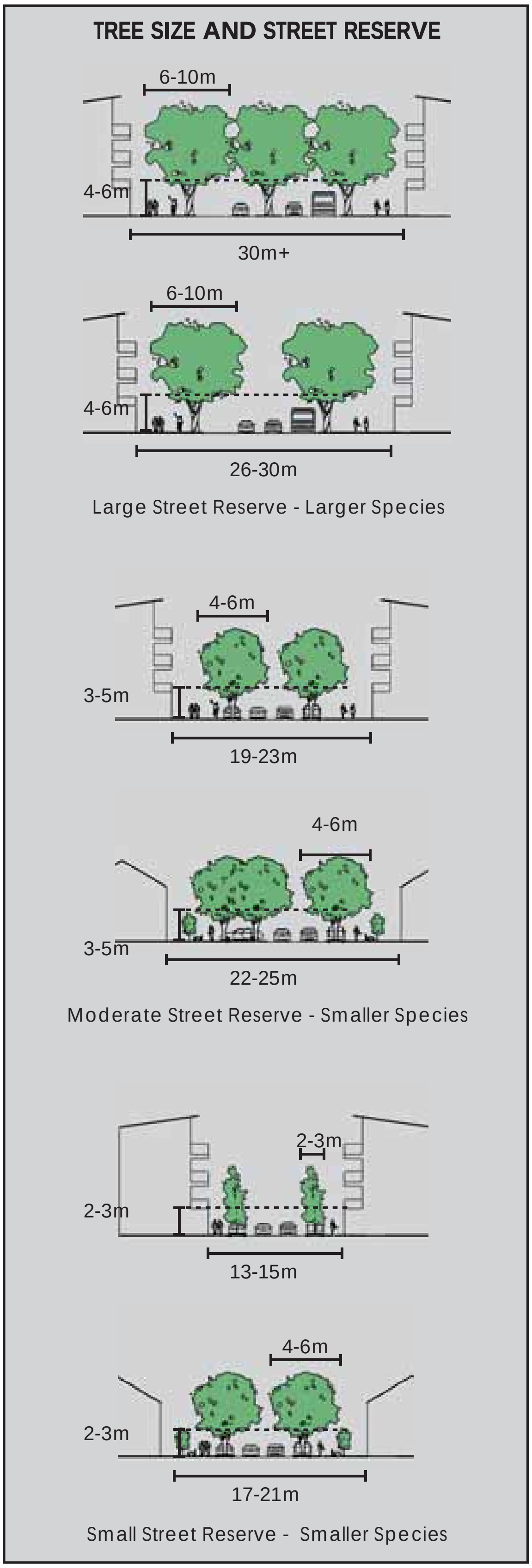


Figure 4.10: General guide to the canopy width and clearance height for street trees.

4.2.3 Active Street Edges

Active street edges provide passive surveillance of the street environment and promote pedestrian activity. This should be a principle aim of the design team. Increased pedestrian activity also has a traffic-calming effect as it causes people to drive more cautiously.[6]

Designers should seek to promote active street edges on all streets within cities, towns and villages. The most effective way to promote pedestrian activity is to place buildings in close proximity of the street (see Section 4.2.1 Building Height and Street Width) with a high frequency of entrances and other openings. In this regard (see Figure 4.11):

- To maximise activity in *Centres* the street edge should be lined with development that promotes a high level of activity and animation such as retail, commercial or other appropriate uses. To maximise the effectiveness of these uses, setbacks should be minimised (for example 0-3m) and a high frequency of entrances provided (for example every 5-10 metres).
- Where larger retail/commercial floor plates are proposed at ground floor level an active street edge may be achieved by creating multiple entrances and/or wrapping them with smaller perimeter units that front on to the street (see Figure 4.12).
- *Arterial* and *Link* streets through intensively developed *Neighbourhoods* may also sustain retail/commercial activity, particularly on corner locations.
- Higher levels of privacy are desirable where residential dwellings interface with streets. This may be provided via a small setback (for example 1-3 metres) which incorporates planted strip that defines public and private space (see Figure 4.13).
- Residential development will also promote on-street activity where individual dwellings (including ground floor apartments) are 'own door' accessed (see Figure 4.14).

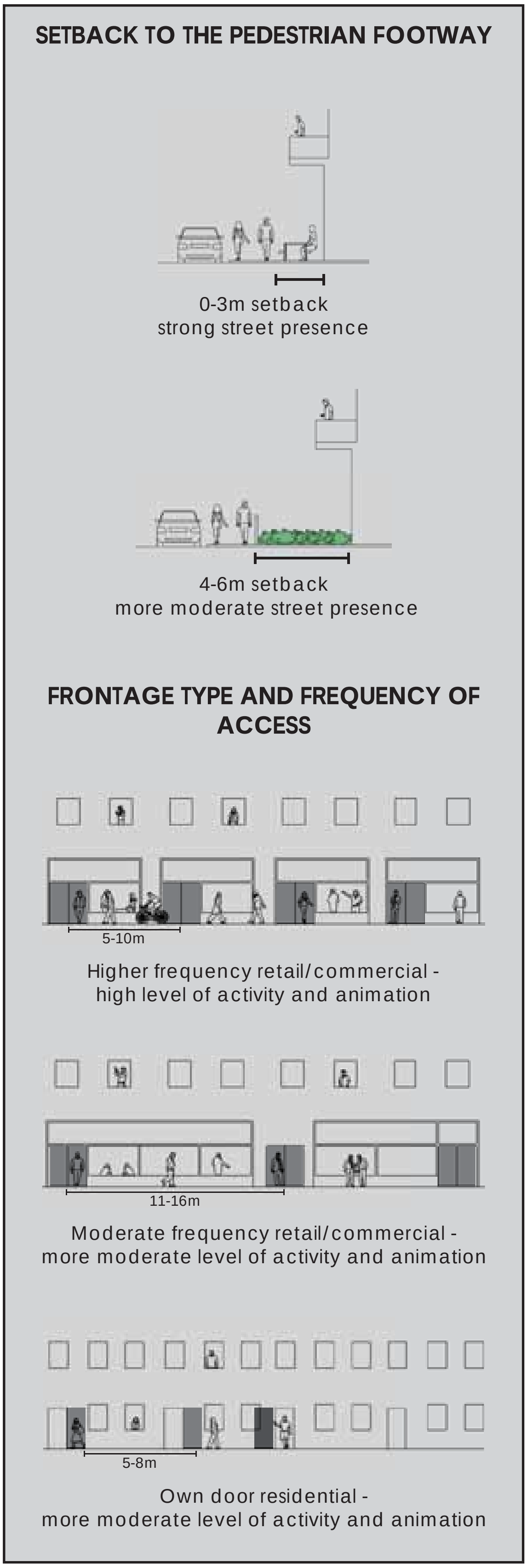


Figure 4.11: Measures that indicate active and animated street interfaces.

6 Refer to Section 2.2.5 of the UK *Manual for Streets* (2007).

- Greater flexibility in regard to setbacks may be needed in existing areas where they are defined by an existing pattern of building lines
- The inclusion of in-curtilage parking within front gardens (i.e. to the front of the building line) may result in large building setbacks that substantially reduce the sense of enclosure. In addition to the above, designers should avoid a scenario where parking dominates the interface between the building and the footway (see Section 4.4.9 On-Street Parking and Loading).

In addition to the above, further advice with regard to the creation of active street edges may also be taken from the *Urban Design Compendium.*[7]

7 Refer to Section 5.1.2 Building Lines and Setbacks and Section 5.2 Animating the Edge, UK *Urban Design Compendium* (2000).

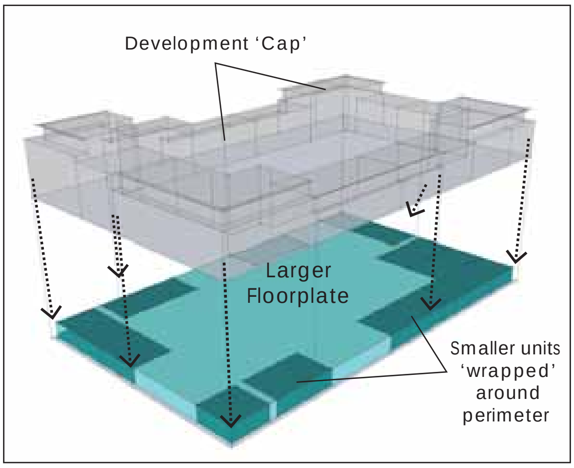


Figure 4.12: Illustration of how a larger retail/ commercial unit can be accommodated within a block whilst promoting an active street edge that is also overlooked from the upper levels.

Figure 4.13: Privacy strip to the front of residential development. The strip provides a buffer and clearly define the private domain from the public.

Figure 4.14: A fine grain residential environment where all ground floor dwellings are directly accessible from the street via 'own door' entrances. Note, in this instance access to upper floors is provided via internal lobby areas.

4.2.4 Signage and Line Marking

The principal source for guidance on signage and line marking is the Department of Transport *Traffic Signs Manual* (TSM) (2010), which categorises signage and road marking into four main categories:

- TSM Chapters 2 and 4: *Information Signs* that give directions and distances to destinations or which provide other information that may be relevant to road users;
- TSM Chapter Section 5: *Regulatory Signs* that give instructions, prohibitions or restrictions which road users must obey and indicate the existence of a Road Traffic Regulation or implement such a Regulation, or both.
- TSM Chapter Section 6: *Warning Signs* are used to alert the driver to a danger or potential danger on the road ahead.
- TSM Chapter Section 7: *Road Markings* are defined as markings on the surface of the road for the control, warning, guidance or information of road users and may either be used on their own or to supplement associated upright signage.

Regulatory Signs can be further divided into three main groups:

- *Mandatory Signs* are used to indicate that a road user must take a certain action. For Example 'Stop', 'Yield' or 'Keep Left'.
- *Restrictive Signs* to indicate a limit must not be exceeded. For Example '50 km/h Speed Limit' or 'Weight Limit 3 tonne'.
- *Prohibitory Signs* to indicate something which must not be done. For Example 'No Right Turn' or 'No Parking'.

The implementation of a self-regulating street environment means that the reliance on signage or line marking to direct or instruct people is significantly reduced. As noted in the *Manual for Streets* (2007)[8], there may also be traffic-calming benefits of a 'less is more' approach to reinforce lower design speeds. For example, the removal of centre line markings has been found to reduce vehicle speeds and the number of accidents.[9] With reduced signage drivers must navigate the street environment with full regard to their own behaviour and the behaviour of others around them. An emphasis on the values of place also requires the visual impact of signage to be considered in order to reduce visual clutter.

The TSM warns against over providing signage and line marking. Section 1.1.10 of the TSM states in relation to signage in general, 'signs should only be erected where there is a demonstrable need, because unnecessary, incorrect or inconsistent signs detract from the effectiveness of those that are required and tends to lead to disrespect for all signs'. There is also a limit to how many signs/line markings drivers can absorb in a short period.

To define where designers are allowed to employ discretion, Section 1.1.12 of the TSM states that:

- 'Shall' or 'must' indicates that a particular requirement is mandatory;
- 'Should' indicates a recommendation; and
- 'May' indicates a permissible option.

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8 Refer to Section 9.1.7 of the *Manual for Streets* (2007). Designers should also note that the *Manual for Streets* recommended monitoring streets where little or no signage is used to confirm its effectiveness.

9 Refer to Improving *Traffic Behaviour and Safety Through Urban Design, Civil Engineering* (2005).

Designers should use this discretion with regard to the self-regulating characteristics of streets and the impact of signs/line marking on the value of place when applying the TSM. In this regard:

- Minimal signage is required on *Local* streets due to their low speed nature and low movement function. The generally lightly trafficked nature of these streets means that the use of signage can be minimised, and in some cases eliminated altogether.

- The requirements for signage on *Arterial* and *Link* streets will be higher than on *Local* streets. The use of signage should be kept to the minimum requirements of the TSM, particularly where place values are very high, such as in the *Centre* context.

Designers may have concerns about minimising signage on streets that carry higher volumes of traffic, but there are many successful examples where the amount of signage provided has been significantly reduced (see Figures 4.15 and 4.16).

Figure 4.15: Walworth Road, Central London, UK, before (top) and after (bottom). The street carries over 20,000 vehicles per day and as part of major upgrade signage and line marking were minimised (image source: Southwark Council).

Figure 4.16. Kensington High Street, London, UK, where as part of upgrade works, a major decluttering exercise took place which included removing all guardrails, minimising signage and line marking. It is notable that upon completion of the works, vehicle speeds decreased and the incidence of accidents decreased by 43% (2003-2005). Left image source: Kensington and Chelsea Borough Council.

With regard to signs and line marking more generally (see Figure 4.17):

- Signage structures should be rationalised. Individual sign poles may be better utilised and signs should be clustered together on a single pole.[10]

- Non-regulatory, and in particular *Information Signs*, signage may be embedded within street surfaces or incorporated into other items of street furniture.

- Local authorities should undertake periodic decluttering exercises to remove unnecessary repetitive and redundant signage.[11]

- The size of individual signs should generally be to the minimum specification stated in the TSM for the particular speed limit.

- The use of *Warning* signs should be limited as they are generally not required in built-up areas where potential hazards are clearly legible and vehicles travel at lower to moderate speeds. Warning signs should be installed only if an engineering assessment indicates a specific need for improving road safety for users and it is clear that the sign will be effective.[12]

10 Refer to Action 16 of *Smarter Travel* (2009) which requires the rationalisation of signage poles

11 Refer to UK Department for Transport *Local Transport Note 1/08*. Examples of guidelines are available from www.english-heritage.org.uk

12 Refer to Sections 6.1.17 and 6.1.19 of the *Traffic Signs Manual* (2010).

- Designers should minimise the duplication of signage and/or road marking. Where signage and road markings provide the same function, preference should be given to the provision of road markings only, unless specifically required by the TSM. In general, road markings are more legible for drivers and have less of a visual impact on the streetscape.

- The use of signage and/or road marking that duplicate existing regulations should be avoided and may lead to confusion. For example the use of double yellow lines around corners to reinforce the standard prohibition on stopping within 5m of a road junction may lead to misinterpretation that loading is generally permitted.[13]

Designers should also note that a *Regulatory* sign may not be required as a 'regulation' or a 'mandatory requirement'. Designers may conclude that a *Regulatory* sign may not be needed due to the self-regulating nature of the street and/or in order to reduce the overall amount of signage used.

13 Refer to Section 7.6.5 of the *Traffic Signs Manual* (2010).

Figure 4.17: Example of the improvements to a streetscape that can be achieved where signage and line marking are substantially reduced. Note all changes have been made within the scope of the TSM.

4.2.5 Street Furniture

Street furniture serves many purposes that relate to both place and function and includes a variety of commonly found items within a street such as public art, lighting, bollards, guardrails, seating and cycle parking. Whilst items such as public art may be of place value only, many other items, if well designed, provide a place and function value (see Figure 4.18).

In general, the provision of street furniture must be considered as part of the overall design of street. In this regard:

- The placement of street furniture should be considered as part of a wider strategy, such as part of an integrated landscape plan or series of street typologies.
- Street furniture should be placed within a designated zone, such as a verge (see Section 4.3.1 Footways, Verges and Strips)
- The items used should be chosen from a limited palette that promotes visual cohesion (see Section 5.2.1 Policy and Plans).
- The number of items used should be balanced with other facilities (including signage and line marking) to reduce clutter.
- Existing items of historic value which promote local character should be clearly identified (see Section 4.2.8 Historic Contexts).

Guardrails

An integrated approach to street design will substantially reduce the need for obtrusive physical barriers such as guardrails. For example, the alignment of crossing points with desire lines will eliminate the need for guardrails to redirect pedestrians (see Section 4.3.2 Pedestrian Crossings)

In this regard:

- Guardrails should not be used as a tool for directing and/or shepherding pedestrians.

Figure 4.18: An example from Drogheda, Co. Louth, where well placed street furniture has a functional role that also provides a major contribution to the streetscape and value of place.

- Guardrails should only by installed where there is a proven or demonstratable safety benefit, for example where people may inadvertently step onto the carriageway (e.g. at a school entrance).[14]

Where the potential need for guardrails is identified (such as via a Road Safety Audit), designers should review their design as this need may highlight inadequacies in the design (such as the failure to take proper account of pedestrian desire lines). Designers should also consider the use of street furniture that may guide pedestrian movement and also contributes to the sense of place and provide amenities (see Figure 4.19).

Authorities should remove unnecessary guardrails on existing streets. The removal of individual sections of guardrails should be the subject of a rigorous and well documented assessment process. Further guidance in regard to the removal of guardrails may be obtained from, UK *Guidance on the Assessment of Pedestrian Guardrail* (2012 update) and UK Department for Transport *Local Transport Note 2/09* (see Figure 4.20). The *National Cycle Manual* (2011) also recommends the removal of guardrail as it poses a safety risk to cyclists.[15] Once guardrails have been removed monitoring should be undertaken to ensure the works have had the desired effect.

Designers may have some concerns in regard to the removal of guardrails on busy streets due to their perception as effective 'crash' barriers. However, guardrails are only effective at stopping vehicles at very low speeds and therefore may provide a false sense of security resulting in pedestrians and vehicles both paying less attention.[16]

Figure 4.19: Items such a bicycle racks, seating and/or bollards are less intrusive elements that can be used to guide pedestrians toward crossing points and reduce illegal kerb mounting.

Figure 4.20: Before and after images near Kings Cross station, London, extracted from the TfL document Assessment of Pedestrian Guardrails. TfL have undertaken a wide program of guardrail removal throughout the streets of London.

14 Refer to UK Department for Transport *Local Transport Note 2/09: Pedestrian Guardrailing,* for further guidance.
15 Refer to Sections 1.1.4, 4.4.1.2-4.4.1.4 and 4.4.4 of the *National Cycle Manual* (2011).
16 Refer to UK *Guidance on the Assessment of Pedestrian Guardrail* (2012).

Lighting

Good quality lighting promotes a safer environment by ensuring inter-visibility between users. Poorly illuminated carriageways and cycle lanes can also make it difficult for users to identify potential hazards. The quality of lighting will also have a major impact on perceptions of security. If lighting levels are not sufficient, a place may not be perceived as safe, particularly for pedestrians and cyclists. This may discourage people from walking and cycling, particularly in the winter months when days are shorter, and undermine the viability of public transport.

The standards used for lighting within Ireland are generally taken from *British Standard Code of Practice for the Design of Road Lighting* (BS 5489). Whilst these documents should be referred to in regard to technical details, there are broader design considerations in regard to type of lighting used and the position and design of lighting columns.

Lighting should be designed to ensure that both the vehicular carriageway and pedestrian/cycle path are sufficiently illuminated. On roads and streets within urban areas white light sources should be used, such as metal halide, white SON, Cosmopolis and LEDs. Where orange (SOX) or softer honey (SON) coloured lights are currently used, they should be replaced with white light as part of any upgrade (see Figure 4.21).

With regard to the height of lighting columns:

- Heights should be sensitive to the scale of the adjacent built environment.
- In city, town and village streets, a lantern mounting height in excess of 8 metres is unlikely to be required.
- On *Local* streets, and in areas of heritage significance, mounting heights should be no greater than 6 metres.
- Where higher numbers of pedestrians are active, such as in *Centres*, consideration should be given to supplementing the traffic route lighting installation with a lower intensity pedestrian lighting lanterns mounted at a lower height on the same columns (see Figure 4.22).

POOR
(Orange SOX)

BETTER
(White SON)

BEST
(Metal Halide)

Figure 4.21: Examples of differing types of lighting and their effectiveness in terms of safety and placemaking.

Lighting installations should be generally located within a verge (see Section 4.3.1 Footways, Verges and Strips) and/or within build-outs that separate bays of on-street parking (see Section 4.4.9 On-street Parking and Loading). Where no verge is available, lighting should be located at the back of footways, to minimise any disruption to pedestrian movement provided:

- They are positioned, where possible to coincide with property party lines to avoid obstructing entrances or windows.

- They are not located in close proximity to properties where they may compromise security.

On narrow streets or streets with narrow footways, consideration should be given to using wall-mounted lanterns

Lanterns should be selected and positioned so as to avoid creating obtrusive light spill on windows, particularly in the case of upstairs residential properties. Internal or external baffle plates can be fitted to lanterns to minimise nuisance light spill. Lights should also be positioned away from trees, which in time may grow to envelop the lanterns or cast shadows which will render the lighting less effective.

To reduce street clutter designers should consider combining lighting with other installations (see Section 4.2.4 Signage and Line Marking and as per Figure 4.22). Traffic signal heads, small signs, bus stop signs etc. can be mounted on lighting columns with a degree of co-operation and co-ordination between the relevant authorities and service providers. CCTV columns, which need to be more rigid than lighting columns, can also accommodate lighting and other functions. Ancillary lighting equipment, such as electrical supply pillars, should also be located with a view to minimising their impact on the streetscape, while not creating an obstruction or hazard to pedestrians. Metering cabinets in particular, which may be up to 1.5 metres high, should be located against walls, as unobtrusively as possible, while bearing in mind that they must be accessible for maintenance and meter reading.

Figure 4.22: Example of a light installation that is designed with both the pedestrian and the vehicle in mind and also incorporates signals for a pedestrian crossing (image source: Camden Streetscape Manual).

4.2.6 Materials and Finishes

The use of materials and finishes is one of the most defining elements of a street, particularly where it is used to define the levels of segregation and integration within a street. The material palette can define space, calm traffic and improve legibility, reducing the need for barriers, signage and line marking in favour of texture and colour. Materials can be used to enhance the value of place and produce more attractive and cost-effective streets.

