

APPENDIX

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Appendix 1 Cyclist movement

London cyclists requirements

London cyclists themselves highlight three key requirements:

- Uninterrupted routes i.e. no loss of priority, no obstruction, no additional stops or turn offs.
- Improved maintenance i.e. a good riding surface.
- More dedicated cycle facilities e.g. cycle lanes offering priority and protection from high volume, high speed or queuing motor traffic.

There are some common situations that are inherently problematic for cyclists.

These include:

- Large roundabouts (two or more circulating lanes).
- Uncontrolled fast moving left filter lanes.
- Banned movements without cyclists exemption.
- Road closures without cycling gaps.
- Interrupted or obstructed lanes.
- "Cyclists Dismount" signs.
- Counter intuitive loss of priority (at side roads).
- One-way streets without cyclists' exemption.

DDA obligations

The Disability Discrimination Act (DDA) requires authorities to make reasonable adjustments to overcome physical barriers to access, by removing or altering the barrier, enabling people to avoid it or providing access by an alternative means. This applies equally to the street environment as it does to public transport services.

DDA responsibilities impact on design for cycling in three ways:

- Removing, altering or avoiding physical barriers to access by cycle or providing alternatives will generally contribute to DDA and access objectives.
- There is a need to make reasonable provision for cycles that have been built or adapted for use by individuals with a disability, affecting their travel, for example, by ensuring cycle gaps are wide enough for trikes and recumbent bikes, and similarly for manual/electric wheelchairs and mobility scooters. Powered invalid carriages are not classed as motor vehicles for the purposes of road traffic legislation and they can be used on footways, footpaths, bridleways or pedestrianised areas, cycle tracks and in cycle lanes provided that appropriate orders are made.

- The necessary steps must be taken to ensure that provision for cyclists does not create new hazards for pedestrians and in particular those most vulnerable e.g. elderly, blind or partially sighted people and children.

¹ *London Cycling Design Standards*, Transport for London, 2005

Review of procedures associated with the development and delivery of measures designed to improve safety and convenience for cyclists. TRL, Transport for London, 2004

Appendix 1 Cyclist movement

London Cycling Network design standards

LCN+ is a planned network of cycle routes approximately 900km in length that will address the barriers to cycling on high demand corridors across London and provide fast, safe and comfortable conditions for cyclists.

The network will be provided on the Transport for London Road Network (TLRN), on borough roads as well as through parks, and on other green corridors that do not come under the jurisdiction of highway authorities.

For this purpose, fast, safe and comfortable means:

- Minimised effort for cyclists.
- Enables uninterrupted, unobstructed movement at a steady speed.
- Easy to follow.
- Well surfaced routes.
- Maintains priority through junctions.
- A good user satisfaction rating.
- A good journey time rating.
- Enhances the environment, distinctive character and improves ambience for cyclists and others.
- Identifies and addresses cyclist casualty locations.
- Manages conflict with motor traffic and pedestrians.
- Raises driver awareness of cyclists.
- Clarifies positioning of cyclists and other highway users.

Roundabouts and gyratories

At roundabouts and gyratories it is essential to understand cyclists' desire lines and manoeuvres in order to provide for their safety. At many existing roundabouts the geometry creates difficulties for cyclists by not sufficiently reducing motor vehicle speeds.

Most accidents involving cyclists arise from vehicles entering the roundabout and colliding with cyclists who are on the circulatory carriageway. The risks to cyclists can be reduced by:

- Controlling entry, circulatory and exit speeds.
- Reducing unused carriageway space, including reducing the number of approach lanes where feasible.
- Providing an alternative route or by-pass for cyclists that does not result in additional delay.
- Raising driver awareness of cyclists.
- Giving cyclists clear, unobstructed passage up to, through, and leaving the junction.
- Managing traffic and conflicting manoeuvres through the use of signals.

Gyratories

Gyratories are normally one-way flow routes around existing streets, effectively turning them into large roundabouts. They should be assessed and improved using broadly the same principles as large conventional roundabouts.

Additional options that specifically apply to gyratories are:

- Remove the gyratory and return to two-way working.
- Provide contra-flow cycle (or bus and cycle) lanes on one or more arms.