When choosing surface materials, designers should:

- Use robust surfaces (such as natural stone, concrete block paving or imprinted asphalt) extensively throughout *Centres* and around *Focal Points* to highlight the importance of place, calm traffic and alert drivers of higher levels of pedestrian activity (see Figure 4.23).

- Use robust surfaces and/or changes in colour around *Gateways* and *Transitional Zones* to alert drivers of changing driving conditions (see Section 3.3.4 Wayfinding).

- Choose items from a limited palette to promote visual cohesion (see Section 5.2.1 Policy and Plans).

- Apply a hierarchical approach to the application of materials. Altering the palette according to the street hierarchy and/or importance of place will assist in way finding.

- Use of contrasting materials and textures to inform pedestrians of changes to the function of space (i.e. to demarcate verges, footway, strips, cycle paths and driveways) and in particular to guide the visually impaired (see Section 4.3.4 Pedestrianised and Shared Surfaces).

The layout and colour of tactile paving used to assist the visually impaired in navigating the pedestrian environment should ensure that a consistent logic is applied. This includes the cumulative impact of tactiles with other material choices. For example, the use of strong red or yellow tactile paving may not be appropriate to avoid visual clutter associated with too many surface types or colours. In such instances the use of a more varied palette or contrasting tones is preferable (see Figure 4.24). Further guidance on the use of tactile paving may also be taken from Section 13.3 of the *Traffic Management Guidelines* (2003) and the UK *Guidance on the use of Tactile Paving Surfaces* (2005).

Figure 4.23: O'Connell Street, Dublin. The high place status, intensity of activity and low design speed (30 Km/h) is highlighted by high quality and robust materials, such as granite paving.

Designers may have concerns in regard to the initial costs associated with using higher specification materials and their ongoing maintenance. The use of higher quality materials has wide economic benefits. For example, in relation to shopping streets, research in the UK has shown that streets finished with better quality materials result in better market prices, better rents and better retail sales.[17] Capital costs should also be measured against savings that result from a reduction in the need for barriers, signage, line marking and longer term costs related to durability and maintenance. Further guidance may be obtained from the *Natural Stone Surfacing - Good Practice Guide* (SCOTS Guide) (2004) .

The quality of materials may also be selected to ensure that more robust and higher quality materials are used where they are most needed and appreciated. Figure 4.25 from the *Adamstown Street Design Guide* (2010) provides an overview of how the standard of materials may be applied with regard to amenity, density and activity. When applied systematically it directs the designers to use the highest specifications of materials in the *Centres* and along streets which are the most active, such as *Arterial* and *Link* streets. It will also direct the use of higher specification materials to the vicinity of *Focal Points*. Good results may also be achieved on lower budgets, provided material selection has the desired effect of supporting other measures aimed at calming traffic and defining place (see Figure 4.26).

Figure 4.24: Example form Drogheda, Co. Louth, of red tactile paving at a zebra crossing which has been toned down to balance the degree of contrast with higher specification materials.

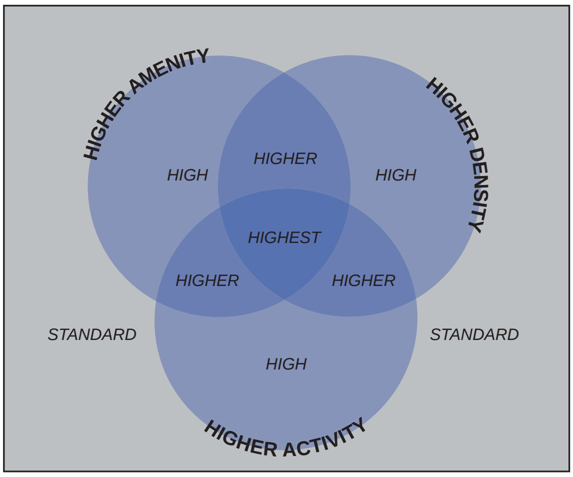


Figure 4.25: Diagram illustrating a hierarchical and cost-effective approach to the specification of materials on streets.

Figure 4.26: Fade Street, Dublin City Centre. To reduce the overall cost of work in remodelling the street, lower budget materials such as HRA with coloured aggregate chips and epoxy resin bound surfaces were used on the carriageway and footpath, respectively.

17 Refer to *Paved with Gold* (2007).

4.2.7 Planting

Planting is generally located in areas such as medians, verges, build-outs and privacy strips. Landscaping is traditionally used to add value to places though visual enhancement. There are many approaches that can be taken with regard to planting, for example:

- Within *Centres* a greater emphasis may be placed on using 'harder' landscape elements that define them as urban, allow greater freedom of movement and are able to withstand higher level of pedestrian traffic (see Figure 4.27).

- In *Neighbourhoods* and *Suburbs* a greater emphasis may be placed on the use of planted materials to promote 'softer' landscape elements to promote a greener 'living' character (see Figure 4.28).

Other key considerations include the ongoing maintenance and size of street trees/planting at maturity. Quality and maintenance should be viewed in a similar regard to the application of materials and finishes (as per Figure 4.27) with a hierarchical approach that promotes the use of higher quality planting within *Centres* and along streets which are the most active, such as *Arterial* and *Link* Streets, and around *Focal Points*.

Figure 4.27: Example from Dundalk of an area with higher activity, the use of planted materials will be more sparsely and selectively applied in favour of more robust and durable materials.

Figure 4.28: Example of a residential character, a rich palette of planted materials will enhance green qualities.

Designers should also consider the size of trees, shrubs and other landscape elements at full maturity. In general designers should avoid planting that will grow to obstruct movement and surveillance. There are exceptions to this, for example overgrown medians can help reinforce narrower carriageways and tall shrubs may deflect sightlines reducing forward visibility.

Streets also support an important drainage function within built-up areas. The shift toward sustainable forms of development has seen the emergence of Sustainable Urban Drainage (SUDs) systems. SUDs consist of a range of measures that emulate a natural drainage process to reduce the concentration of pollutants and reduce the rate and volume of urban run-off into natural water systems (and thus the pollutants it carries). The incorporation of SUDs elements into the fabric of the street itself can also serve to increase legibility and add value to place (see Figure 4.29). Further advise with regard to the use of SUDs may be found in the *Greater Dublin Strategic Drainage Study* (2005).

Figure 4.29: Examples of Sustainable Urban Drainage incorporated into a street in the form of a small 'swale' (top) and larger linear basin (bottom). These treatments not only assist in containing urban surface water run-off but also contribute to the sense of place by adding a unique feature.

4.2.8 Historic Contexts

Additional design considerations must be taken into account in areas of historic significance that are highly sensitive to interventions. Historic features help reinforce an areas character/place value and may also play a role in managing speeds (see Figure 4.30). The most appropriate course of action should be to minimise any level of intervention to existing historical features.

Elements of street furniture associated with the historic use of the street should be identified and protected, where appropriate (see Figure 4.31). Significant historic features may also include the street surface itself (as per Figure 4.30)[18] and any features set into it such as coalhole covers, weighbridges, pavement lights, cellar doors etc.

An 'assessment of significance' should be prepared when dealing with interventions within historic core areas. This is seen as addressing/acknowledging essential elements of the historic urban environment which may have architectural, historical and technical significance. For example when dealing with an established street layout and associated materials a distinction is drawn between three levels of significance:

1. Undisturbed areas of existing historic streets, which have the highest value and bear witness to the skill of historic craftsman;

2. Areas where streets have been altered or reconfigured using the original design/ material;

3. Reinstated street areas re-using salvaged material from other places.

The mechanism for the protection of historic areas is based on statutory protection. If an area lies within an Architectural Conservation Area (ACA) or forms part of the setting of a protected structure (or a number of protected structures), development policies will be set out in the relevant County/City Development Plan, as well as active planning control.[19]

Figure 4.30: The stone sett paved carriageways of Temple Bar, Dublin, are of historical significance, enhance the areas value as a cultural corner and calm traffic by creating a sense of shared space.

Figure 4.31: An example of a historic water fountain in Newcastle, Co. Dublin. Such features are integral of local identity and should be retained.

18 *Refer to Paving: the Conservation of Historic Ground Surfaces.* Forthcoming in 2013. Department of Arts, Heritage and the Gaeltacht.'

19 Refer also to the *Architectural Heritage Protection Guidelines for Planning Authorities* (2011).

4.3 Pedestrian and Cyclist Environment

4.3.1 Footways, Verges and Strips

A strong sense of enclosure and active street edges contribute to a pedestrians/cyclists sense of security and comfort by creating streets that are overlooked, animated and sheltered from inclement weather conditions. Studies have found that providing wider and better quality walking facilities can lead to an increase in walking.[20] Well designed footpaths are free of obstacles and wide enough to allow pedestrians to pass each other in comfort. For this purpose the footpath is divided into three areas (see Figure 4.32):

- Footway: this is the main area along which people walk.
- Verges: These provide a buffer between pedestrians and the vehicle carriageway and provide space for street furniture and street trees as well as overflow space for pedestrian movement (see Figure 4.33).
- Strips: These spaces, provided directly to the front of a building, may be occupied by activities generally associated with retail/commercial uses such as stalls or outdoor seating. Strips may be incorporated into the private space of a dwelling (as per Figure 4.13).

Footways

Minimum footway widths are based on the space needed for two wheelchairs to pass each other (1.8m). In densely populated areas and along busier streets, additional width must be provided to allow people to pass each other in larger groups. In this regard:

- The width of footways should increase from *Suburbs* (lower activity), to *Neighbourhood* (moderate activity) and to *Centres* (higher activity) and as development densities increase.
- The width of footways should increase according to function from *Local* (lower activity), *Link* (moderate activity), to *Arterial* streets (moderate to higher activity) as connectivity levels increase.
- The footway should be maintained at a consistent width between junctions and should not be narrowed to accommodate turning vehicles.

Figure 4.34 illustrates the space needed for pedestrians to comfortably pass each other with reference to the anticipated levels of activity within a street. These standards should be used to formulate the minimum footway widths.

20 Refer to Section 5.1 of the UK *Manual for Streets 2* (2010).

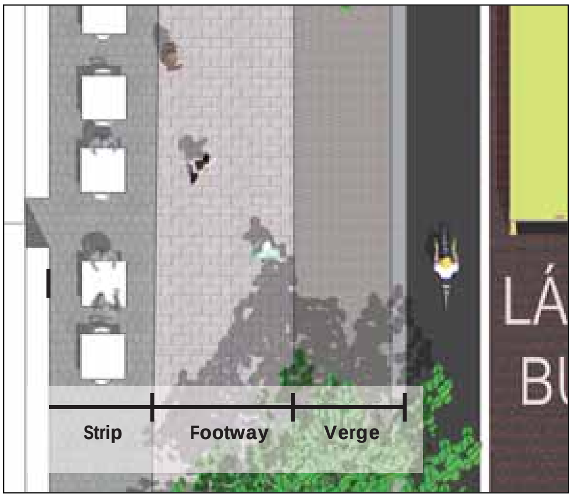


Figure 4.32: Illustration of the area generally thought of as the footpath. This area should be viewed and designed as three areas of activity.

Figure 4.33: Example from Castlebar, Co. Mayo, where the verge acts a designated space for street furniture, lighting facilities and planting of trees, keeping the footway clear of obstacles.

In areas of particularly high pedestrian activity, such as shopping streets or close to major nodes (such as a train station) more complex modelling may be needed to determine footway widths. In such cases designers may refer to the UK *Pedestrian Comfort Guidance for London* (2010) for further guidance in regard to footpath widths based on the volume of pedestrians per hour (provided these do not fall below the thresholds in Figure 4.34). This guidance may also be of particular assistance in assessing pedestrian comfort levels on existing footways.

In a retrofit situation increasing footpath widths should be a priority for designers and where appropriate, accommodated by narrowing vehicular carriageways (see Section 4.4.1 Carriageway Widths). Increases in width should also be considered as part of a package of facilities, including the provision of cycle lane/tracks, on-street parking and other street facilities (including street trees).

Designers should also ensure that the design of vehicle crossovers clearly indicate that pedestrians and cyclists have priority over vehicles. There should be no change in level to the pedestrian footway and no use of asphalt (which would incorrectly indicate vehicular priority across a footpath). Large or busy driveways (i.e. access to large car parks) may, however, be demarcated by a change in surface materials, such as contrasting paving and/or coloured concrete (see Figure 4.35). Designers should also refer to Section 5.4 - Entrances and Driveways of the *National Cycle Manual* (2011) for further design guidance where cycle tracks are present.

Verges

The need and size of the verge will largely be dependent on the function of the street and the presence of on-street parking. In general:

- On *Arterial* and *Link* streets with no on-street parking a verge of 1.5-2m should be provided as a buffer and to facilitate the planting of large street trees and items of street furniture.

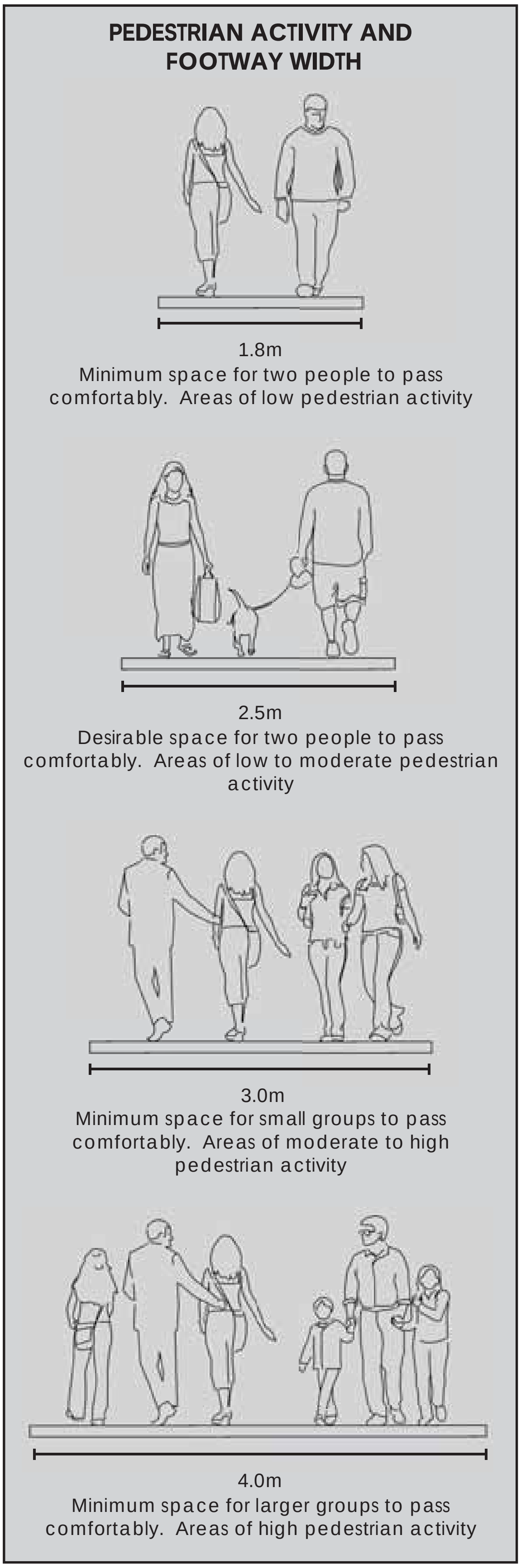


Figure 4.34: Diagram showing the amount of space needed for pedestrians to pass each other with regard to pedestrian activity levels.

- There is no minimum requirement for verges on *Local* Streets, but designers may need to provide space to prevent any encroachment of street furniture into the footway.
- Where on-street parking is provided, a verge (and change in kerb line) may be needed on approaches to junctions to enforce the visibility splays (see Section 4.4.5 Visibility Splays). In such cases the width of the verge will generally correspond to the width of car parking spaces.
- A verge should be provided where cycle tracks are located adjacent to parking spaces (see Section 4.3.5 Cycle Facilities)
- A verge (minimum of 0.3m) should be provided in areas of perpendicular parking where vehicles may overhang the footway (see Figure 4.36)

Strips

Strips may be provided as a designated zone that further animates the street and, in the case of a residential property, provide a buffer between the footway and the private residence.

With regard to areas of commercial activity:

- Where outdoor seating is provided the minimum width of a strip should be 1.2m.
- Outdoor seating may also be provided within a verge area, where the footway runs between the shop front and seating area.
- There is no recommended maximum size of a strip, but the design team should consider the impact of larger setbacks on the sense of enclosure of the street if a large area is proposed.
- A designated strip may also be considered within *Centres* on shopping streets to provide additional space for window shopping.

For residential areas designers should refer to Section 4.2.3 Active Street Edges, with regard to the width of privacy strips.

Figure 4.35: Example from Dublin where pedestrian priority across driveways is indicated by maintaining footway levels and surface treatments.

Figure 4.36: An example where a narrow verge is provided to ensure that vehicle overhangs do not intrude on the footway.

4.3.2 Pedestrian Crossings

Crossings are one of the most important aspects of street design as it is at this location that most interactions between pedestrians, cyclists and motor vehicles occur. Well designed and frequently provided crossings are critical to the balancing of movement priorities. The design of crossings, and the frequency at which they are provided, will have a significant impact on pedestrian/ cyclist mobility and comfort and the flow of vehicular traffic.

Crossing Selection

Crossings are referred to as controlled, such as zebra or signalised crossings or uncontrolled.[21] Uncontrolled crossings include less formal types such as courtesy crossings and/or those identified by a drop kerb. At junction locations the type of crossing used will generally be determined in conjunction with the form of junction control that is used to manage traffic (see Section 4.4.3 Junction Design). More generally, designers should be guided by pedestrian demands, safety and vehicle flows. In this regard:

- In general, signalised crossings should be provided on busy *Arterial* and *Link* streets and/or where cyclists are likely to cross.
- Zebra crossings provide greater pedestrian priority and may be used on *Arterial* and *Link* streets within lower speed environments, such as *Centres* (see Figure 4.37).
- Zebra crossings are also highly effective where both levels of pedestrian and vehicular activity are more moderate[22] and may also be used more generally, such as on Link streets in *Suburban* areas.
- Courtesy crossings, which are generally defined by a change in material and/ or vertical deflection (see Section 4.4.7 Horizontal and Vertical Deflections) allow pedestrians to informally assert a degree of priority over drivers and are particularly effective at promoting pedestrian priority. They may be used in lower speed environments (and will also assist in making such environments self regulating, see Figure 4.38)
- *Local* streets, due to their lightly-trafficked/ low-speed nature, generally do not require the provision of controlled crossings. The provision of drop kerbs will generally suffice. However zebra crossings or courtesy crossing should be considered where pedestrian demands are higher such as around *Focal Points*.

21 Refer to Section 12.3-12.4 of the *Traffic Management Guidelines* (2003).

22 Refer to Section 12.3 of the *Traffic Management Guidelines* (2003).

Figure 4.37: Example of a Zebra crossing within the town centre of Dundalk, Co. Louth. Zebra crossings promote greater levels of pedestrian priority as drivers must give way to pedestrians once they have commenced the crossing.

Figure 4.38: Example of an informal 'courtesy' crossing in Westport, Co. Mayo. Drivers stop and wait for pedestrians to cross as a courtesy.

Crossing Locations

The location and frequency of crossings should align with key desire lines and be provided at regular intervals. Within larger areas this may need to be addressed via a spatial analysis and supporting plan (see also Section 5.2.1 Plans and Policies). Methods that rely on absolute figures, such as the system of warrants, should not be used. More generally, designers should:

- Provide pedestrian crossing facilities at junctions and on each arm of the junction.

- Minimise corner radii so that crossing points are located closer to corners on pedestrian desire lines (see Section 4.3.3 Corner Radii).

- Provide regular mid block crossings in areas of higher pedestrian activity, such as *Centres*, where the distance between junctions is greater than 120m.

- Locate mid-block crossings at strategic locations where pedestrians are likely to cross, such as adjacent to bus stops and *Focal Points,* or to coincide with traffic-calming measures on longer straights (see Section 4.4.7 Horizontal and Vertical Deflections).

Crossing Design and Waiting Times

Smarter Travel (2009) requires that pedestrian movement at signalised crossings be given priority by timing traffic signals to favour pedestrians instead of vehicles by reducing pedestrian waiting times and crossing distances at junctions.[23] To achieve this objective, designers should:

- Optimise pedestrian movement, with pedestrian cycle times of no more than 90 seconds at traffic signals.

- Allow pedestrians to cross the street in a single, direct movement (see Figure 4.39). Staggered/staged crossings should not be used where pedestrians are active, such as in *Centres, Neighbourhoods* and *Suburbs* (except where stated below).

- Where staggered/staged crossings currently exist they should be removed as part of any major upgrade works. This should include realignment works to slow vehicle movements, such as reduced corner radii and/or carriageway narrowing (see Figure 4.40 and Section 4.3.3 Corner Radii)

23 Refer to Action 16 of *Smarter Travel* (2009).

Figure 4.39: Example of a wide streets with a crossing that allows pedestrians to cross in a direct manner and in a single movement. The median acts as a refuge island for those users who cannot cross the street in a reasonable time.

Designers may have concerns regarding the omission of staggered/staged crossings on wide streets (i.e. with four or more lanes and a median) on the grounds of safety and traffic flow. With regard to safety these concerns may be overcome by:

- Ensuring enough green time is provided for pedestrians to cross in a single movement.
- Removing flashing amber lights phases where vehicles may move forward not realising pedestrians are still on the median or far side of the crossing.
- Providing build-outs, where possible, to reduce the crossing distance.
- Providing a refuge island (minimum of 2m) for those who are unable to make it all the way across in a reasonable time. Under such circumstances a Push Button Unit (PBU) and the required signals must be provided within the refuge.

Safety concerns regarding pedestrian crossings should also be viewed in the context of pedestrian behaviour. Research has found that pedestrians are less likely to comply with the detour/delay created by staggered crossings, leading to unsafe crossing behaviour.[24] It will generally be more desirable, from a safety point of view, to provide a direct single phase crossing.

With regard to traffic flow on wide streets a more flexible approach may be taken where traffic modelling confirms that junctions would become overly saturated for long periods if designed with single phase/direct pedestrian crossings. A judgement will need to be made as there may be circumstances where it is acceptable to saturate junctions in order to prioritise/promote more sustainable travel patterns (see Section 3.4.2 Traffic Congestion) In these circumstances designers may also consider:

- A straight ahead two stage crossing within lower speed environments where the median is sufficiently wide to clearly distinguish each arm of the crossing.
- Increase pedestrian cycle times up to 120 seconds for short or intermittent periods (i.e. when saturation is likely to occur).
- Implement more conventional staggered crossings where the balance of place and movement is weighted toward vehicle movement such as on *Arterial* streets in *Suburban* areas or more broadly in *Industrial Estates* and the *Rural Fringe.* Where applied, the width of the central area for pedestrian circulation should be a minimum of 2m.

24 Refer to *Pedestrian Crossing Behaviour at Signalised Crossings* (2008).

BEFORE AFTER

Figure 4.40: Example from Kensington High Street, London, of a left hand turning slip point was removed and replaced with a safer single phase crossing which also slowed vehicle turning movements (image source: Hamilton Baillie).

When determining the width of crossings designers should refer to Section 7.16 of the *Traffic Signs Manual* (2010) which contains maximum and minimum design specifications for pedestrian crossings. In this regard (see Figure 4.41):[25]

- Within *Centres* and on *Arterial* streets, all crossings should generally be a minimum of 4m wide.
- The minimum width of all other pedestrian crossings should be 2m.
- The minimum width for Toucan crossings should be 4m.
- In determining the optimal width of a pedestrian crossing, designers may refer to Figure 4.34 to ensure that pedestrians are able to pass each other in comfort.
- On crossings where very high numbers of pedestrians and/or cyclists cross, a width in excess of those above may be required, to a maximum of 10m.

It is also an objective of *Smarter Travel* (2009) that level grade crossings (i.e. those that are aligned with the height of footways) be provided for pedestrians across junctions.[26] These are highly recommended in areas where pedestrian flows are high such as in *Centres*. They are also an effective measure for calming traffic and enforcing lower speeds (See Section 4.4.7 Horizontal and Vertical Deflections).

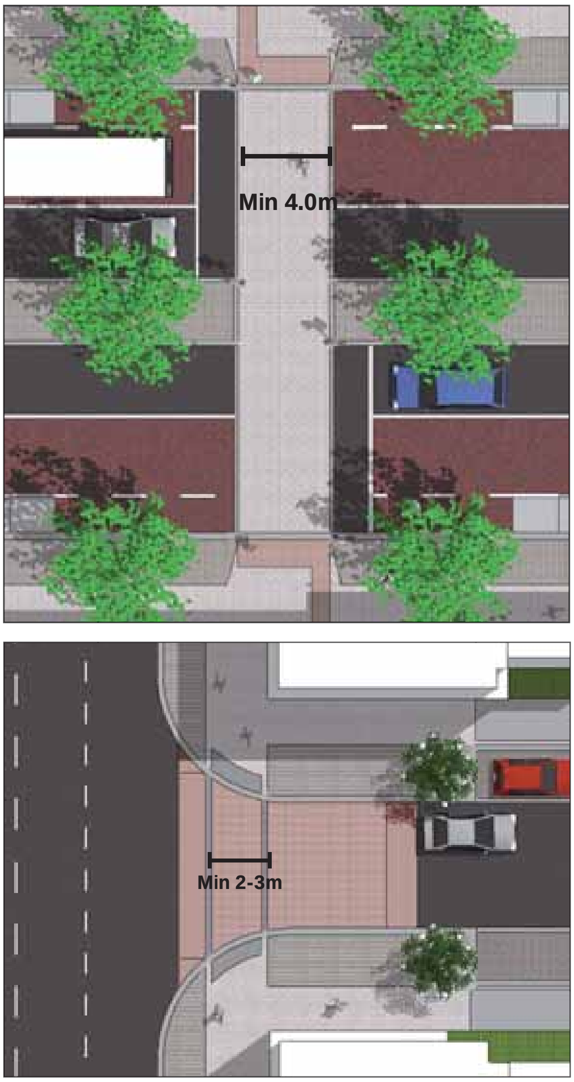


Figure 4.41: Standard crossing widths to be used in most circumstances across the main carriageway of Access or Link streets and across side junctions with Local streets.

25 Refer to Section 7.16 of the *Traffic Signs Manual* (2010) which contains maximum and minimum design specifications for pedestrian crossings.
26 Refer to Action 16 of *Smarter Travel* (2009).

4.3.3 Corner Radii

Reducing corner radii will significantly improve pedestrian and cyclist safety at junctions by lowering the speed at which vehicles can turn corners and by increasing inter-visibility between users (see Figure 4.42). Reduced corner radii also assist in the creation of more compact junctions that also align crossing points with desire lines and reduce crossing distances.

Corner radius is often determined by swept path analysis. Whilst swept path analysis should be taken into account, designers need to be cautious as the analysis may over estimate the amount of space needed and/or the speed at which the corner is taken. Furthermore, such analysis also tends to cater for the large vehicles which may only account for relatively few movements.

Designers must balance the size of corner radii with user needs, pedestrian safety and the promotion of lower operating speeds. In this regard designers must consider the frequency with which larger vehicles are to be facilitated as follows (see Figure 4.43):

- In general, on junctions between *Arterial* and/or *Link* streets a maximum corner radii of 6m should be applied. 6m will generally allow larger vehicles, such as buses and rigid body trucks, to turn corners without crossing the centre line of the intersecting road.[27]

27 Refer to Sections 6.9, 9.3 and 10.4 of the *Traffic Management Guidelines* (2003).

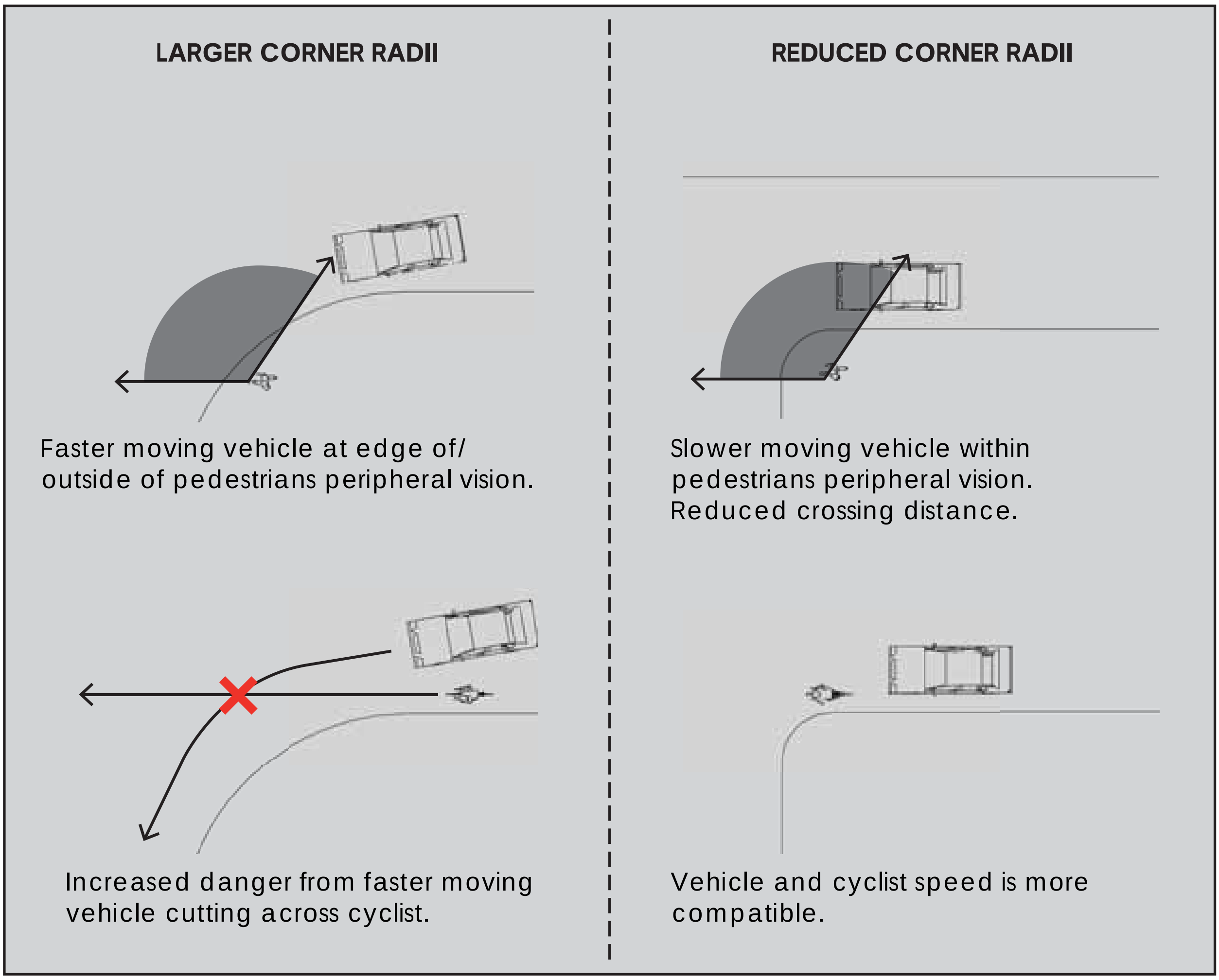


Figure 4.42: Illustration of the benefits of reduced corner radii on pedestrian and cyclist safety (images based on Figures 6.3 and 6.15 of the UK Manual for Streets (2007)).

- Where turning movements occur from an *Arterial* or *Link* street into a *Local* street corner radii may be reduced to 4.5m.

- Where design speeds are low and movements by larger vehicles are infrequent, such as on *Local* streets, a maximum corner radii of 1-3m should be applied.

- In circumstances where there are regular turning movements by articulated vehicles, the corner radii may be increased to 9m (i.e. such as in *Industrial Estates*).

Designers may have concerns regarding larger vehicles crossing the centre line of the intersecting street or road. Such manoeuvres are acceptable when turning into/or between *Local* or lightly trafficked *Link* streets as keeping vehicle speeds low is of higher priority. Where designers find it difficult to apply the radii referred to above, or to further reduce corner radii where pedestrian activity is high (such as within centres) designers may also:

- Increase the carriageway width at junctions to provide additional manoeuvrability without signalling to drivers that the corner can be taken at greater speeds (see Figure 4.44).

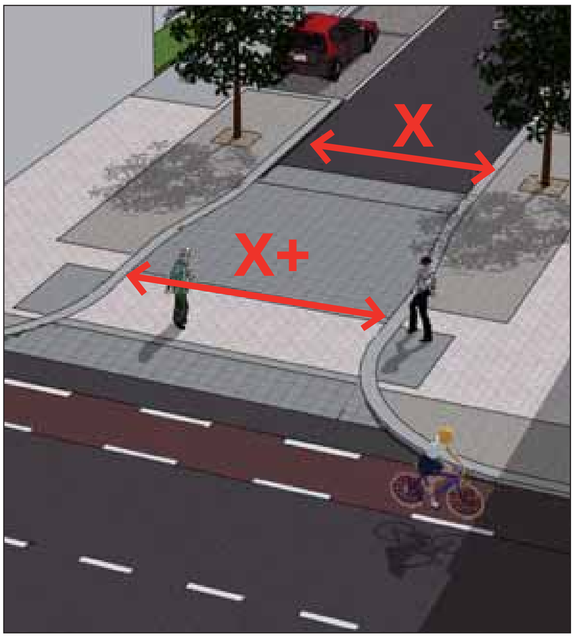


Figure 4.44: Illustration of how tighter corner radii can be applied to a junction, with additional manoeuvrability for larger vehicles provided by widening the street entrance.

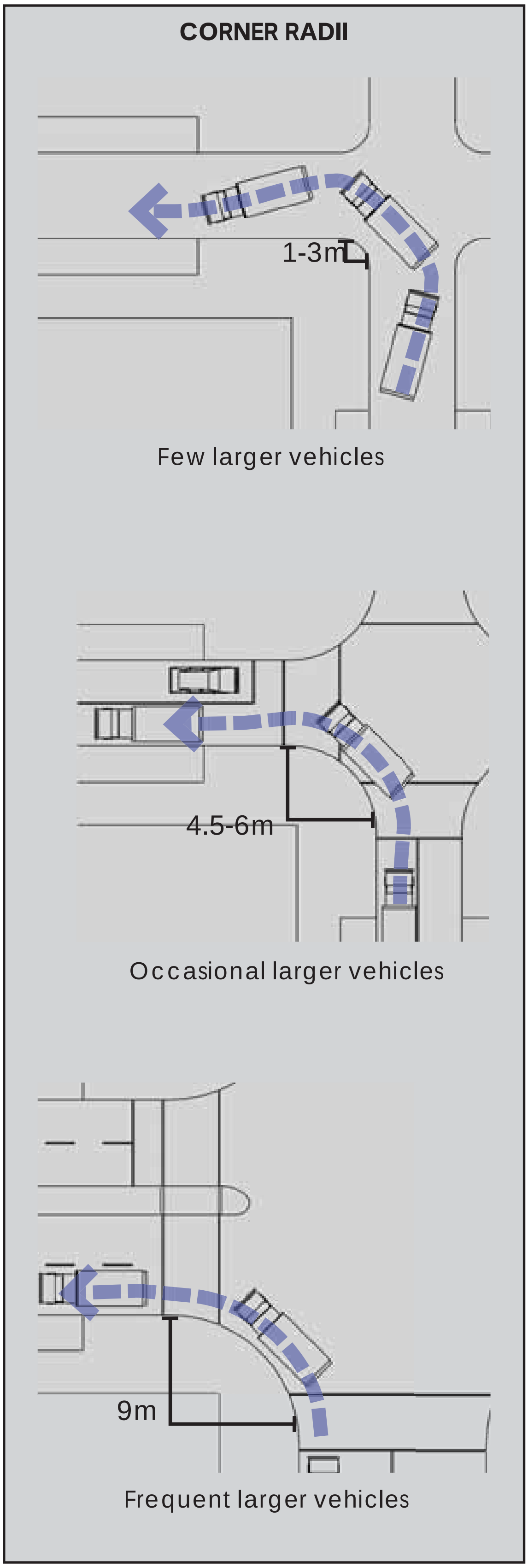


Figure 4.43: Approaches minimising corner radii according to level of service by larger vehicles.

- Apply setback vehicular stop Lines at signalised junctions to allow turning vehicles to cross the centre line of the intersecting street without conflicting with oncoming movements (see Figure 4.45 and Section 4.4.2 of the *National Cycle Manual* (2011)).

- Designers should also consider the use of setback stop lines on Arterial and Links streets within centres to further reduce corner radii.

- Keeping corners clear of obstacles (or removing obstacles such as guardrails) to allow emergency vehicle overrun.

Figure 4.45: Setback stop lines allow for additional vehicular manoeuvrability for larger vehicles at signalised junctions without the need for larger corner radii.

4.3.4 Pedestrianised and Shared Surfaces

Pedestrianised and shared surfaces are an effective way of promoting place and providing pedestrians and cyclists with a more enjoyable experience, particularly in areas of historic significance. These streets operate as linear 'squares' or corridors of public open space.

Pedestrianised streets fully segregate pedestrians and cyclists from motor vehicular movement (although emergency access is possible and limited access may also be provided for service vehicles). They are generally only appropriate in areas where higher levels of activity can be sustained throughout the day and into the evening period, as the removal of vehicular traffic will reduce surveillance levels. They are best suited to the *Centres* around areas of retail, commercial and cultural activity (see Figure 4.46).

Shared surface streets and junctions are integrated spaces where pedestrians, cyclists and vehicles share the main carriageway. This may include streets where the entire street reserve is shared (see Figure 4.47) or where designated sections may provide for pedestrians and/or cyclists use only with a shared surface carriageway along part of the street (see Figure 4.48). Shared surface streets may also periodically transfer from pedestrian only spaces to shared spaces at different times of the day (as per Figure 4.47).

Shared surface streets and junctions are particularly effective at calming traffic. Research has found that shared carriageways perform well in terms of safety and there is also evidence to suggest that well designed schemes in appropriate settings can bring benefits in terms of visual amenity, economic performance and perceptions of personal safety.[28]

Shared surface streets and junctions are highly desirable where:

- Movement priorities are low and there is a high place value in promoting more livable streets (i.e. homezones), such as on *Local* streets within *Neighbourhood* and *Suburbs*.

Figure 4.46: Fully pedestrianised street within a Centre. Activity is sustained by a mix of retail, commercial and cultural activities.

Figure 4.47: Street in Waterford City Centre which changes from a pedestrianised space to a shared surface area at different times of the day.

Figure 4.48: Exhibition Road, London, an example where distinct zones that delineate pedestrian only space from shared space have been created (image source architects).

28 Refer to UK Department for Transport *Shared Space Project Stage 1: Appraisal of Shared Space* (2009).

- Pedestrian activities are high and vehicle movements are only required for lower-level access or circulatory purposes. This include streets within *Centres* where a shared surface may be preferable over full pedestrianisation to ensure sufficient activity occurs during the daytime and the evening period.

The application of shared surfaces may also be desirable on a wide variety of streets and junctions. The implementation of shared surfaces in the UK and internationally has evolved from lightly-trafficked areas to include heavily-trafficked streets and junctions (as per Figure 4.48 and Figure 4.49). Where designers consider the use of shared surfaces on more heavily-trafficked routes the location must be the subject of a rigorous analysis that assesses the suitability of a street for such purposes.

The key condition for the design of any shared surface is that drivers, upon entering the street, recognise that they are in a shared space and react by driving very slowly (i.e. 20km/h or less). To ensure this, designers should:

- Use a variety of materials and finishes that indicate that the carriageway is an extension of the pedestrian domain (such as paving: see Section 4.2.6 - Materials and Finishes).
- Avoid raised kerb lines. Any kerb line should be fully embedded within the street surface (see Section 4.4.8 Kerbs).
- Minimise the width of the vehicular carriageway and/or corner radii (see Sections 4.3.3 Corner Radii and 4.4.1 Carriageway Widths).

Shared surface streets can be very intimidating for impaired users. Visually-impaired users in particular usually rely on kerb lines to navigate streets. To assist navigation and movement through shared spaces, designers should apply design measures such as:

- Sections of tactile paving that direct movement along the street or across spaces (see Figure 4.50).
- The creation of distinct zones that delineate pedestrian only space from shared space (as per Figure 4.48).
- Flush kerbs, drainage lines and/or sections of tactile paving to assist guide dogs and indicate movement from a pedestrian only space to a shared carriageway (see Section 4.4.8 Kerbs).

Figure 4.49: Shared surface junction in Ashford, Kent, UK, carries significant amounts of traffic and challenged conventions regarding traffic volumes along shared surfaces. An informal zebra crossing has also been marked adjacent to the junction to provide a place for less confident pedestrians to cross.

- Verges that act as refuge zones allowing pedestrians to step on and off the carriageway to let cars pass (see Figure 4.51).

Further information regarding the design and application of Shared Surfaces may also be sought from the UK Department for Transport *Local Transport Note 1/11* and supporting research volumes.[29]

Figure 4.50: Examples from Cork city of the use of tactile paving that assist the visually impaired by guiding movement across a shared space.

Figure 4.51: Examples from Adamstown, Co. Dublin, where a verge is provided as refuge that pedestrians can hop on and hop off as cars slowly pass.

29 Refer to *Designing the Future: Shared Space: Qualitative Research* (2010).

4.3.5 Cycle Facilities

This Manual and the *National Cycle Manual* (2011) (NCM) promote cycling as a sustainable form of transport and seek to rebalance design priorities to promote a safer and more comfortable environment for cyclists. To achieve these goals, the NCM recognises the importance of slowing vehicular traffic within cites, towns and villages, and advocates many of the measures contained within this Manual, such as narrower vehicular carriageways and tighter corner radii.

The principle source for guidance on the design of cycle facilities is the NCM published by the National Transport Authority. The NCM provides designers with a comprehensive set of design measures aimed at achieving an overall quality of service that is appropriate to user needs.

Figure 4.52, from the NCM, provides an overview of the integration and segregation of cycle traffic within the carriageway based on vehicle speeds and traffic volumes. For example:

- On lightly-trafficked/low-speed streets, designers are generally directed to create *Shared Streets* where cyclists and motor vehicles share the carriageway
- On busier/moderate speed streets, designers are generally directed to apply separate cycle lanes/cycle tracks.

Designers must also have regard to the measures contained within this Manual when applying the NCM. For example:

- To minimise the width of vehicular carriageways from kerb to kerb, preference should be given to the implementation of *Raised Cycle Lanes* or *Raised Cycle Tracks* over those design solutions where cyclists and vehicles are at grade.