High speed is likely to be problematic with gyratories, even more so than with many large conventional roundabouts. In view of this, the need to reduce motor vehicle speed requires particular attention.

Appendix 2 Route choice preference patterns - centrality as process

Live centre location and urban layout

The 'centre' of a settlement, whether city, town or village, usually means a concentration and mix of land uses and activities in a prominent location. At any point in time, it is usually fairly clear where the centre is and what its limits are. However, the need to revitalize the centres of towns and cities, has drawn attention to how little we know of the processes by which centres are generated and sustained. Historically, it is clear that centres not only grow and shrink, but also shift and diversify, and with growth to a large town or city level, a whole hierarchy of centres and sub centres usually appears diffused throughout the settlement. The challenge is to understand centrality as a process, rather than to describe it as a state.

Through the everyday process of path selection behaviour and their different modal ranges we have shown that well defined spatial factors would play a critical role in the formation and location of centres, and then play an equally critical role in developing and sustaining their vitality. The process works through the impact of spatial configuration on route choice preference patterns, and the subsequent influence this has on land use location choices, and the development of the area as an 'attractor' in the settlement layout as a whole. A proper understanding of these spatial factors and the processes they set in train is vital to any programme for the revitalization, sustaining or long term development of centres.

The socio-economic make up of an area and its cycles are indeed important. All else being equal we analyse the role of urban design in enhancing or inhibiting 'live centrality' at all levels of settlements. 'Live centrality' means the element of centrality which is led by retail, markets, catering and entertainment, and other activities which benefit unusually from movement.

At first sight, understanding centrality in towns and cities does not seem to be problematic. Both spatial and functional aspects seem clear and stable: a historic high street or market square as a focus, perhaps, and a concentration of urban functions that have grown up around it to create a central area. Typically, a centre would be marked by a focal 'live centre' of markets and retail, with quieter zones of administration, business and religion in close spatial proximity defining the limits of the central area. All we would need know to understand centrality in such cases would be to identify the focus, describe the limits and map the various functions in their locations.

As soon as we take time into account, we find that centrality is often neither clear nor stable, either in its focus or its limits. Although in many settlements the location and limits of the centre do remain more or less in the same place over long periods, in others the centre not only expands or contracts, but may also shift its focus. Most commonly the displacement of the centre is from a historical core towards what was once an edge.

Centres can also diversify with growth, and the tendency to functional specialization of sub areas that we find in historic 'centres' can, in larger cities, become spatially distinct centres for different types of function.

Town centres can be defined as complexes of interdependent facilities, so that if you come to use one, it is easy to use others. The criterion for whether or not a development would be 'part of the town centre' reflects this interdependence: if people come to use this, will they also use other facilities in the centre? Whether or not interdependency is effective depends on inter-accessibility: it must be possible to get from any facility to any other by a quick and easy route which stays within the town centre and which itself is lined with town centre facilities to maximize natural access to all facilities.

In a town centre, in short, it must be possible to search, explore and find, and the basic rule is that wherever you get to, you can still find an easy route to anything else you want to visit without going back over the same route. Inter-accessibility should also be reflected in the pattern of access to the centre: whichever direction you approach the centre from, the whole centre should quickly make its inter-accessibility available and obvious. The effect of this will be that although bits of the centre grow out along these routes to some extent, it will happen in such a way as to conserve the integrity of the whole.

The overall shape of a town centre is thus a "compact convex" shape with spikes -the 'spiky potato'- with a series of quantifiable spatial characteristics reflecting inter-accessibility which peak in the live centre, and fall off towards the edges of the settlement.

From a spatial point of view, then, centrality seems to be a product both of the overall configuration of the grid, which decides where the centre should be, and the kind of local process of grid adaptation and intensification.

In contrast to this, the second kind of movement is 'moving around' movement within a local area, and relates all origins and all destinations within that area. This type of movement is essentially convex in form, and optimally generates not quasi-linear sequences of lines connected by obtuse angles but quasi grids, in which lines intersect approximately at right angles, and continue to form other quasi-right angle intersections with other lines.