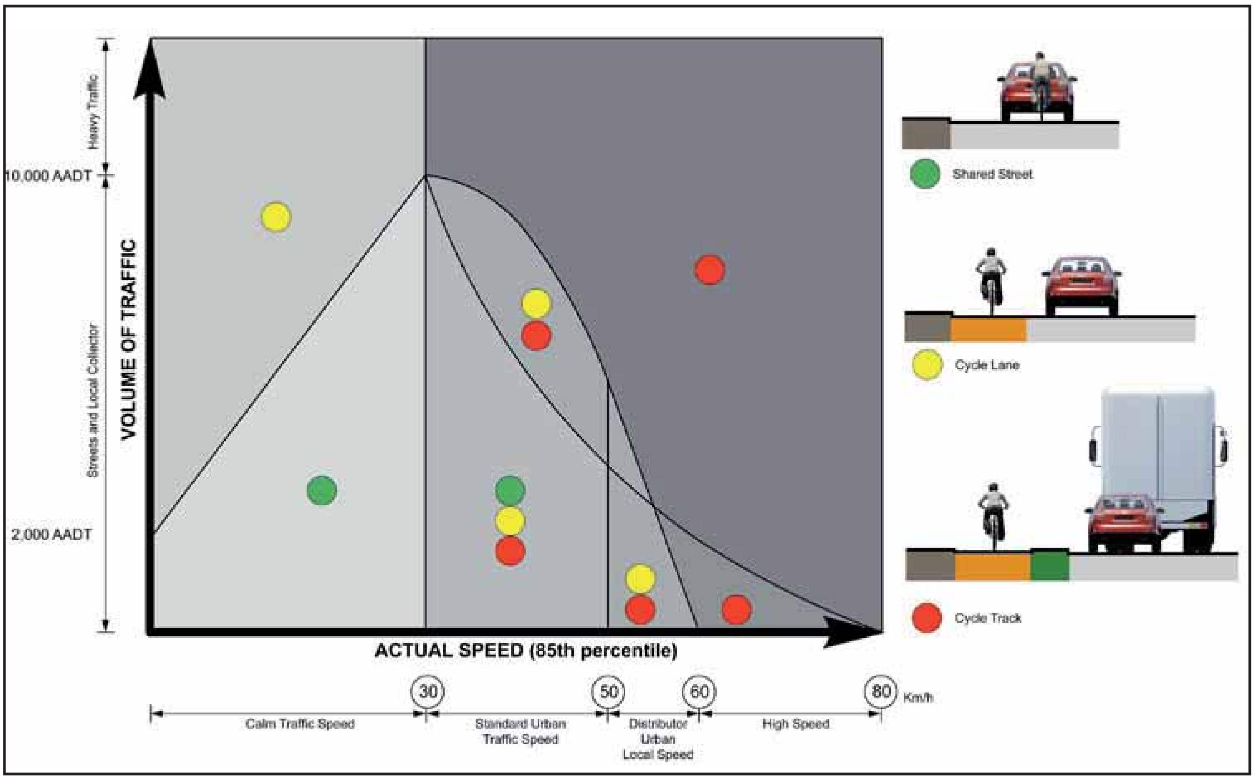


Figure 4.52: Extract from the National Cycle Manual (2011) which illustrates the appropriate use of integrated or segregated cycle facilities according to the volume and speed of traffic.

- Cycle facilities on most streets within *Centres*, *Neighbourhoods* and *Suburbs* will need to be integrated with on-street parking. Pages 138-139 and 149 of the NCM illustrate how this can be achieved with Cycle Lanes. Figures 4.53 and 4.54 illustrate this with regard to a Cycle Track.

- To reduce clutter, the use of hatching, bollards and signage associated with cycle facilities should be minimised within areas with a higher place value such as *Centres*, *Neighbourhoods* and *Suburbs*. A similar logic may be applied in respect of the requirements for signage and line marking within the NCM as with the application of the *Traffic Signs Manual* (2010), refer Section 4.2.4 Signage and Line Marking.

The NCM also makes several references to the *Traffic Management Guidelines* (2003). As the *Traffic Management Guidelines* precede this Manual many of these references may no longer be relevant and designers should refer to the corresponding principles, methods and standards contained within this Manual.[30]

30 For comparison between the road classification system used within the *National Cycle Manual (2011)* and *Traffic Management Guidelines (2003)* designers should refer to Table 3.1.

Figure 4.53: Example of a narrow verge between a cycle track and on-street parking. This verge provides a buffer that protects cyclists from opening doors.

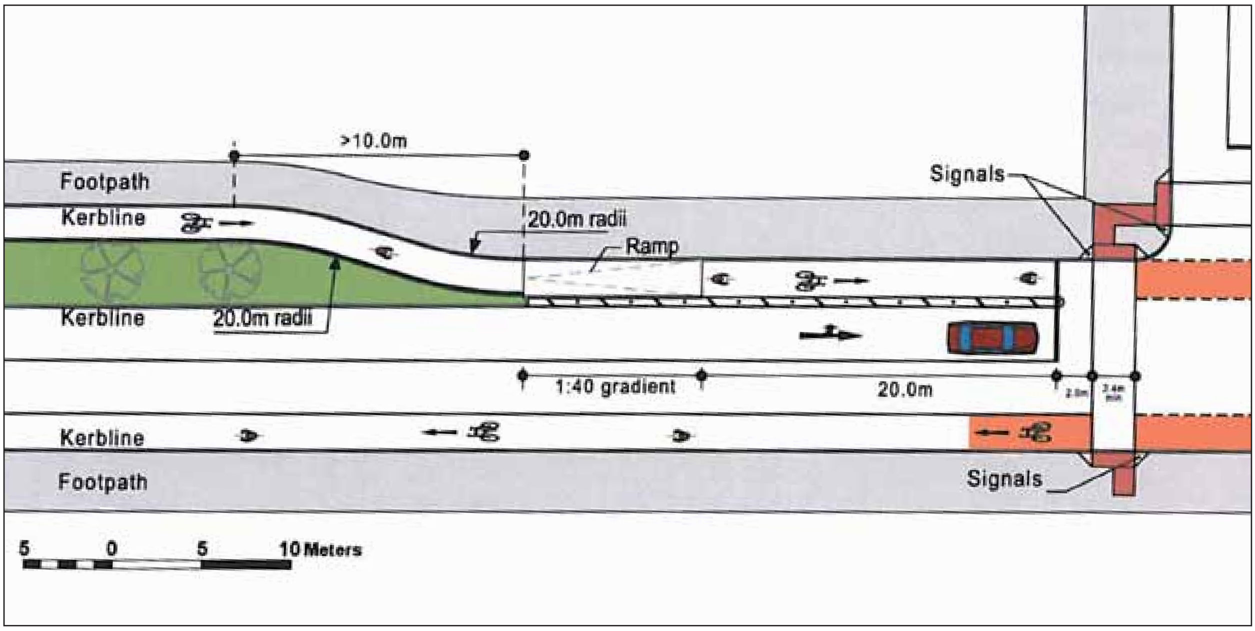


Figure 4.54: Extract from page 86 of the National Cycle Manual illustrating how to re-establish from an Off Road Cycle Track to Cycle Lane on approach to a junction. This design can be adapted to cater for on-street parking by placing spaces within the green area or verge between the vehicular carriageway and Cycle Track.

4.4 Carriageway Conditions

4.4.1 Carriageway Widths

Research from the UK has found that narrow carriageways are one of the most effective design measures that calm traffic.[31] The width of the vehicular carriageway is measured from kerb to kerb or from the outside line of a Cycle Lane or from the edges of parking spaces (where the latter facilities are provided).

Designers should minimise the width of the carriageway by incorporating only as many lanes as needed to cater for projected vehicle flows and by reducing the size of individual lanes to meet predominant user needs (see Figure 4.55). In this regard:

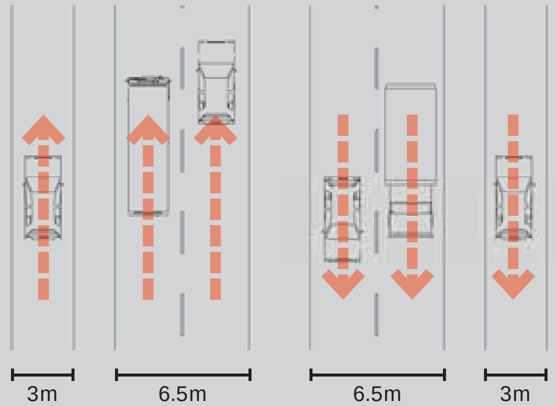
- The standard lane width on *Arterial* and *Link* Streets should be 3.25m.
- Lane widths may be increased to 3.5m on *Arterial* and *Link* streets where frequent access for larger vehicles is required, there is no median and the total carriageway width does not exceed 7m.
- Lane widths may be reduced to 3m on those *Arterial* and *Link* streets where lower design speeds are being applied, such as in *Centres* and where access for larger vehicles is only occasionally required.
- The standard carriageway width on *Local* streets should be between 5-5.5m (i.e. with lane widths of 2.5-2.75m).
- Where additional space on *Local* streets is needed to accommodate additional manoeuvrability for vehicles entering/leaving perpendicular parking spaces, this should be provided within the parking bay and not on the vehicle carriageway (see Section 4.4.9 On-Street Parking and Loading).
- The total carriageway width on *Local* streets where a shared surface is provided should not exceed 4.8m.

On heavily-trafficked *Arterial* and *Link* streets with multiple lanes (see Section 3.4.5 Noise and Air Pollution) in urban areas designers should consider the street as *Boulevard* with a median that is no less than 2m wide to provide areas of pedestrian refuge and allow for the planting of large trees.

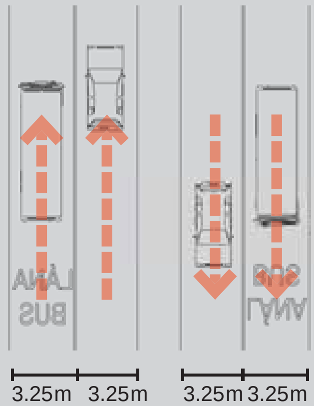
When carrying out upgrades, or traffic-calming works on existing streets, the first priority of authorities should be to narrow existing carriageways where they exceed those standards listed above. This will not only calm traffic, but will free up additional space within the street reserve to widen footpaths, insert cycle lane/tracks, provide bus lanes, street trees and on-street parking (all of which will further contribute to traffic calming).

31 Refer to Figure 7.16 of *UK Manual for Streets* (2007).

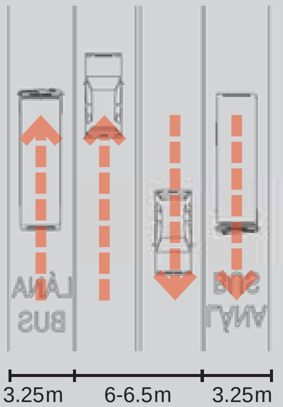
FIGURE 4.55: CARRIAGEWAY WIDTHS
(note: Illustrations do not include cycle facilities)



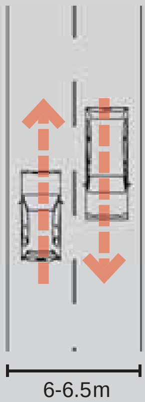
Carriageway widths for heavily-trafficked *Arterial* and *Link* streets in boulevard configuration. Main carriageway suitable for moderate design speeds. Includes access lanes with a lower design speed.



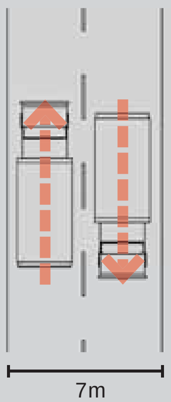
Standard lanes widths for multi lane carriageway for *Arterial* and *Link* streets in boulevard configuration, including bus lanes.



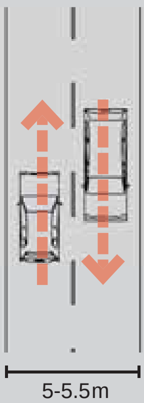
Standard lane/carriageway widths for multi lane *Arterial* and *Link* streets, including bus lanes. Range for low to moderate design speeds.



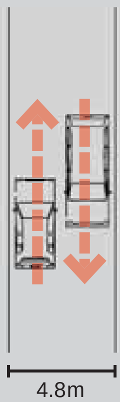
Standard carriageway widths for *Arterial* and *Link* streets. Range for low to moderate design speeds.



Carriageway width for *Arterial* and *Link* streets frequently used by larger vehicles.



Standard carriageway width for *Local* streets



Carriageway width for *Local* streets with a shared surface carriageway.

4.4.2 Carriageway Surfaces

The material, texture and colour of the carriageway are important tools for informing drivers of driving conditions. Research has found that the use of robust surface materials (such as block paving) can reduce vehicle speeds by 4-7 km/h alone.[32] The use of paving, imprinted or looser materials (combined with no kerbing, see Section 4.4.8 Kerbs) is one of the clearest ways of reinforcing a low-speed environment and of signalling to all users that a the main carriageway is to be shared (see Figure 4.56). The use of such surfaces also adds value to place, particularly in historic settings.

With regard of surface types:

- The use of standard materials, such as macadam/asphalt should generally be confined to streets with moderate design speeds (i.e. 40-50km/h).
- Where lower design speeds (i.e. 30km/h or less) are desirable changes in the colour and/or texture of the carriageway should be used, either periodically (30km/h) or for the full length of the street (below 30km/h).

The use of robust finishes may also be used, on all streets, for the full carriageway where large numbers of pedestrians congregate. Such treatments should be considered in *Centres* (i.e. along shopping streets), in all urban areas around *Focal Points* and adjacent to schools, squares, parks and other areas where vulnerable pedestrians are present (see Figure 4.57).

Designers should also consider the use of at-grade material changes (up to 25mm in height) such as at crossings, particularly on streets with more moderate speeds and where the aim is not to require large reductions in speed but to alert drivers of a change in driving conditions ahead (see Figure 4.58).

Figure 4.56: Example from Adamstown, Co. Dublin of a shared surface 'homezone' adjacent to a school. Paving materials, combined with embedded kerbs encourage a low speed shared environment.

Figure 4.57: Example from Chapelizod, Co. Dublin, where the carriageway has been paved adjacent to a square in a village centre to add value to place and calm traffic in an area of higher pedestrian activity.

Figure 4.58: Examples from Tallaght, Co. Dublin of a robust surface material (including a slight vertical deflection) designed to add value to place and increase pedestrian safety by alerting/slowing vehicles on approach to the crossing.

32 Refer to Section 7.2.15 of the UK *Manual for Streets* (2007).

4.4.3 Junction Design

Junction design is largely determined by volumes of traffic. As noted in Section 3.4.2 Traffic Congestion, the design of junctions has traditionally prioritised motor vehicle movement. Designers must take a more balanced approach to junction design in order to meet the objectives of *Smarter Travel* (2009) and this Manual. In general designers should:

- Provide crossings on all arms of a junction.
- Reduce kerb radii, thereby reducing crossing distances for pedestrians and slowing turning vehicles (see Section 4.3.3 Corner Radii).
- Omit left turn slips, which generally provide little extra effective vehicular capacity but are highly disruptive for pedestrians and cyclists. Where demand warrants, they may be replaced with left tuning lanes with tighter corner radii (see Figure 4.59).
- Omit staggered crossings in favour of direct/single phase crossings (see Section 4.3.2 Pedestrian Crossings).
- Omit deceleration lanes. These are not required in low to moderate speed zones (i.e. up to 60km/h).
- Include pedestrian, cyclist and bus passenger delays in the optimisation of traffic signal phasing and timings. This will almost certainly lead to a reduction in cycle times.
- Minimise waiting with pedestrain cycle times of no more than 90 seconds at signalised junctions (see Section 4.3.2 Pedestrian Crossings).

Designers should also have regard to *Context* and *Function* when selecting junction types (see Figure 4.60). Junction design will also need to be considered in conjunction with crossing types and ratio of flow to capacities (see Sections 4.3.2 Pedestrian Crossings and 3.4.2 Traffic Congestion).

Figure 4.59: Left turning slips (left) generally offer little benefit in terms of junction capacity and increase the number of crossings pedestrians must navigate. They also allow vehicles to take corners at higher speeds, exposing pedestrians and cyclists to greater danger. Where a large number of turning movements occur, left turning lanes (right) with tighter corner radii should be used.

Traffic Signals

These can provide a wide range of capacities depending on the widths of the approaches, the presence of bus lanes on approach, cycle times and turning traffic flows. Traffic signal junctions can include pedestrian phases and advanced stoplines for cyclists, thus making them safer. Traffic Signals should generally be used at all junctions between *Arterial* and *Link* streets. Where pedestrian activity is particularly high (such as within a *Centre* or around a *Focal Point*), designers may apply all-round pedestrian phase crossings with diagonal crossings.

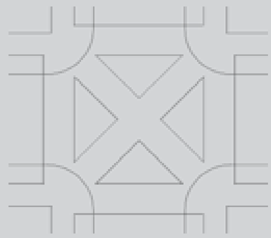
Roundabouts

These have a wide range of capacities depending on the size and geometry of the roundabout, its approaches, and turning traffic flows, but are generally lower than signalised junctions. Large roundabouts are generally not appropriate in urban areas. They require a greater land take and are difficult for pedestrians and cyclists to navigate, particularly where controlled crossings/cycle facilities are not provided, and as such, vehicles have continuous right of way.

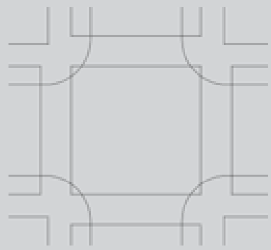
The use of large roundabouts (i.e. those with radii greater than 7.5m) should be restricted to areas with lower levels of pedestrian activity. Where large roundabouts currently exist, road authorities are encouraged, as part of any major upgrade works, to replace them with signalised junctions or retrofit them so that are more compact and/or pedestrian and cycle friendly, as is appropriate.

The use of more compact roundabouts (i.e. those with a radii of 7.5m or less) may address many of the issues highlighted above and may also be useful as a traffic-calming measure. These may be considered where vehicle flows are not sufficient to warrant full signalisation, such as on *Links*, and pedestrian activity is more moderate, such as in *Suburbs* and *Neighbourhoods*, provided they are appropriately fitted with the appropriate pedestrian crossings.

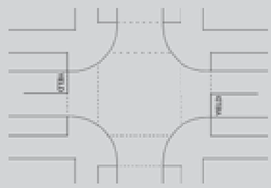
JUNCTION CONTROL



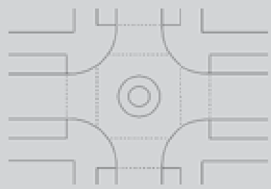
Signalised junction with all-round pedestrian phase crossing. Areas of high pedestrian and vehicular activity.



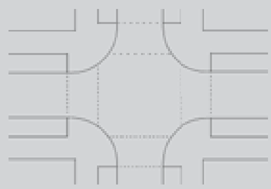
Standard Signalised Junctions. Areas of moderate pedestrian/high-moderate vehicular activity.



Priority Junction. Areas of lower/moderate pedestrian and vehicular activity.



Mini or shared roundabouts with informal crossings. Areas of low pedestrian activity.



Uncontrolled Junctions. Areas of lower/moderate pedestrian and vehicular activity.

Figure 4.60: General junction selection based on the optimising pedestrian and cyclist movement whilst also balancing the needs of motor vehicle users.

Section 4.8 of the *National Cycle Manual* (2011) also contains further guidance on the design and use of roundabouts to make them more pedestrian and cycle friendly. With regard to the application of these models.

- Where compact roundabouts are proposed, designers may apply the *Mini* or *Shared* roundabout models.
- The use of large roundabouts, such as the *Segregated Track on Roundabout* or *Fully Segregated Roundabout,* should be restricted to areas where pedestrian activity is low (as noted above). The application of these models may be acceptable where it is proposed to retrofit an existing roundabout to make it more pedestrian and cycle friendly.

Designers may also consider the use of shared space/informal roundabouts within low speed environments, such as *Centres*. These junctions incorporate the design characteristics of a shared space junction (i.e. no kerbs, paved surfaces etc) with circular features placed at the centre and edges. Examples of roundabout type features (sometimes referred to as 'roundels') have been successfully implemented in the UK on heavily trafficked junctions with the effect of enhancing place, calming traffic and increasing cyclist/pedestrian mobility (see Figure 4.61).


Figure 4.61: Examples from Ashford, UK (top) and Poynton, UK (bottom). The placement of a circular features with the shared space/traffic calmed environment creates an informal roundabout with fewer restrictions pedestrian/cyclist movement when compared to more conventional types (image sources: Hamilton-Baillie Associates and Ashford Borough Council).

Priority Junctions (i.e. Stop and Yield junctions).

These generally have low capacity and are appropriate for low to medium flows. They should generally be applied where *Local* streets meet *Arterial* or *Link* streets.

Uncontrolled Junctions

These generally have low capacity and rely on informal communication between drivers. They should generally be used where vehicle flows are low, such as those between *Local* streets. Designers may also consider the use of shared space junctions at busier junctions within low speed environments, such as *Centres*. There are also examples of uncontrolled shared space junctions which cater for higher flows without signalisation (see Figure 4.62 and Section 4.3.4 Pedestrianised and Shared Surface Streets).

Figure 4.62: Example from Coventry, UK of a shared surface uncontrolled junction. The level of traffic using the junction would normally warrant some form of control, however, its traffic calmed nature allows for drivers to communicate with each other and pedestrians to establish movement priorities (image source: Hamilton-Baillie Associates).

4.4.4 Forward Visibility

Forward Visibility, also referred to as Forward Sight Distance (FSD), is the distance along the street ahead which a driver of a vehicle can see. The results of research carried out by Transport Research Laboratory UK (TRL) for the UK *Manual for Streets* (2007) found that reducing forward visibility is one of the most effective measures used to increase driver caution and to reduce speeds.[33]

The minimum level of forward visibility required along a street for a driver to stop safely, should an object enter its path, is based on the Stopping Sight Distances (SSD). The SSD has 3 constituent parts:

- Perception Distance: The distance travelled before the driver perceives a hazard.
- Reaction Distance: The distance travelled following the perception of a hazard until the driver applies the brakes.
- Braking Distance: The distance travelled until the vehicle decelerates to a halt.

The perception and reaction distances are generally taken as a single parameter based on a combined perception and reaction time. The formula for the calculation of SSD is:

SSD = vt + v2/2d

Where:

v = vehicle speed (m/s)
t = driver perception-reaction time (s)
d = deceleration rate (m/s2)

SSDs have generally been applied according to those contained within the NRA DMRB TD 9 which where derived from the UK DMRB Manual of the same name using a perception reaction time of 2 seconds, and a deceleration rate of 0.25g, or 2.45 m/s2. TRL found these SSD values to be overly conservative as they underestimated driver reaction times, deceleration rates and did not take into account actual road design details.[34] Based on this research, a driver perception-reaction time of 1.5 seconds, and a deceleration rate of 0.45g, or 4.41 m/s, should be applied with design speeds of 60 km/h and below. For larger vehicles such as HGVs and buses, a deceleration rate of 0.375g, or 3.68 m/s should be applied.

A revised set of reduced SSDs, based on the parameters included in the UK *Manual for Streets* (2007), are presented in Table 4.2. The reduced SSDs should be applied according to the design speed of a street (see Section 4.1.1 A Balanced Approach to Speed) at junctions and along the alignment of a street (see Sections 4.4.5 Visibility Splays and 4.4.6 Alignment and Curvature, respectively).

33 Refer to Section 7.4.4 of UK *Manual for Streets* (2007) and *UK Manual for Streets: Redefining Residential Street Design* (2006).

34 Refer to *Manual for Streets: Evidence and Research (TRL Report 661)* (2007).

SSD STANDARDS

Design Speed (km/h)	SSD Standard (metres)
10	7
20	14
30	23
40	33
50	45
60	59

Forward Visibility

Design Speed (km/h)	SSD Standard (metres)
10	8
20	15
30	24
40	36
50	49
60	65

Forward Visibility on Bus Routes

Table 4.2: Reduced SSD standards for application within cities towns and villages. Reduced forward visibility increases driver caution and reduces vehicle speeds.

4.4.5 Visibility Splays

Visibility splays are included at junctions to provide sight lines along the intersected street to ensure that drivers have sufficient reaction time should a vehicle enter their path. Visibility splays are applied to priority junctions where drivers must use their own judgement as to when it is safe to enter the junction. Junction visibility splays are composed of two elements; the X distance and the Y distance.

- The X distance is the distance along the minor arm from which visibility is measured. It is normally measured from the continuation of the line of the nearside edge of the major arm, including all hard strips or shoulders.
- The Y distance is the distance a driver exiting from the minor road can see to the left and right along the major arm. It is normally measured from the nearside kerb or edge of roadway where no kerb is provided.

The procedure for checking visibility splays at junctions is illustrated in Figure 4.63. An additional check is made by drawing an additional sight line tangential to the kerb, or edge of roadway, to ensure that an approaching vehicle is visible over the entire Y distance.

Longer X distances allow drivers more time to observe traffic on the intersected arm and to identify gaps more readily, possibly before the vehicle comes to a stop, thus allowing increased vehicle speeds through junctions. Furthermore, a longer X distance may encourage more than one vehicle on the minor arm to accept the same gap even where it is not ideal that they do so. Neither circumstance is desirable in urban areas. The attention of a driver should not solely be focused on approaching vehicles and the acceptance of gaps. The pedestrian/ vulnerable road users should be higher in the movement hierarchy

For this reason, priority junctions in urban areas should be designed as Stop junctions, and a maximum X distance of 2.4 metres should be used. In difficult circumstances this may be reduced to 2.0 metres where vehicle speeds are slow and flows on the minor arm are low. However, the use of a 2.0 metre X distance may result in some vehicles slightly protruding beyond the major carriageway edge, and may result in drivers tending to nose out cautiously into traffic. Care should be taken to ensure that cyclists and drivers can observe this overhang from a reasonable distance and manoeuvre to avoid it without undue difficulty.

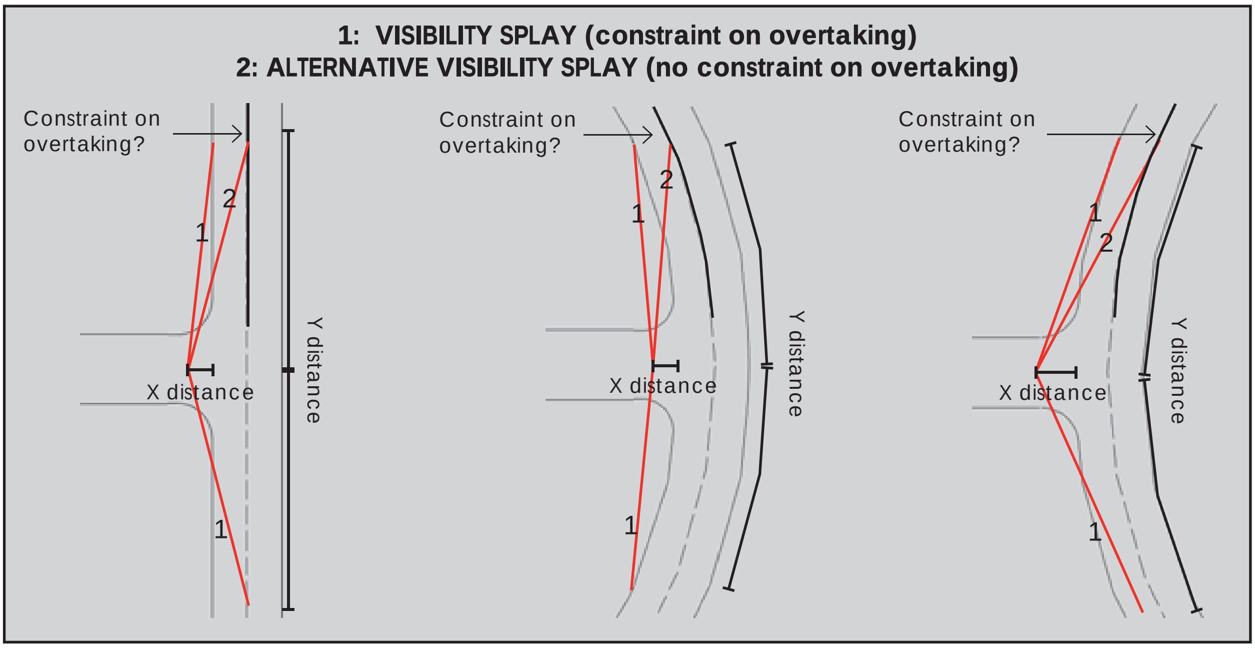


Figure 4.63: Forward visibility splays refer to an X and Y value. The X value allows drivers to observe traffic on the intersected arm. The Y value allows the driver of a vehicle to stop safely should an object enter its path, and is based on the SSD value.

The Y distance along the visibility splay should correspond to the SSD for the design speed of the major arm, taken from Table 4.2 while also making adjustments for those streets which are frequented by larger vehicles. For example, within *Industrial Estates* and/or on *Arterial* and *Link* streets with higher frequency bus routes.

In general, junction visibility splays should be kept clear of obstructions, however, objects that would not be large enough to wholly obscure a vehicle, pedestrian or cyclist may be acceptable providing their impact on the overall visibility envelope is not significant.

Slim objects such as signs, public lighting columns and street trees may be provided, but designers should be aware of their cumulative impact.

- Street furniture, such as seats and bicycle stands may also be acceptable, subject to being sufficiently spaced.
- Splays should generally be kept free of on-street parking, but flexibility can be shown on lower speed streets with regard to minor encroachments.
- Pedestrian guardrails can cause severe obstruction of visibility envelopes, and the use of guardrails should be avoided (see Section 4.2.5 Street Furniture).

Designers should also check the visibility envelop in the vertical plane on approach to junctions (see Section 4.4.6 Alignment and Curvature, Figure 4.67)

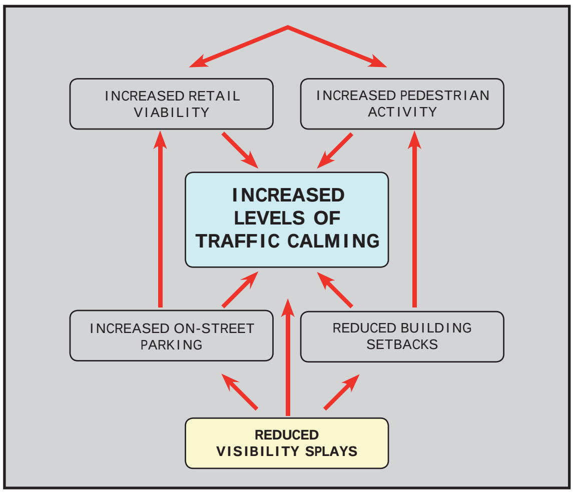


Figure 4.64: Flow diagram showing the inter-linked traffic calming and place making benefits of reduced visibility splays.

Designers may have concerns about reducing visibility splays at junctions that carry higher volumes of traffic at more moderate speeds. This issue was addressed further in respect of research carried for the UK *Manual for Streets 2* (2010). This included 'busy radial roads', many of which included bus routes within a variety of 20, 30 and 40 mph environments.[35] The research concluded that there is no evidence that reduced SSDs are directly associated with increased collision risk, as shown on a variety of street types at a variety of speeds. The *Manual for Streets 2* (2010) also refers to research where it was found that higher cycle collision rates occurred at T-Junctions with greater visibility.[36] The research concluded that this was because drivers were less cautious where greater visibility was provided.

Designers must also take a holistic view of the application of reduced forward visibility splays. As illustrated in the *Adamstown Street Design Guide* (2010), there are other place making and traffic calming benefits that can be implemented by reducing forward visibility splays at junctions (see Figure 4.64).

35 Refer to 10.4 of *UK Manual for Streets 2* (2010) and the report *High Risk Collision Sites and Y Distance Visibility* (2010).
36 Refer to *Layout and Design Factors Affecting Cycle Safety at T-Junctions* (1992).

4.4.6 Alignment and Curvature

Changes in the alignment of roads and streets are generally referred to in the horizontal and vertical sense. When these changes occur, the FSD, is reduced and, as noted above, this is one of the most effective measures used to increase driver caution and calm traffic (see Figure 4.65).

Horizontal Alignment

The horizontal alignment of a street consists of straight sections and curves. Whilst changes to the horizontal alignment calms traffic, this needs to be balanced with safety concerns. To prevent abrupt changes in direction minimum FSD required along a street should correspond to the minimum SSD appropriate to the design speed. FSD is checked at horizontal curves by measuring between points on the curve along the centreline of the inner lane (see Figure 4.66).

Frequent changes to the horizontal alignment should also be balanced with permeability and legibility. Overuse of changes in the direction of streets may disorientate pedestrians and increase walking distances between destinations. In this regard:

- Designers should avoid major changes in the alignment of *Arterial* and *Link* streets as these routes will generally need to be directional in order to efficiently link destinations.
- Major changes in horizontal alignment of Arterial and Link streets should be restricted to where required in response to the topography or constraints of a site.
- There is greater scope to use changes in horizontal alignment on *Local* streets to promote lower speeds and a more intimate sense of place (see Section 4.4.7 Horizontal and Vertical Deflections)
- Designers should not rely on curvature alone to reduce vehicle speeds. Changes in horizontal alignment should be combined with contextual measures that reduce forward visibility, such as building lines and on-street parking.

Figure 4.65: Example from Clongriffin, Co. Dublin where a change in the alignment of the street calms traffic as drivers proceed cautiously due to the uncertainly of what lay ahead (image source: Google Street View).

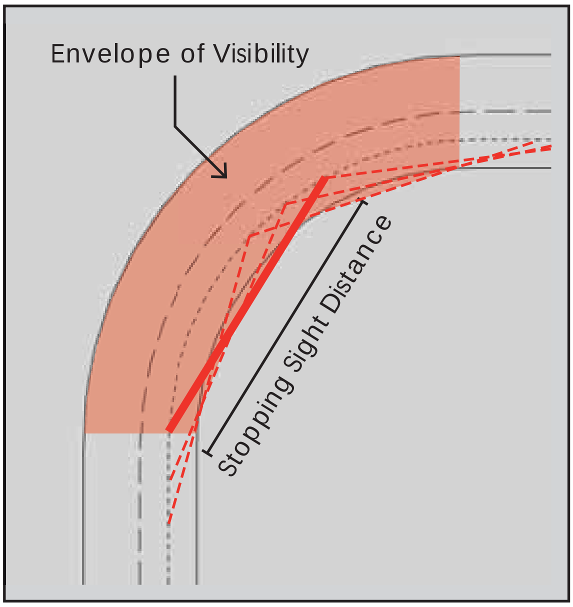


Figure 4.66: Forward visibility at horizontal curves need to take account of SSD values

Horizontal Curvature

At a horizontal curve, the centrifugal force a vehicle travelling around that curve is generally counteracted by a combination of 2 factors: friction between the tyres and the road surface, and superelevation of the carriageway, where the carriageway is constructed such that the outside carriageway edge is higher than the inside carriageway edge. Traditionally, the design approach has been to combine these factors to ensure that a vehicle can travel around a bend without reducing speed or without causing significant discomfort to the occupants of the vehicle. Where a horizontal alignment along a street requires changes in direction, the curves between straight sections should have radii in accordance with Table 4.3.

Crossfall

Designers should also consider superelevation where one side of the road is designed to be higher than the other in order to resist the centrifugal effect of turning a corner. As the aim of superelevation is to assist drivers to maintain higher speeds around curves, its use is inappropriate where the design is intended to achieve a moderate or low speed environment. As also noted in the *Manual for Streets 2* (2010), superelevation is also difficult to implement in urban areas with frequent junctions and points of access.[37]

However a crossfall of 2.5% is generally provided on carriageways to assist in drainage, which would tend to result in adverse camber at horizontal curves. Consequently, in order to assist in achieving lower vehicle speeds through a more restrictive horizontal alignment, there is a need to provide sharper horizontal curves that do not have the benefit of high levels of superelevation to counteract the centrifugal force. Designers should refer to Table 4.3 for minimum radius with adverse camber of 2.5%.

Where the introduction of radii less than those for minimum radius with adverse camber of 2.5% is unavoidable, a reasonable level of superelevation may be introduced to eliminate adverse camber and introduce a favourable crossfall. Minimum curve radii for a superelevation rate of 2.5% are also presented in Table 4.3, and may be used in such circumstances.

HORIZONTAL CURVATURE

Design Speed (km/h)	**10**	**20**	**30**	**40**	**50**	**60**
Minimum Radius with adverse camber of 2.5%	-	11	26	56	104	178
Minimum Radius with superelevation of 2.5 %	-	-	-	46	82	136

VERTICAL CURVATURE

Design Speed (km/h)	**10**	**20**	**30**	**40**	**50**	**60**
Crest Curve K Value	N/A	N/A	N/A	2.6	4.7	8.2
Sag Curve K Value	N/A	N/A	2.3	4.1	6.4	9.2

Table 4.3: Carriageway geometry parameters for horizontal and vertical curvature.

Vertical Alignment

A vertical alignment consists of a series of straight-line gradients that are connected by curves, usually parabolic curves. Vertical alignment is less of an issue on urban streets that carry traffic at moderate design speeds and changes in vertical alignment should be considered at the network level as a response to the topography of a site.

The required envelope of forward visibility in the vertical plane is illustrated in Figure 4.67 below. The envelope should encompass the area between a driver eye height in the range of 1.05 metres to 2.00 metres, and an object height in the range of 0.6 metres to 2.00 metres

Vertical Curvature

Where changes in gradient are required along an alignment, vertical curves are introduced, such that the appropriate SSDs are achieved, and an adequate level of driver comfort is provided. Ordinarily in urban areas where it can be expected that vehicle speeds will reduce in response to changes in alignment, it will be sufficient to design vertical curves such that the minimum SSD is provided.

Vertical curves can take the form of Crest or Sag curves, the length of a vertical curve, L, is the critical design parameter, and is determined by multiplying the K Values set out in Table 4.3 by the algebraic change of gradient expressed as a percentage, that is:

$$L = Ka$$

Where:

K = The constant of curvature
a = The algebraic change in gradient.

Vertical Crest Curve Design

At crest curves visibility can be obstructed by the road surface itself. Crest curve, accordingly, should be designed such that the curvature is sufficient to maintain an adequate FSD and SSD for a driver. In urban areas, where vehicle speeds are low and gradients are generally modest, the design of vertical crest curves can be simplified as follows:

- For very low design speeds (i.e. less than 40 km/h), and where the algebraic difference in gradient between straight sections is less than 12%, it will generally not be necessary to specifically design a vertical crest curve; however the carriageway should be shaped to avoid an abrupt change in vertical alignment.
- For design speeds of 40 km/h and above, and again where the algebraic difference in gradient is modest, up to a maximum of 12 %, it will normally be sufficient to provide a vertical curve with a length determined using the K-values presented in Table 4.3.

In exceptional circumstances where the algebraic difference in gradient exceeds these limits, it will be necessary for the designer to determine a crest curve length suitable for the circumstances from first principles.

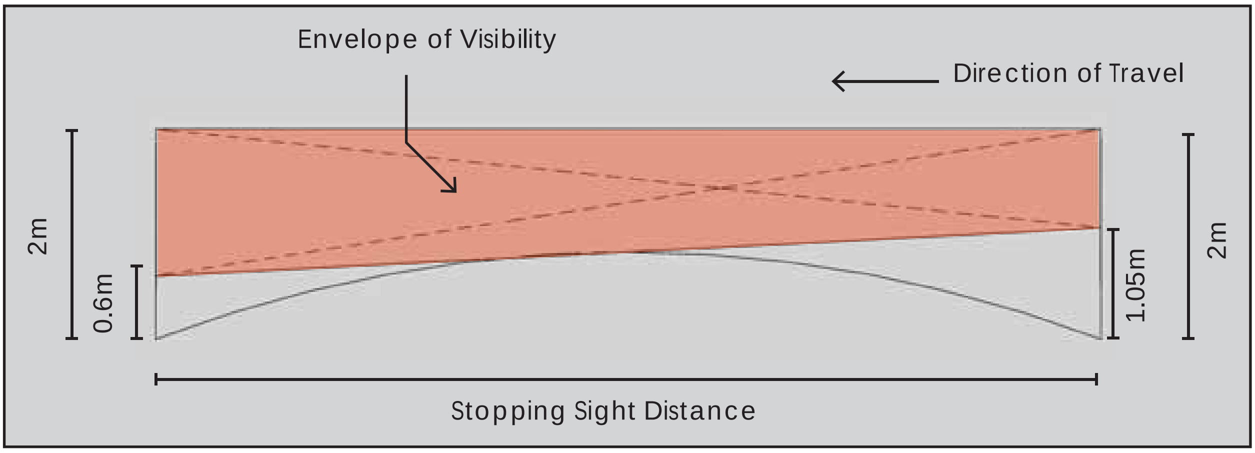


Figure 4.67: Visibility envelope in vertical plane.

Vertical Sag Curve Design

When designing vertical sag curves, there are three potential design parameters that need to be considered:

- Driver Comfort.
- Clearance from Structures.
- Night-time Conditions.

In urban areas, the obstruction of visibility due to structures (overbridges, gantries etc.) is likely to be an uncommon occurrence, and night time visibility only becomes an issue on unlit roads. Therefore the sag curve K values presented in Table 4.3 are based on the driver comfort parameter, and have been derived using a comfort criterion of 0.3m/s2 maximum vertical acceleration.

Maximum and Minimum Gradients

In urban areas, it is likely that the comfort of vulnerable road users will be the determining factor for desirable maximum longitudinal gradients on streets. Part M of the building regulations advises that access routes with a gradient of 1:20 or less are preferred. Therefore a maximum gradient of 5% is desirable on streets where pedestrians are active.

In hilly terrain, steeper gradients may be required but regard must be had to the maximum gradient that most wheelchair users can negotiate of 8.3%, although this should be limited to shorter distances A designer may need to consider mitigation measures, such as intermediate landings, to ensure that pedestrian routes are accessible. This also needs to be considered at the network level and as a response to place making.

The inclusion of streets that exceed these gradients may not be significant within a network where there are alternative routes that can be taken between destinations and where steeper gradients may in fact have placemaking benefits.

A minimum longitudinal gradient of 0.5% is desirable to maintain effective drainage on streets. Care needs to be taken at vertical curves, and in particular at sag curves, to ensure that there is provision at level points of curves to allow surface water to run off the carriageway.

4.4.7 Horizontal and Vertical Deflections

Horizontal or vertical deflections are changes that occur within the alignment of the carriageway to slow vehicles by requiring drivers to slow and navigate obstacles. Deflections include chicanes (horizontal) or ramps (vertical). The use of such physically intrusive measures is not necessary within a self-regulating street environment. Less aggressive features, such as junction offsets (see Figure 4.68), raised tables and changes to kerb lines, can be used strategically as supplementary measures which calm traffic and assist pedestrian movement by allowing them to cross at grade (see Section 4.3.2 Pedestrian Crossings).