Appendix 2 Route choice preference patterns - centrality as process

Movements and centralities

Two kinds of movement are at work. The first is linear movement from specific origins to specific destinations. The dominant manifestations of this are the quasi-linear radials that connect the central areas of cities with their edges. These alignments are usually composed of long lines, or sequences of fairly long lines, connected to each other by slight changes of direction, thus minimizing distance from origin at the edge to destinations in or around the centre.

In contrast to this, the second kind of movement is 'moving around' movement within a local area, and relates all origins and all destinations within that area. This type of movement is essentially area based in form, and optimally generates not quasi-linear sequences of radials connected by slight changes of direction but intensified quasi-simple grids, in which streets intersect approximately at right angles, and continue to form other quasi right angle intersections with other streets. This process has the effect of optimizing 'metric distance', that is, minimizing mean trip lengths from all points to all others within that area.

Reflections on centralities

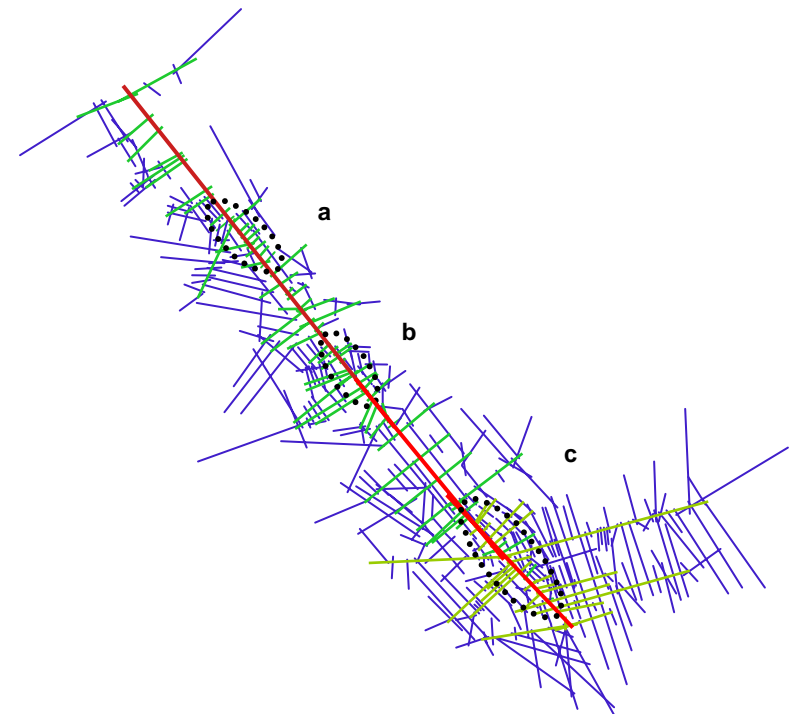
- Initially, the live centre is linear, on a section of a most spatially accessible street of the wider network context, probably defined in relation to its most accessible intersection.
- As the settlement grows, a process of grid intensification and metric accessibility develops in the live centre. Centrality become area based.
- With linear growth away from the centre, local sub centres develop on radials selected by local intensification conditions, but in themselves remain linear.
- With further growth, smaller scale sub centres develop away from main radials.

Figure 1 Edgware Road, a radial road in London extracted with the streets that are directly connected and the streets that connect to these.

Three distinct (and quite large) local live centres lie along its length, each picked out by a dotted ellipse: Cricklewood High Street (a) the most northerly, Kilburn High Street (b), and finally the section between the Harrow Road and Oxford Street, marked (c). Is there any way in which the sections of the road that have become live centres are distinctive?

The answer is clear. Each such section is characterized by a more intensive 'two step grid' than the non-centre sections of the lines, in the sense that there are larger numbers of smaller blocks close to the line section. This has the simple effect that good numbers of buildings whose entrances face on to those lines are within the short distance of the live centre line.

Figure 1



Appendix 3 Built Form Development Organisations



Pod development is typified by single use sites, with no interconnection, accessed by one or occasionally two roads coming off a main distributor. The pod is never on a main distributor; we have termed this 'off-line' development.

Uses can be entirely residential, business, education, leisure or retail. Retail and leisure can sometimes be found together in a single site. Edge of town land availability, market forces and planning policy led to a lot of this kind of development in the latter quarter of the last century and it is still a dominant urban form for current new build. This form has become the most prevalent, in that it can be found in the widest range of scales and sizes. It result from the congruence between zoning planning and transport planning as it is easy to handle within transport modelling that required zone to be of similar uses.