Raised tables, or platforms, may be placed strategically throughout a network to promote lower design speeds, slow turning vehicles at junctions and enable pedestrians to cross the street at grade. Key locations where these should be considered include:

- On longer straights where there is more than 70m between junctions.[38]
- At equal priority junctions.
- At entrance treatments where Local streets meet *Arterial* and *Link* streets (see Figure 4.69).
- Outside *Focal Points* and areas of civic importance (such as schools).
- At pedestrian crossings.
- To reinforce a change between design speeds (such as at entrance treatments).

As raised tables are primarily designed to reinforce lower speed environments, their use should generally be limited to *Local* streets and/or the *Centres*. The use of raised tables more broadly across *Arterial* and *Link* streets (excluding those within *Centres*) should be limited to sections where speeds are to be lowered for a particular purpose (i.e. adjacent to *Focal Points* and/or key pedestrian crossings).

The principal aim of the designer should be to slow vehicles without causing undue discomfort. In this regard:

- An entry slope of 1:20 will allow most vehicles to cross at moderate speeds
- An entry slope of 1:15 is more appropriate for lower speeds.
- The minimum length of level section of the table should be 2m (to allow a pedestrians to cross).
- The height of a raised table should generally correspond with that of the adjoining kerb. Where buses operate the maximum height should be 75mm to reduce passenger discomfort.

38 Refer to Section 7.4.3 of the UK *Manual for Street* (2007).

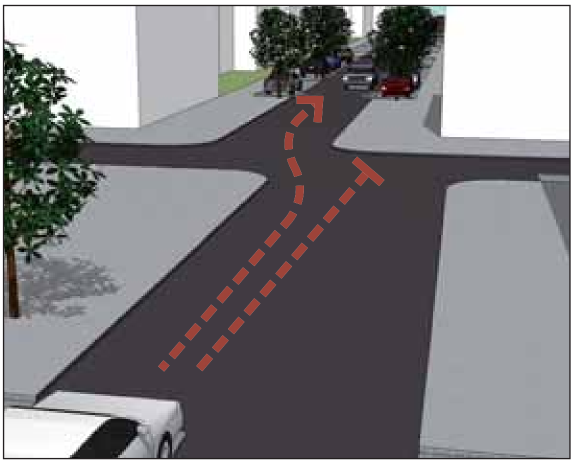


Figure 4.68: illustration of how off-setting junctions can create a change in alignment (without reducing permeability or legibility) and reduce forward visibility.

Figure 4.69: Example from Dorset Street, Dublin, where the carriageway has been raised and paved to slow turning vehicles and enhance the pedestrian crossing.

Horizontal deflections are particularly effective when considered at the network level and used in combination with restrictions in forward visibility (see Section 4.4.6 Alignment and Curvature and Figure 4.70). When deployed throughout a network on *Local* streets they can also be used to discourage through traffic (see Section 3.4.1 Vehicle Permeability). Deflections can be created by varying the kerb line/street alignment causing the carriageway to broaden and narrow and/or creating a series of directional adjustments. Car parking may also be used to similar effect (see Section 4.4.9 On-Street Parking and Loading). Other methods that may be considered at the network level include off-setting junctions to create a 3 Way Off Set Network (See Section 3.4.1 Vehicle Permeability).

Singular treatments include pinch-points that narrow the width of the carriageway over a short section of the street. These can be used in combination with raised tables at key locations on *Local* streets and/or within the *Centres* (see Figure 4.71). To be visually effective a pinch point should seek to reduce the width of the carriageway by a minimum of 0.5m for a minimum length of 6m.[39]

39 A minimum of 3.7m (3.1m at 'gateways') is required for fire vehicle access as per Table 5.2 of the *Building Regulations* 2006 (Technical Guidance Document B – Fire Safety).

Figure 4.70: Examples from Poundbury, Dorchester, UK, where changes in the kerb line and carriageway alignment calm traffic by limiting forward visibility, creating pinch points and requiring multiple changes in direction.

Figure 4.71: An example from Ingress Park, Kent, UK, of how the path and speed of a vehicle is altered within a low speed environment through the use of vertical and horizontal deflections (and material changes).

4.4.8 Kerbs

Kerbs traditionally provided a street drainage function but have more recently come to define the pedestrian domain from the vehicular carriageway. In so doing kerbs are key to establishing the level of segregation or integration which is to occur within a street. Lower kerbs, or lack thereof, can therefore create a greater sense of shared space and can be used to calm traffic. Lower kerb heights are also easier for pedestrians to negotiate, particularly for the mobility impaired.

With regard to the height of kerbs:

- The standard height for kerbs is 125mm and this provides a clear definition of a segregated street environment. These should be used on all streets where design speeds and pedestrian activity are more moderate, such as on *Arterial* and *Link* streets.

- Lower kerbs of 50-75mm or less are more appropriate in areas of higher pedestrian activity and where lower design speeds are applied, such as on all streets within the *Centres*, around *Focal Points* and on *Local* streets (see Figures 4.72 and 4.73).

- Where a shared surface is proposed a kerb should not be used. Designers may consider embedding a kerb line or drainage channel (see Figure 4.74) into the carriageway to indicate an area of pedestrian refuge. This is particularly important for visually-impaired users who feel less comfortable on shared surfaces and also require a kerb line for navigation (see Section 4.3.4 Pedestrianised and Shared Streets).

Changes to kerb lines can also be used to slow drivers at critical points by changing the alignment of the carriageway to create pinch-points, build-outs and horizontal deflections (see Section 4.4.7 Horizontal and Vertical Deflections). Build-outs should be used on approaches to junctions and pedestrian crossings in order to tighten corner radii, reinforce visibility splays and reduce crossing distances (see Sections 4.3.2 Pedestrian Crossings and 4.4.5 Visibility Splays).

Figure 4.72: Example of a low kerb from Drogheda, Co. Louth, which is used to reinforce lower design speeds and create a greater sense of shared space.

Figure 4.73: Example from Clongriffin Co. Dublin, where the footpath, kerb line and vehicular carriageway are at the same level. Whilst pedestrian and vehicular space are still clearly defined, a greater sense of shared space is still created.

Figure 4.74: Example of an drainage channel on Exhibition Road, London. The kerb line indicates an area of pedestrian refuge and is used to guide the visually impaired.

4.4.9 On-Street Parking and Loading

One of the principal objectives of this Manual is to promote the use of more sustainable forms of transport. Whilst a place-based approach to street design will reduce car dependency, as noted in the Urban Design Manual,[40] people may wish to own and park a car, even if it is not used on a regular basis. On-street parking and loading refers to spaces that are directly adjacent to and accessible from the main vehicular carriageway. On-street parking, when well designed can:

- Calm traffic by increasing driver caution, visually narrow the carriageway and reduce forward visibility.
- Add to the vitality of communities by supporting retail/commercial activities that front on to streets through the generation of pedestrian activity as people come and go from their vehicles.
- Contribute to pedestrian/cyclist comfort by providing a buffer between the vehicular carriageway and foot/cycle path.
- Reduce the need or temptation for drivers to kerb mount and block foot/cycle paths.
- Provide good levels of passive security as spaces are overlooked by buildings.

The quantity of on-street parking that is needed in a given area depends on a number of factors, but is most closely related to proximity to *Centres,* the availability of public transport and the density, type and intensity of land use. Notwithstanding these factors, on-street parking has a finite capacity, depending on the per unit parking requirements. For example in residential areas:

- On-street parking alone can generally cater for densities up to 35-40 dwellings per ha (net).
- Once densities reach 40-50 dwellings per ha (net) the street will become saturated with parking and reduced parking rates (a max of 1.5 per dwelling) and/or supplementary off-street parking will be required.
- For densities over 50 dwelling per hectare, large areas of off-street parking, such as basements, will generally be required.

Getting the balance right presents a challenge to designers. If parking is over provided it will conflict with sustainability objectives and can be visually dominant. Conversely, if parking does not cater for user needs or is under provided it may encourage poor parking practices (including illegal ones) such as kerb mounting, parking on footpaths and within areas of open space.

Whilst off-street parking may form part of a design response, the first priority of a designer should be to locate parking on-street as follows:

- On *Arterial* and *Link* streets on-street parking spaces should be provided in a series of bays that are parallel to the vehicular carriageway.
- Perpendicular or angled spaces may be provided in lower speed environments such as *Local* streets. They may be applied more generally in *Centres* to cater for increased demands around shopping areas.
- On-street parking on public streets should not be allocated to individual dwellings. This allows for a more efficient turnover of spaces and, as such, fewer spaces are needed overall.
- Loading facilities should preferably, be provided off street. However, this is not always possible or desirable within older centres and/or where it would lead to an excessive number of access points to driveways.

There are a number of measures that should be used by designers to ensure that parking and loading areas are well designed (see Figures 4.75 and 4.76):

- To reduce the visual impact of parking the number of parking spaces per bay should generally be limited to three parallel spaces (including loading areas) and six perpendicular spaces.

40 Refer to Section 11 of the *Urban Design Manual* (2010).

- Perpendicular parking should generally be restricted to one side of the street to encourage a greater sense of enclosure and ensure that parking does not dominate the streetscape.

- To reinforce narrower carriageways (particularly when spaces are empty) each parking/loading bay should be finished so that it is clearly distinguishable from the main carriageway.

- Kerb build-outs, or similar treatment, should be provided to separate each bank of parking/loading. These will enable space for the planting of street trees and other street facilities (such as lighting or bike racks).[41]

- Kerb build-outs should also be provided on the approach to junctions to facilitate visibility splays (see Section 4.4.5 - Visibility Splays), reduce corner radii (see Section 4.3.3 Corner Radii) and ensure a clear line of sight between vehicles and pedestrian crossings.

41 Refer to page 186 of the *National Cycle Manual* (2011).

Figure 4.75. Example from Ballymun, Co. Dublin (top) and Leixlip, Co. Kildare (bottom) where kerb build-outs and contrasting materials are used to separate and define bays of parking from the vehicular carriageway, reduce corner radii and facilitate planting or landscape treatments.

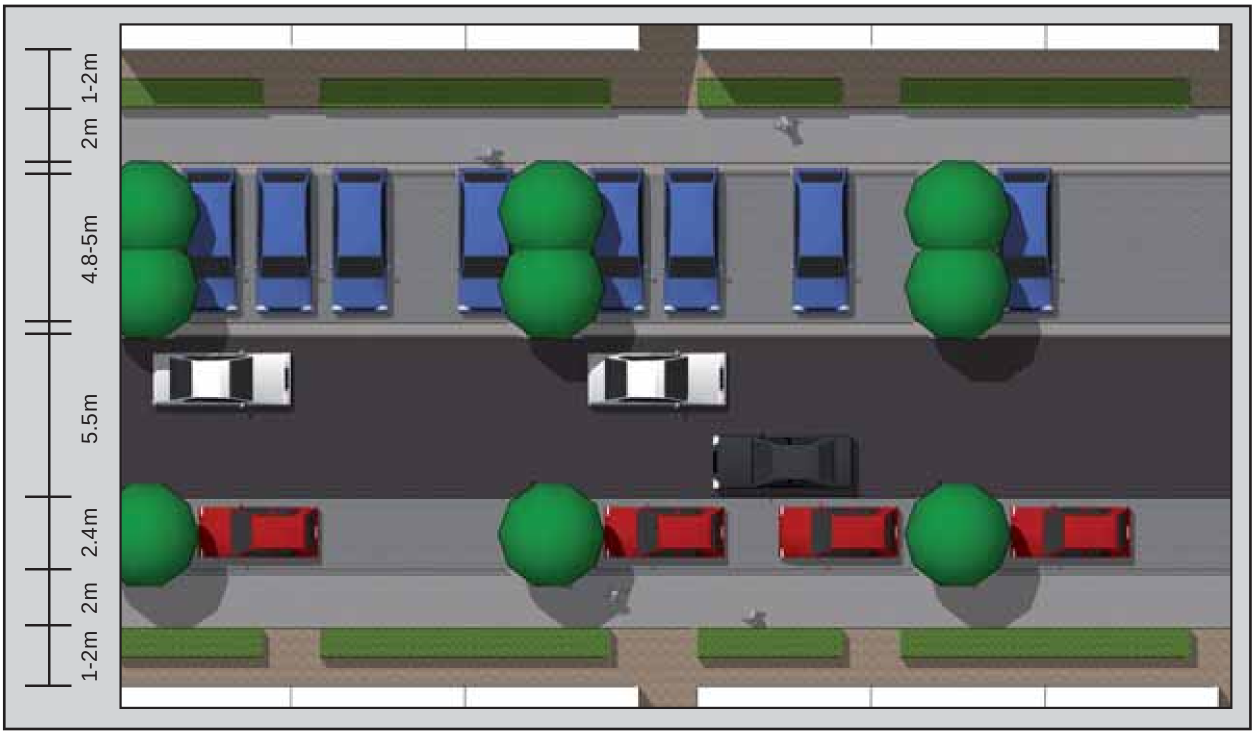


Figure 4.76: Extract from the Newcastle LAP (South Dublin County Council) illustrating the layout of a Local street with a uniform mix of parallel and perpendicular parking.

- Where on-street parking is provided adjacent to cycle paths/lanes a verge should be provided to allow additional space for opening doors (see Section 4.3.5 Cycle Facilities).

Parking may be added to existing streets where the carriageway is excessively wide as a means of narrowing it (see Figure 4.77). However, as noted in Section 4.4.1 Carriageway Widths, the first priority of designers should be to improve facilities for pedestrian and cyclists, prior to the addition of on-street parking.

A range of less formal or alternative parking arrangements may be used where design speeds are lower, particularly on *Local* streets and within Centres. A diverse range of parking types may be provided to create more intimate spaces, reduce the amount of line marking/constructed elements and/or reinforce the low speed environment. Such measures may include the following:

- Horizontal deflections may be produced by switching the location of parking bays from one side of the street to the other, or from the side of the street to the centre (see Figure 4.78).

Figure 4.77: Example from Fettercairn, Co. Dublin where a 'distributor' style road was narrowed by adding bays of parallel parking as part of a package of works aimed at calming traffic and improving the sense of place.

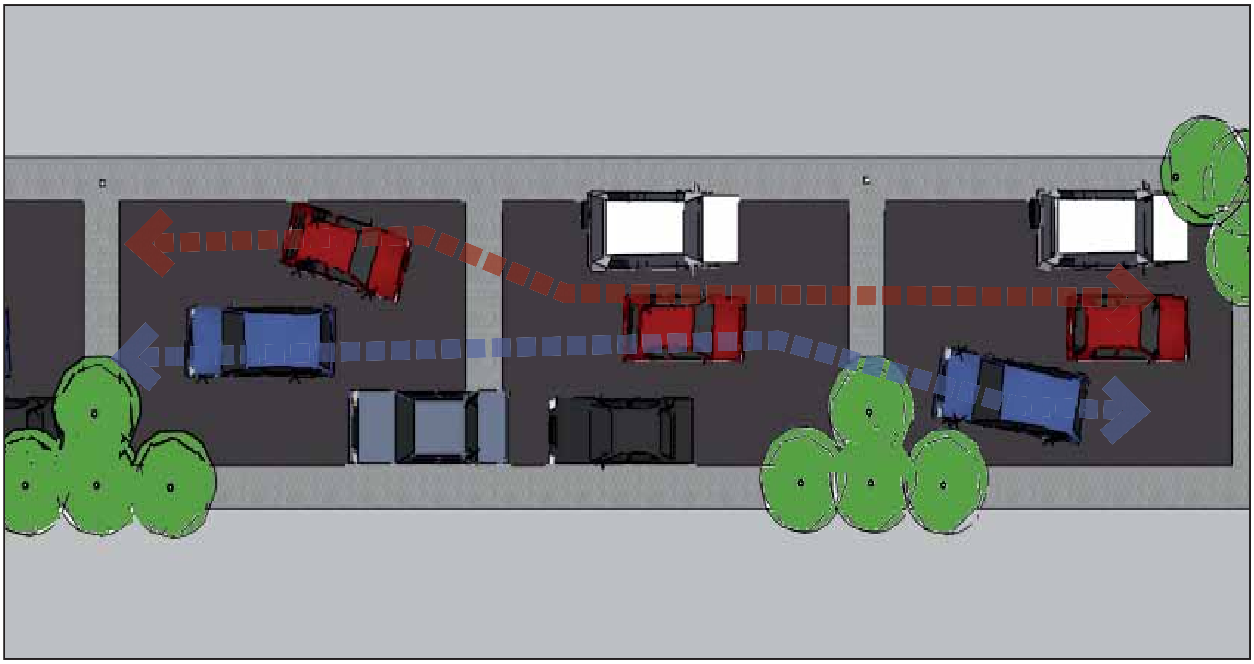


Figure 4.78: Illustration of informal on-street parking distributed to form a series of horizontal deflections and pinch points to reinforce a low speed environment.

- Parking bays may be less formally defined for example, the presence of the street tree embedded into the carriageway will also indicate where to park (see Figure 4.79).

- On-street and in-curtilage spaces may be integrated to reduce the overall amount of parking that is on-street and create a 'mews' like environment (see Figure 4.79.)

- Placing parking within the central area of a street to provide a greater level of surveillance.

- Loading areas may be provided at grade with footpath areas (i.e. within a verge), so that when not in use they revert back to pedestrian use (see Figure 4.80).

In areas of high demand, parking may be provided within the central areas of street as well as the edge of the carriageway to create an on-street parking courtyard (see Figure 4.81). Such spaces should be limited in size, well planted and landscaped to ensure that the courtyard is not overly dominated by parked vehicles.

Designers may also refer to the *Urban Design Manual* (2010)[42] and UK *Parking: What Works Where* (2006), for further guidance.

With regard to the design of individual parking/loading spaces:

- The standard width of a space should be 2.4m.

42 Refer to Chapter 11 of the *Urban Design Manual* (2010).

Figure 4.79. Example from New Hall, UK where a variety of in-curtilage and on-street parking is provided. On-street parking is provided semi-informally (indicated by the planting of trees). The parking of vehicles further calms traffic by providing a series of horizontal deflections.

Figure 4.80: Example from Walworth Road, London, UK, where a loading bay, provided within a verge, can revert to pedestrian space when not used.

- The standard length of a space should be 6m (parallel spaces).

- The standard depth of a perpendicular space should be 4.8m (not including a minimum 0.3m overhang, see Section 4.3.1 Footways, Verges and Strips).

- The depth of angular parking should be 4.2m for 60° angle parking and 3.6m for 45° angle parking.

- The dimensions of a loading bay should be 2.8 x 6m to cater for large vans. Facilities for larger vehicles, such as trucks, should be located off-street.

There are additional design considerations associated with perpendicular or angled spaces to ensure that they do not result in excessively wide vehicular carriageways. Perpendicular spaces generally require a minimum carriageway width of 6m, which is generally too wide for *Local* streets. Where additional space is needed, manoeuvrability should be provided within the parking bay itself and kerb build-outs should extend forward of each bank of parking to narrow the carriageway. Alternatively, additional manoeuvrability can be provided by designing wider spaces. For example, if the width of parking spaces is 2.6m, the carriageway may be reduced to 5m (see Figure 4.82).

Figure 4.81: Examples from Belmayne (top) and Ballycullen (bottom), Co. Dublin of a well landscaped parking court integrated within a street environment .

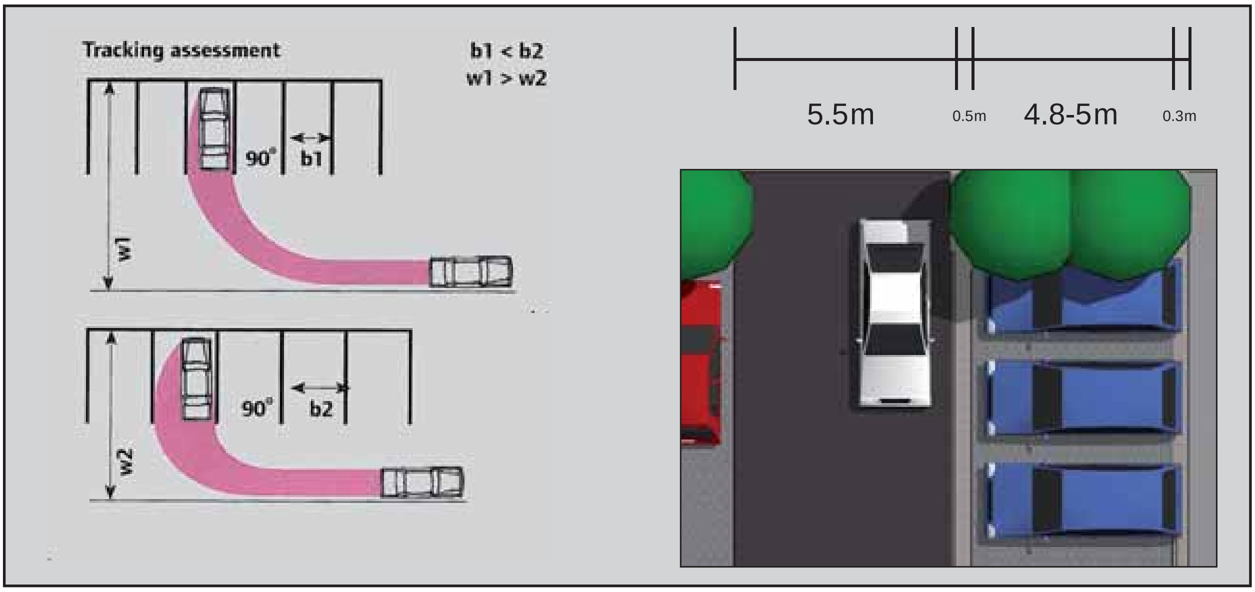


Figure 4.82: Example of how additional manoeuvrability may be provided for vehicles in areas of perpendicular parking whilst minimising carriageway widths. The images to the left are extracted from the Manual for Streets (2007) and illustrate the provision of wider spaces. The image to the right also shows the use of small verges.