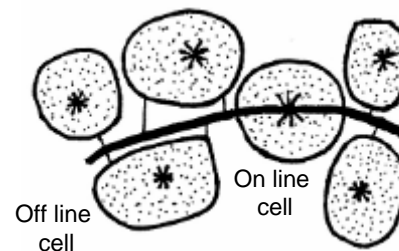
Single pods can be anything from 1ha, a small residential development of 20 houses, to 500ha, a large business park campus. Since the pods are designed as independent developments, they can be found as one-offs, e.g. infill development, or spread over a wide area often as district-wide edge of town development.

Market forces play a very strong role in determining the pod. Attributes such as size, density, access, building type, land use are market led. Socially driven agendas such as provision of public open space, community facilities, quality of the public realm are only addressed where regulation dictates or local planning places constraints. Environmental performance issues tend to be driven by regulation.

Pod development accessibility

This type of development can increase very significant adverse impact on average trip length and legibility (see Urban grain, size, shape and configuration, Fig. 8a, b, c). It does not valorise sustainable mode of transport such as walking and cycling or public transport.

Movement to and from	---
Movement within	--
Movement between	---



Cell development's underlying concept is to provide identifiable 'neighbourhoods'. Each neighbourhood is provided with a central focus with higher density and grid intensification (local shops, a pub and often a social element such as a church, community centre or other local public or health facilities). Some cells are designed to be independent and the boundary does not allow much movement in or out. The term 'closed' neighbourhood described this condition (off line interconnection).

Access is usually via two or three access roads from main distributors. Alternatively, the cell and its central facilities lie on the main distributors, i.e. 'on-line' interconnection development. This increases the viability of its central shops and service and such an 'on-line' cell may act as a district centre.

As the cell has to function as a neighbourhood there is less size variety than that found with pods. In order for the central functions to be viable the minimum population is taken as 4,000.

The upper end of population is determined by accessibility (10,000). For viability the local centre needs to be within approximately 5 minutes walking distance of most of catchment 'customers'. This equates to 400m across flat unobstructed land and in a road network, where direct routes are constrained to a 400m walking distance.

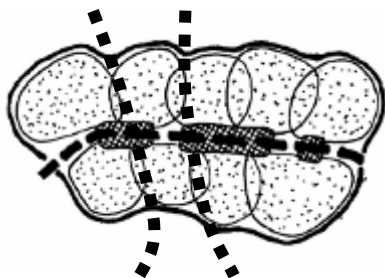
Cell development accessibility

This type of development is a mixed use elaboration of the previous type where the on line cell preceded off cell development. If accessibility within each cell can be developed to support sustainable modes of transport the accessibility between cells is often limited to modal separation and raises a problem of proximity and safe accessibility at all times. It often difficult to provide efficient public transport.

Online	
Movement to and from	+++
Movement within	+??
Movement between	+

Off Line	
Movement to and from	---
Movement within	+??
Movement between	---

Appendix 3 Built Form Development Organisations



Linear developments are part of the large scale radial and orbital movement corridors. These are along public transport corridors and as well may includes transport interchange nodes.

Mixed use is found in these higher densities. Facilities are located on the central road corridor with some variation of position. Density is graded down from the corridor.

As an urban continuum the form could contain populations of between 20,000 – 40,000, covering some 1 - 3 km in length. The linear form is not continuously even but displays the characteristics of a series of fuzzy neighbourhoods, the boundaries of which are dynamic in time.

They may integrate open space. This open land could also contain a parallel non-congested road bypassing the main central road but giving intermediate access to it. The central road will have the local traffic slowed down by good access to shops and facilities.

The diagram shows a 'single strand' of development but the form can also be developed as a 'double strand' along two parallel transport routes. There are high levels of permeability (particularly for non-motorised movement) between neighbourhoods (deformed on a line cell grid).

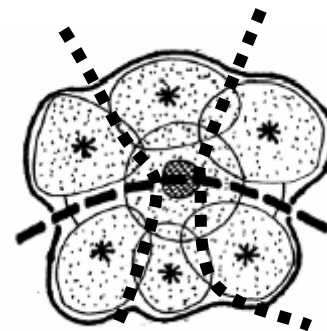
Consolidated linear development often arises historically from what was at first primarily a linear built form organisation.

Linear development accessibility

This type of development has often been a transport corridor that in time has been reinforced by different modes of public transport (tramway, buses, underground). For example, in London, early underground lines were built by opening up main roads.

Depending on the detail of the urban form, connectivity and geometry of the urban realm, accessibility can vary greatly and is often reflected in a variety of mixed use locations, which tend to take advantage of location with both global and local accessibility.

Movement to and from	+++
Movement within	+??
Movement between	+??



Intensified cluster This urban form is described in the Urban Task Force as clear urban centre with distinct neighbourhoods. A series of inter-related neighbourhoods around a centre, maximise the number of people within walking distance of the district centre hub. The hub centre must be 'on-line' for viability. Each neighbourhood has its own local facilities at a level that will be viable.

A high degree of mixed use is found in the district centre with some also but to a lesser extent in the local centres. There may be no identifiable boundary, i.e. fuzzy boundaries. Density is graded with higher densities towards the centre of each open cell and more intensively toward the hub centre, the highest densities. In the interstices lowest density uses such as education and small-scale green space are sited. Transport spoke corridors join the different parts to the hub and towards further away settlements.

Intensified cluster development accessibility

Depending on the detail of the urban form connectivity and geometry of the urban realm, accessibility can vary greatly and is often reflected in location variations of mixed uses in the district centre and the local centre with a tendency to optimise both global and local accessibility.

Movement to and from	+++
Movement within	+??
Movement between	+??

Over time, on line cell development and linear development may evolve into an intensified cluster. These types are abstract, each place is unique, each place at any one time reflect the local geographic, topographic constrains along historical and more recent development phase. Centrality, the concentration of mix uses activity should been seen as a process, sometime accelerating sometimes slowing down.

Appendix 4 Understanding pedestrian behaviour in the public domain

The life on an urban dweller is made up of series upon series of everyday pedestrian journeys.

The public realm is the setting in which these journeys unfold and, occasionally, in which they pause. People use the public domain to move between private origins and destinations (from a house to an office, for example), between public origins and destinations (from the train station to the shopping mall), or between a mixture of the two. And sometimes people stop – perhaps to rest, ask directions, browse in a market or take refreshment.

The purposes people have for moving and stopping may be necessary or practical (to buy food or re-energise themselves), or they may be optional or recreational (walking for exercise or people-watching). In fact, the presence of the latter – leisure activities – is often taken as a sign of a successful urban area.

The public domain offers opportunities for socialising with others, and high rates of socialising are another traditional sign of success. But of course, the city can also be a place for solitude.

In the end, the true success for a city or town lies in the creation and maintenance of a network of spaces that support a variety of uses and users. Knowing about the relative levels of usage for streets, squares, walkways, bridges, and other spaces helps agencies responsible for

creating and maintaining the public domain to better target limited resources.

Pedestrian behaviour baseline assessments can assist in this process. These studies are concerned with the routes and public spaces individuals choose to use – either while going about their necessary daily tasks, or while spending their leisure time – and, in the patterns such decisions form, in aggregate.

Methods for understanding pedestrian movement

In undertaking pedestrian baseline assessments, it is crucial to employ methods for capturing individual pedestrian choices, and aggregate patterns, in an efficient, yet accurate manner. This section reviews what is known on the topic.

There are two methods for gathering information about the choices pedestrians make in moving about an area. On the one hand, individuals can be questioned and their answers recorded in 'stated preference' surveys. This type of observation is typically undertaken as part of the UK planning consultation requirements for development plan production processes.

On the other hand, individuals' actual movements can be observed, and then mapped. This often takes the form of

cordon counts. People are counted as they pass through a series of virtual 'screen lines', located throughout a study area.

Although this sort of data is frequently used as an indicator of activity, it can also be viewed as a consultation which presents the 'revealed preferences' of an area's users – the manner in which they are consulted is by a 'vote with their feet'.