CHAPTER 5: IMPLEMENTATION

The interlinked nature of street design requires designers to take a strategic plan-led approach that embraces a range of skills and perspectives from design professionals and the broader community.

5.0 IMPLEMENTATION

5.1 The Challenge Ahead

This Manual offers designers the rationale and the tools to enact the change required by broader government policies. Implementing such change is highly challenging. As highlighted by the numerous exemplar designs contained within this Manual, such change is achievable (see Figure 5.1).

The implementation of integrated design solutions to urban road and street design requires a strategic approach where design professionals, elected members and the broader community work collaboratively.

Such integrated solutions should be supported by :

- A plan-led approach to design for development of all sizes, and inclusive of those undertaken by the public or private sectors.
- Greater collaboration from a variety of design professions and more in-depth consultation with/between road authorities and the broader community.

A plan-led and multi-disciplinary approach is discussed in the ensuing sections.

Figure 5.1: Images of Dorset Street, Dublin (part of the N1 national route), demonstrate how better outcomes can be achieved by shifting away from convention and embracing a more inclusive and strategic approach to design.

5.2 A Plan-Led Approach

5.2.1 Policy and Plans

Spatial plans are a key element in the implementation of more integrated street design. They should include information on how the principles, approaches and standards within this Manual can be applied to promote sustainable cities, towns and villages. In particular when preparing policies and objectives on transportation and the promotion of more sustainable modes of transport, regard must be had to the detailed technical advice and guidance in this Manual.

The hierarchy of spatial plans is as follows;

1. Development Plans
2. Local Area Plans
3. Masterplans*
4. Movement Frameworks*
5. Public Realm Strategies*

(* denotes non-statutory plans)

1. County Development Plans

The promotion of sustainable settlement and transportation strategies in urban and rural areas as part of development plan shall be informed by the principles in this Manual.

2. Local Area Plans

Local Area Plans shall be underpinned by an assessment of transportation and mobility in the relevant area. This will inform the formulation of policies aimed at:[1]

- Promoting a walking and cycling environment.
- Creating high levels of connectivity, particularly for more sustainable forms of transportation.
- Land use and transport integration to reduce car dependency.
- Parking for cycles and cars.

The implementation of these policies should be reflected in a range of strategies that address broader movement and place considerations, such as:

- Major connections
- Vehicle circulation
- Public transport routes
- Cycle routes
- Pedestrian routes.

Such strategies should be illustrated via a number of diagrams that indicate the basis of any future street network (see Section 3.3.1 Street Layouts).

LAPs should also be used to address more detailed matters such as those contained within Chapter 4. Such issues may be addressed via Urban Design Codes[2] which set out a series of prescriptive measures to which development should adhere. With regard to street design these may take the form of cross sections and typologies (see Figure 5.2) and/or may include detailed illustrations relating to a particular place (see Figure 5.3)

3. Masterplans

Masterplans, like LAPs, are used to provide a more detailed framework for areas where significant change or development is anticipated. Masterplans may also act as a companion guide or subset of an LAP. Such Masterplans are often referred to as an Urban Design Frameworks.

Masterplans may contain a greater level of detail than LAPs and may also include more comprehensive guidance on the design of individual streets. For example, whilst street typologies may be provided in an LAP document, they are a significant component of a Masterplan.

1 Refer to Section 5.6 Achieving Smarter Travel of the *Draft Local Plans Planning Guidelines* (2012).

2 *The Draft LAP Guidelines* (2012) recommend the incorporation of cross-section diagrams of streets and junctions within LAPs.

Further guidance on the role, scope and content of Masterplans may also be sought from *Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas (Cities, Towns & Villages)* (2009)[3] and the UK *Creating Successful Masterplans* (2004).

4. Movement Frameworks

Movement Frameworks are a form of Masterplan that are primarily concerned with issues relating to the mobility and management of users within a street/road network. A Movement Framework may focus on the broader structural/strategic aspects of movement as well as more detailed considerations. A comprehensive Movement Framework may also include a traffic management strategy that models the movement of traffic within a network. Although a Movement Framework is primarily focused on the functionality of a street/road network, such plans should also take into account the interrelationship between movement and place.

5. Public Realm Strategies

Public Realm Strategies may address broader strategic issues similar to an LAP or Masterplan, but they are more closely associated with detailed design outcomes. In some cases Public Realm Strategies may include detailed material palettes and construction specifications. Examples of public realm strategies have been prepared by various local authorities including, Dublin City, Wicklow Town and Castlebar (see Figure 5.4).

3 Refer to Section 2.13 of the *Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas (Cities, Towns & Villages)* (2009).

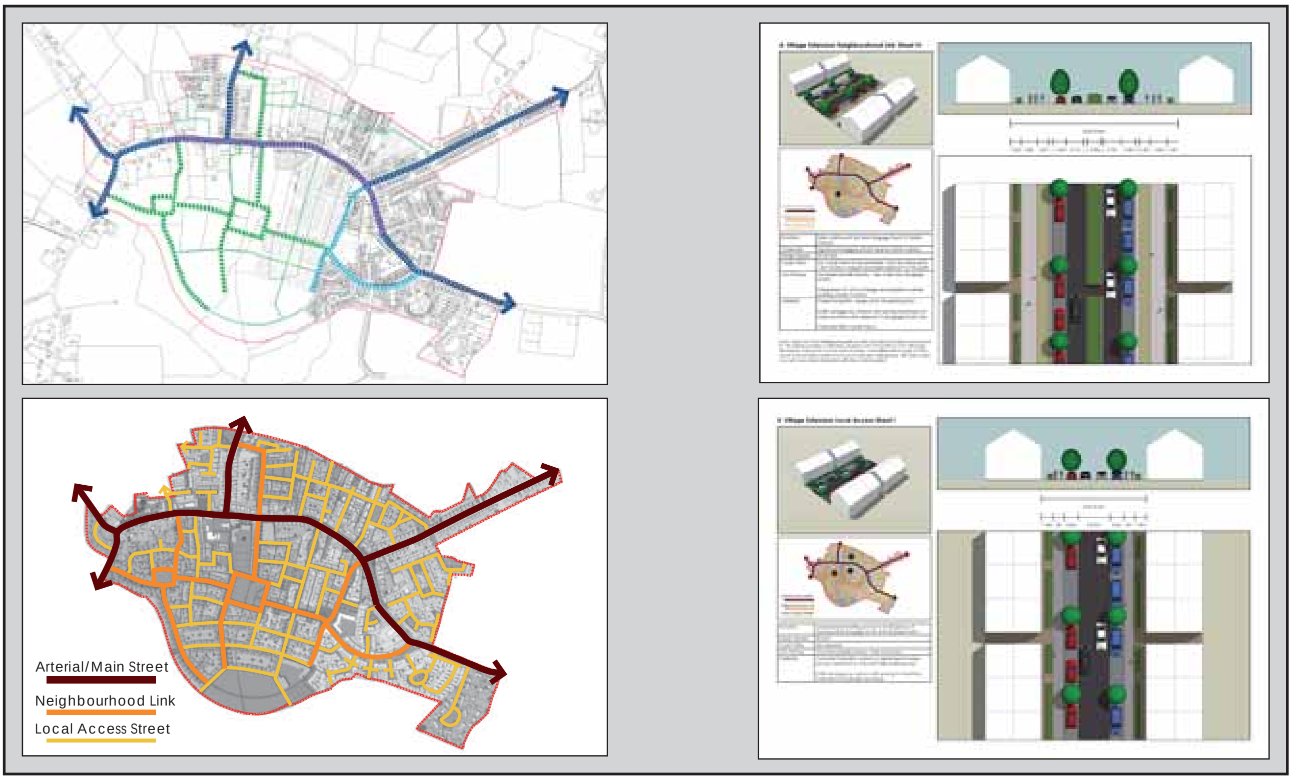


Figure 5.2: The Newcastle LAP (2012) is an example of a Local Area Plan where a series of strategic connections are proposed to shape the future expansion of the village. These connections are further detailed through a series of Urban Design Codes in the form of a street hierarchy, cross section and layouts (street typologies).

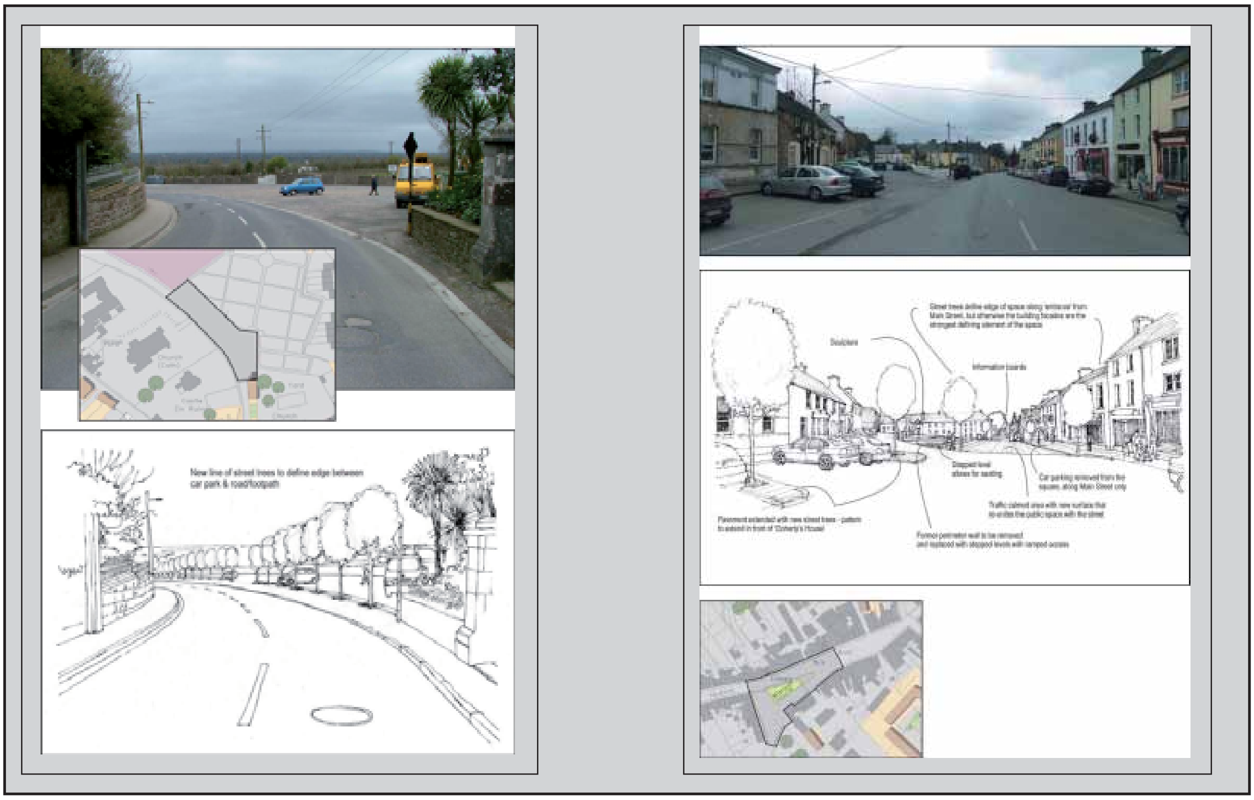


Figure 5.3: Extracts from the Kilfinane LAP (2012) illustrating a number of streetscape improvements that better define the street as a place.

Figure 5.4: Extracts from the Castlebar Town Centre Regeneration Project

An example of a detailed Public Realm Strategy. Castlebar town was described as being characterised by visual clutter, poor pedestrian infrastructure and an excessive vehicle presence. The works have significantly improved the place value of the town centre and created a sense of shared space with ‘a safe pedestrian environment along with suppressed vehicle dominance’.

BEFORE

AFTER

5.2.2 Development Rationale

To effectively communicate how the principles, approaches and standards within this Manual have been applied, it is recommended that all proposed developments, regardless of scale, are accompanied by documentation that provides a clear rationale for the project, such as within a design statement[4], including:

- A clear set of objectives for the project (see Section 5.3.2 Process).
- How context and function were determined (see Sections 3.2.1 Movement Function and 3.2.2 Context).
- Strategic drawings outlining the structure of the street network (see Section 3.3.1 Street Layouts).
- Detailed street layouts that clearly illustrate all relevant geometric standards and other treatments aimed at promoting a sense of place, sustainable forms of transportation and traffic calming.
- A comprehensive auditing process (see Section 5.4 Auditing).

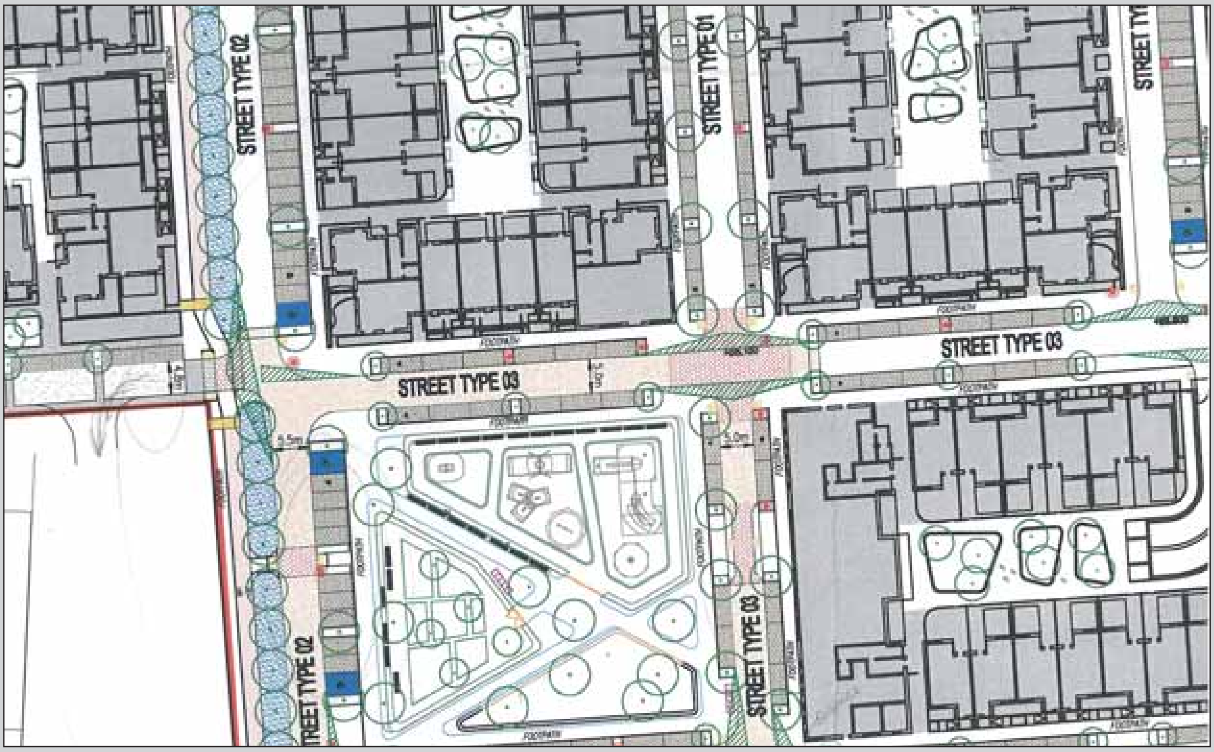
To ensure that street layout plans communicate a complete picture of the design, it is recommended that the following information be presented, as appropriate (see Figure 5.5):

- The width of streets, footways, verges, medians and privacy strips.
- The location, type and configuration of crossings and junctions.
- Corner radii (including swept paths).
- On-street parking.
- Horizontal and vertical alignment data.
- Horizontal and vertical deflections.
- Forward visibility splays.
- Kerb lines (including heights).
- Surface Materials and Planting.
- Street furniture and facilities.
- Signage and Line Marking.
- Lighting.

Design teams and planning authorities will need to balance the level of detail given at any stage of the design/consent process. For example, more technical specifications may be better suited to later compliance submissions so that the initial consent process is not overly burdened with detail. Such specifications may include matters such as final material palettes, construction details and planting schedules. They should be matters which do not affect the amenities of a third party, without that party having the right to comment on the compliance submission following the grant of permission.

4 Refer to Section 3.10 of the *Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas (Cities, Towns & Villages)* (2009).

FIGURE 5.5: EXAMPLES OF DETAILED DRAWINGS



Street Design Layout Plan illustrating street types and fundamental elements of the street geometry. Drawing by WSP based on design by Henry J Lyons Architects.

Landscape Plan illustrating surface materials and planting materials. Drawing by Gross Max landscape architects based on design by Henry J Lyons Architects.

5.3 Multidisciplinary Design Processes.

5.3.1 Design Team

The design team should include a broad range of professionals with varying levels of technical expertise in streets/road design (see Figure 5.6). The final make-up of a design team will depend on the resources available and the scale of the project. Design input should ideally be sought from a range of skill sets to ensure that a holistic design approach is implemented. As the scope of projects broaden, or in response to particular issues, design input may also be needed from more specialised skill sets. For example, if designing within a historic context, input should be sought from a conservation expert (see Figure 5.7).

A project manager should be appointed to oversee sizable or complex projects. The project manager may come from any background associated with the design of the built environment. It is recommended that the project manager has extensive experience in critically analysing and evaluating advice from a range of design professions.

On larger scale, or high profile projects, it is recommended that a Design Champion be assigned to the project. The UK DoT recommends that the Design Champion not form part of the day-to-day working group within the design team.[5] Rather the Design Champion should assist the team in developing a vision and set of design objectives for the project, ensuring that these are adhered to and promoting them to the broader community, including elected representatives.

The formation of a multi-disciplinary team is critical for the assessment of any project. Whilst the formal assessment and consent process for different design projects may vary, it is essential that they have multi-disciplinary input so that they can be fully assessed against the broad range of principles, approaches and standards contained within this Manual, particularly where any conflicts of place and movement may arise. To assist this process it is recommended that multi-disciplinary professional teams within planning authorities work together as a cohesive unit.

5 Refer Section 2.10 of *Local Transport Note 1/08 Traffic Management and Streetscape (2008).*

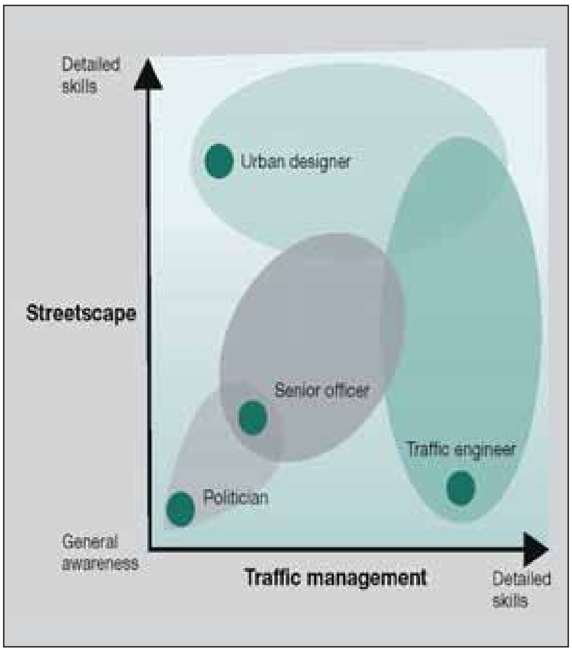


Figure 5.6: Extract from Local Transport Note 1/08 showing how a range of technical skills contribute to the design process.

Range of Inputs Required

Required

Engineering
Town Planning
*Urban Design**

Desirable

Architecture
Landscape Architecture

As required

Heritage Specialist
Conservation Specialist
Environmental Specialist

*May also include an architect, engineer or town planner with urban design skills.

Figure 5.7: The range of skill needed for input into a multidisciplinary design team. Skill sets have been ranked to indicate where resources should be prioritised and where additional input may be desirable.

5.3.2 Process

There several guidelines that provide in-depth advice on collaborative multidisciplinary design processes. These include the *Manual for Streets* (2007), which outlines a process for multi-disciplinary teams for projects of various scales[6] and the UK Department for Transport *Local Transport Note 1/08 - Traffic Management and Streetscape* (2008), which focuses on collating and coordinating inputs of a range of designers under the direction of a project manager. The 'In Practice' section of the *Urban Design Manual* (2010) also outlines a process for the preparation of planning applications. Figure 5.8 illustrates a simplified process that incorporates four key stages for a design team, as discussed briefly below.

6 Refer to Table 3.1 of the *UK Manual for Streets* (2007)

Analysis and Vision

The first stages of a process should be to undertake an analysis and establish the objectives for the project so that the design team has a clear understating of the task ahead.

Collecting information for a site analysis will generally consist of two parts:

- a desktop study where all relevant plans, policies and previously collected information about a project is collated and reviewed.
- an on-site study where observations are made and data is collected.

Key information for the process includes:

- Plans and policies (relevant national, regional and local plans).
- Spatial characteristics (such as land uses, destinations, densities, activity generators).
- Movement patterns (such as user mobility, key desire lines, obstructions, public transport).

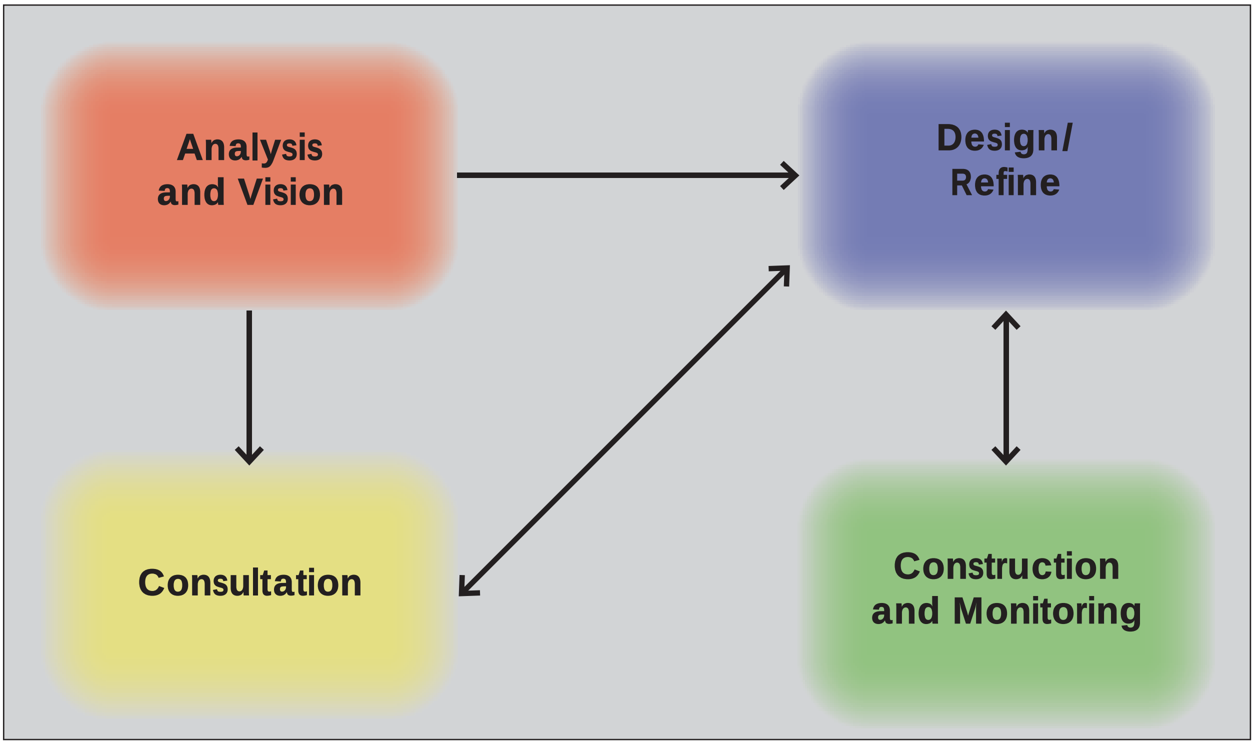


Figure 5.8: The key stages of the design process.

- Built form (enclosure, interface, street geometry).
- Traffic Survey (such as traffic counts, car parking).
- Topography and landscape (such as slopes, planting and ecology).
- Heritage and conservation (where appropriate).

A key outcome of the analysis process should also be the identification of the *Context(s)* of the project and the *Function(s)* of the street/street network. Further guidance on site analysis may also be taken from the *Urban Design Manual* (2010).[7]

The analysis process should provide a solid understanding of the issues that need to be addressed. One of the first steps in formulating a response is to establish a clear vision that addresses core issues of place and movement. A vision for the project will enable the formation of a set of objectives that acts as a 'mission statement'. This will set the context for the application of more detailed design. Objectives may relate to a number of aspects of any design, such as the character of the place, levels of connectivity for different users and traffic calming.

The objectives of a scheme should be referred to throughout a design process, and may also form the basis of a formal design brief.[8]

Consultation

Several stages of consultation may be undertaken by designers depending on the type and scale of a project. It is recommended that designers undertake consultation as early as possible. Designers may engage with a community and/or roads authority prior to any detailed design work taking place, to identify further issues and to gauge the aspirations of the community (to further refine the objectives for the project). A workshop environment may encourage participants to play an active role in the initial design of the project. Further advice to assist designers with more in-depth community involvement, particularly at the early stages of a design process, is available from the UK Royal Town Planning Institute[9] and UK Planning Advisory Service.[10]

It is also recommended that designers undertake pre-planning meetings where a design is to be submitted to a local authority. Both the design team and the local authority should ensure that this occurs within a multidisciplinary environment to ensure that a broad range of issues are considered. The design team should ensure that all relevant design disciplines are present. The local authority should ensure that all relevant disciplines are represented.

Design and Refine

The optimal solution is rarely achieved on a first attempt and is likely to emerge over many drafts, having been informed by a solid analysis and appropriate level of consultation. A thorough design process is likely to include:

- Production of strategic level drawings that illustrate the key routes and links within a street/street network (see Sections 3.3.1 Street Layout).
- Typologies or conceptual individual street designs.
- Initial detailed design and refinement prepared to a professional/technical standard.

7 Refer to the 'In Practice' section of the *Urban Design Manual* (2010).

8 *Refer to Part 3.8 of the Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas* (2010) and the In Practice Section of the *Urban Design Manual (2010).*

9 Refer to UK *Guidelines on Effective Community Involvement and Consultation: Good Practice Note 1* (2005).

10 *Refer to* UK *Community Engagement in Plan Making* (2010).

- Design finalisation and formal consent process.

The optimal time to undertake an audit process is when the design has reached a stage where the outcomes can be clearly evaluated, such as after initial refinement and prior to finalisation. This will also allow the design to be formally tested against the objectives of the project and with regard to other critical matters such as safety (see Section 5.4 Auditing).

Once the design is finalised and all the relevant approvals have been granted it must not be retrospectively revised in a manner that would contradict the approved plan at later stages. Any potential future taking in charge issues related to design geometry and layouts should be fully resolved as part of the consent process.

Construction and Monitoring

The design phase will largely conclude once any relevant approvals have been granted and all technical specifications have been formalised, it is recommenced that the design team participate in the project through to its completion and periodically monitor its performance.

During the construction phase it is recommended that the design team/planning authorities carry out periodic inspections to ensure that the project is being carried out in accordance with the approved design. This will not only assist in ensuring the objectives of the project are fully implemented, but will reduce the potential for error and abortive or wasteful works.

Periodic monitoring is recommended, particularly where innovative design techniques and/or untested materials have been used. Post-construction performance monitoring should be focused on the safety record and vehicle operating speeds to ensure that project objectives have been met. Design teams/roads authorities are encouraged to make such findings publicly available so as to add to the growing body of work that informs more integrated design solutions.

The issue of maintenance is also of primary concern for many roads authorities, particularly where higher specification materials are used. Many local authorities within the UK have issued specific streetscape design guidance that detail a palette of street furniture, materials and finishes that are acceptable to planning authorities.[11] Part B of the *Adamstown Street Design Guide* (2010) also provides examples of accepted standards. It is recommended that local authorities collate and issue similar guidance to encourage better quality 'workmanship' and to simplify the maintenance regime.

11 Examples include the *Camden Streetscape Design Manual* (2005) and *Streetscape Design Manual for Nottingham City Centre* (2006).

5.4 Auditing

5.4.1 Road Safety Audits

Auditing processes in Ireland are generally in the form of a Road Safety Audit (RSA). The NRA has published a set of standards[12] that define the role of, and outline the process for carrying out a RSA. The primary purpose of a RSA is to identify potential hazards and how they could affect road users using the following criteria:

- Does the design layout create confusion or ambiguity for road users that could lead to potential road traffic accidents?
- Is there too much, or too little information for road users?
- Is there too little, or too much visibility, or an obstruction to road users' view?
- Does the layout create hazards or obstacles to road users that could contribute to an increased risk of injuries?

If the answer is 'yes' to any of these questions, then it is deemed that the safety of the scheme could be compromised and remedial measures may be required to remove a potential or actual deficiency.

Within Ireland it is mandatory to carry out a RSA on any permanent change to the road layout on National Roads. The standard is commended to roads authorities for use in preparation of their own road schemes on Regional or Local roads' and it is common practice for local authorities to require an RSA for all road schemes. *Circular RLR 16/2008, Road Safety Audits and Road User Audits* issued by the Department of Transport also required that roads authorities carry out such audits on schemes funded or co-funded by the Department.

The implementation of the *Manual for Streets* (2007) in the UK has raised many issues in relation to the application of RSA. These issues are also further addressed in the UK *Manual for Streets 2* (2010).[13] These manuals note that the application of RSA standards require a different perspective when applied within an integrated street environment. Concerns are raised that the RSA process is predisposed to segregated/conventional design solutions that may detract from the sense of place, reduce levels of pedestrian amenity and, in some cases, actually reduce safety levels, as 'where the appearance is one of safety, individuals may drop their guard and accidents ensue'.[14]

To reduce the possibility of conflict with this Manual, the audit team responsible for carrying out a RSA:

- Must take full cognisance of the principles, approaches and standards contained within this Manual.
- Should not recommend any actions that will reduce ease of movement for pedestrians/cyclists in favour of motor vehicles or seek to add or remove measures that may result in the operating speed exceeding the intended design speed.
- Should promote the creation of a self-regulating street environment.
- Should have a clear understanding of the objectives of the design. The audit team should refer to the Road Safety Audit Brief Checklist.[15]

The RSA should, where appropriate, also be part of a larger *Quality Audit* (see Section 5.4.2 Quality Audits), this may assist in identifying many of the issues highlighted above.

12 Refer to NRA DMRB Volume 5, Section 2, Part 2 NRA HD 19 Road Safety Audit (2012).

13 Refer to Sections 3.7 of the UK *Manual for Streets* (2007) and 4.5 of the *UK Manual for Streets 2* (2010).

14 Refer to the UK *Highway Risk and Liability Claims: A Practical Guide to Appendix C of the Roads Board Report* (2009).

15 As required within NRA DMRB Volume 5, Section 2, Part 2 NRA HD 19 Road Safety Audit (2012) – Audit Brief.

The audit process may include direct communication between the audit team and design team if clarification is required on any of the above issues. This can be achieved through the existing RSA procedures 'if following the road safety audit, discussion or clarification of any issues is required by the Audit Team, the Designer or the Employer, the Employer shall convene a meeting between the Audit Team, the Designer and the Overseeing Organisation to resolve as many of the audit issues as possible.'[16] This process will allow the design team the opportunity to clarify any contentious issues and gain feedback on any alternative courses of action, prior to the finalisation of the design.

The audit team should also carry out a risk assessment,[17] ranking both the audit problems and the audit recommendations.
This process may assist in identifying the level and type of 'risk' associated with a potential 'hazard'. This is of particular importance on schemes where elements of risk are introduced to calm traffic and create a self-regulating street. In this regard design teams / audit teams may also refer to the third edition of the UK Institute of Highways and Transportation *Road Safety Audit Guidelines* (2008), produced following the publication of the UK *Manual for Streets* (2007). This document also includes a Risk Assessment process that takes into account the likely severity of outcome and frequency of occurrence that is attributable to any perceived hazard and notes that an auditor should:

> 'not assume that behaviour on roads will necessarily be displayed on streets'
>
> and;
>
> 'the emphasis within Audit should be on trying to assess what types of collisions may occur'.

16 As outlined within *NRA HD 19 Road Safety Audit* - Subsequent Actions to the Report)
17 Refer to NRA HD 42/04 Road Safety Audit Guidelines - Section 6.2 Risk Assessment

5.4.2 Quality Audits

A *Quality Audit* should be undertaken to demonstrate that appropriate consideration has been given to all of the relevant aspects of the design. The UK Department for Transport notes the key benefits of a *Quality Audit as*:[18]

- A transparent process that demonstrates that the needs of all user groups and the design objectives.
- Enables the projects objectives to be delivered by putting in place a check procedure.
- Contributes to cost efficiency in design and implementation.
- Encourages engagement with stakeholders.

Quality Audits generally consist of a number of individual and overlapping audits that may include:

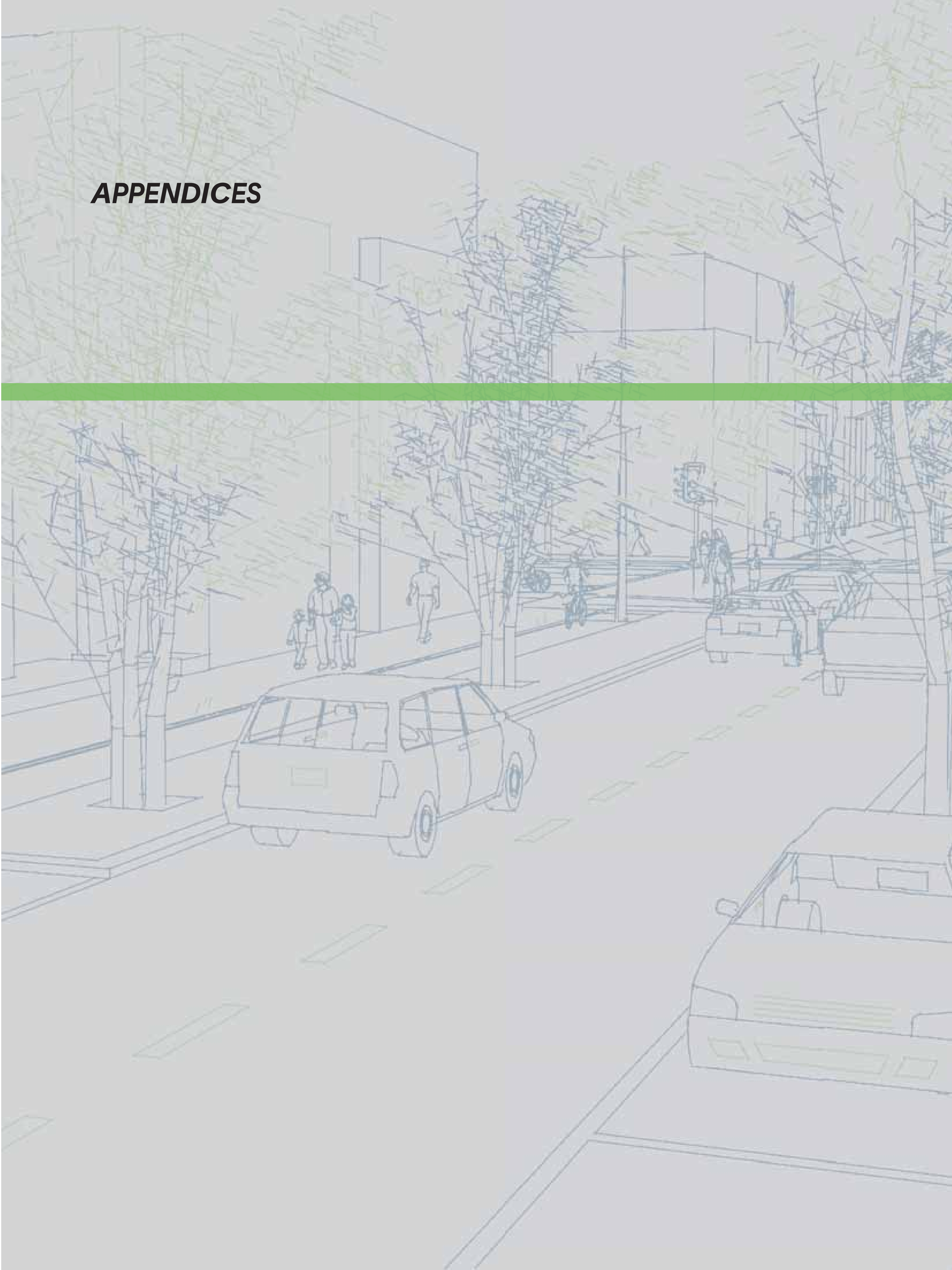
- an audit of visual quality;
- a review of how the street is/may be used by the community;
- a road safety audit, including a risk assessment;
- an access audit;
- a walking audit;
- a cycle audit;
- a non-motorised user audit;
- a community street audit (in existing streets); and
- a place check audit.

The extent to which these processes are undertaken will vary according to the scale and scope of any given project. The intention of a Quality Audit is not to 'pass' or 'fail' a design. Rather it is intended as an assessment tool that highlights the strengths and weaknesses of a design and a documented process of how decisions were made.

To assist designers, it is intended that further guidance in relation to Quality Audits will be issued in the form of downloadable content to accompany this Manual.

18 Refer to UK Department for Transport *Traffic Advisory Leaflet 5/11- Quality Audits* (2011).

APPENDICES



GLOSSARY

Active Streets
Streets where building edges/frontages are orientated toward, and are directly accessible from, the street by foot to promote pedestrian activity.

Animation
The creation of an interface with the street via a range of architectural treatments that promote the physical and visual accessibility to interior activities, such as openings and shop fronts.

Boulevard
A street type that generally consist of well planted medians and/or verges that provide a buffer between a heavily trafficked carriageway and the surrounding environment.

Carriageway
The section of a street or road that is primarily used by motor vehicles (but may also be used by pedestrians and cyclists).

Connectivity
How easily and directly users are able to move through street networks (see also Permeability and Legibility)

Corner Radii
The measure of how broad or tight corners are at a junction, measured from the outside of a kerb or the outside line of a cycle lane (where present).

Cul-de-sac
A street or road which terminates without connecting to another street (see also *Vehicular Cul-de-sac*)

Cycle Friendly
A street environment designed to allow cyclists to move about in safety and comfort.

Design Speed
The maximum speed at which it is envisaged/intended that the majority of vehicles will travel under normal conditions.

Desire Lines
Normally the shortest route from one place to another, but can be the most convenient, easy to use or comfortable route.

Enclosure (Sense of)
A condition created by providing a continuous line of buildings and/or street trees that has the effect of calming and creating a greater perception of safety, especially for pedestrians.

Footpaths
The area within a street reserve that is generally reserved for pedestrian use.

Footway
The main section of the footpath along which people walk.

Homezone
A type of *Shared Surface Street* in a residential area which may also include items of street furniture that would normally be used within areas of open spaces.

Horizontal Alignment
Horizontal alignment refers to the directional transition of a road or street in the horizontal plane. In essence a horizontal alignment consists of straight sections joined by curves.

Horizontal Deflections
Changes that occur within the horizontal alignment of the carriageway, such as pinch points, which slow vehicles and require drivers to change direction.

Human Scale
A person's perception of the size, scale, height, bulk and/or massing of buildings and other features of the built environment.

Integration (Integrated Streets)
Streets where real and perceived barriers to movement within and between modes of transport are removed to promote improved interaction between users in a safe and traffic-calmed environment.

An integrated approach to street design also includes a more holistic view of the street and a more collaborative approach its design where factors such as the type of place and needs of all users are taken into account.

Integrated Street Networks
Highly connected street networks that support the integration of land use and transportation.

Legibility
The ease in which user can navigate a street or street network using series of environmental cues such as buildings, landscape treatments, materials and finishes.

Mixed Use
A development, street or broader area that contains a range of different land uses.

Modal Shift
A change in the method of transportation used by people.

Multidisciplinary Approach
A collaborative approach to design where the skills of a number of design professional are utilised to produce a design.

Naked Street(s)
A street or street network in which there is little or no regulatory signage and line marking.

Nodes
Major places of convergence and interchange between different forms of transportation.

Passive Surveillance
Overlooking of streets and spaces from adjoining buildings.

Pedestrian Friendly
A street environment designed to make pedestrians feel safe and secure and allow them to move about with relative ease.

Place (Sense of)
The character or characteristics of an area in relation to how it is perceived by a user.

Pedestrianised Streets
Streets that are designated for pedestrian use only, although emergency access and limited access for service vehicles is provided.

Permeability
The degree to which an area has a variety of pleasant, convenient and safe routes through it.

Self-Regulating Street
A street where the environmental conditions and/or series of design measures are used to influence drivers behavior, minimising the use of physically intrusive measures or large amounts of regulatory signage and line marking.

Segregated Street Networks
Street networks where the movement of different modes of transport are restricted to a particular route based on purpose, destination and/or type.

Segregation (Segregated Streets)
Streets within which interactions between modes of transport are discouraged or prevented through the use of a series of barriers and other design measures.

Severance
Where the provision of road infrastructure (e.g. a distributor style road) bisects an area, making people movement within the area more difficult.

Shared Space (Sense of)
See *Integration*

Shared Surface Streets
A street where pedestrians, cyclists and vehicles share the main carriageway and where pedestrians have priority of movement over other uses.

Speed (Very Low, Low, Moderate and High)
Described within the context of cites, towns and villages as very low(<30km/h), low (30km/h), moderate (40-60km/h) and high (>60km/h).

Stopping Sight Distance
The distance ahead a driver needs to see in order to stop safely should an obstruction enter their path.

Street Furniture
Items placed within the street with the purpose of directing movement and/or enhancing its place value including public art, lighting, bollards, guardrails, seating and cycle parking.

Sustainable Modes of Transportation
Transportation which has a lower impact on the environment including walking, cycling and public transport.

Sustainability
Meeting today's needs without compromising the ability of future generations to meet their needs.

Sustainable Urban Drainage
A drainage system which seeks to emulate or restoring a more natural hydrological regime so that the impact of urbanisation on downstream flooding and water quality is minimised.

Updesign(ing)
The application of standards intended for higher order roads/streets that detract from the sense of place and inappropriately increase design speeds.

Vertical Alignment
Vertical alignment refers to the change in elevation of a road or street along it's longitudinal profile. A vertical alignment consists of a series of straight-line gradients that are connected by curves.

Vertical Deflections
Changes in level on a carriageway, such as raised tables, designed to slow vehicles.

Visibility Splays
Visibility splays are provided at junctions to provide sight lines towards and down intersecting streets to ensure that drivers have sufficient reaction time to stop should a vehicle enter their path (see also *Forward Visibility* and *Stopping Sight Distance*)

Vulnerable Users
Road users who are most at risk – pedestrians and cyclists, specifically children, the elderly and people with mobility impairments.

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INDEX