Perhaps surprisingly, the results of these data collection activities often differ. This is because it is rarely possible to achieve a sample for stated preference surveys of the same size, or geographic density, as with observations of actual movements. The two methods are complementary, with the former providing a useful qualitative understanding of the quantitative data generated by the latter.

There are limitations to most methods of observing actual movement. With current technology, even in small areas, it is not possible to monitor all spaces and capture all of pedestrian movement. In any area, only a selection of spaces within it can ever be observed. Even observing a small sample of spaces can be expensive and time-consuming and, therefore, difficult to undertake with any frequency.

In addition, these observation methods can only answer questions about how a specific change to the environment affects pedestrian behaviour *after* that change has been made. They do not offer any help to decision-makers evaluating change proposals.

Fortunately, the results of extensive observational research show that pedestrian movement patterns tend to follow certain rules. Individuals appear to use specific intentional, environmental and (most importantly of all) *spatial* criteria when they choose a route between an origin and destination.

These rules can be used to generate criteria for qualitatively evaluating the pedestrian infrastructure of an urban area.

Taken together, these methods can be very useful to those responsible for planning, designing, maintaining, and monitoring urban infrastructure.

Appendix 4 Influences on pedestrian movement

Influences on pedestrian movement

People construct mental maps of an area by using both perceptual information (what they can see, hear, etc.), and inferences about things they cannot directly perceive. These mental maps then inform route choice plans across an area. They also change in response to new information, and are thus part of a 'way-constructing' and 'way-finding' process.

Beyond mental maps, research has shown that the influences on pedestrian route choice preferences include income level, gender, age, perception of one's own strength and stamina, familiarity with an area, and the time and place of their journey's origin.

Pedestrians also tend to exhibit a number of spatially-related tendencies that affect route choice decisions. Most of the time most people will:

- use spaces that lie on the shortest path towards their seen or unseen destination
- select the longest direct leg earlier in a journey, when faced with alternatives
- minimise directional changes along a journey and avoiding back-tracking

- select spaces offering natural surveillance/deterrence, such as those with active frontages, and clear indications of use and ownership
- select routes which allow them to link into 'chain' destinations, and so facilitate multi-purpose journeys

Proceeding from and 'multiplying' all these other factors, the presence or absence of other people along routes or in spaces will also affect on individuals' route choice preferences.

Influences on public space use

Extensive research has found that there are six main influences on pedestrian stopping and public space use:

- 1 Proximity to high levels of pedestrian movement* – good public spaces are located close to the routes with high levels of pedestrian movement.
- 2 Good accessibility from the surrounding area* – successful squares are located at strategic points in the pedestrian movement network (such as at the intersections of important pedestrian movement routes).
- 3 Movement routes pass through the body of the space* – to achieve good levels of use, it is important that the routes bring movement from several directions through the heart of the space, and do not just 'skirt' around the edges.

4 Multi-directional views into the surrounding urban area – people are more likely to use squares where they can see where they are going, and feel safe. Similarly, people prefer to stay where they have good visibility from within a space into the surrounding areas.

5 Proximity of 'live-uses' – land uses such as retail and catering attract activity over and above the effects of spatial layout, and contribute to the natural surveillance of the space by providing presence in the space.

6 Adequate seating and street furniture – good seating, lighting, and high-quality landscaping all encourage informal / stationary activity within public spaces.

Influences on visitors' spending in town centres

The mode of transport used to access town centres has an impact on the average spending of visitors, as suggested by research prepared for TfL Surface Transport in 2004.

Visitors' average spending per week by mode of transport

Walking	£91
Car	£64
Bus	£63
Tax/cycle/other	£56
Train/underground	£46

People who most contribute, are those who walk. Their average spending per week exceeds that of people who use any other mode of transport. This group is followed by people who travel by car or bus.

This implies that the way people move, dwell or stop within the public realm influences their spending or 'contribution to the economic health and viability of town centres across London.'

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Town Centre Survey 2003-4: Summary Report. July 2004 by Accent Marketing Research for TfL Surface Transport. London

For an overview see:

Network and psychological effects in urban movement. Hillier B. & Shinichi I., 2005. Proceedings of the Fifth Space Syntax Symposium, Technological University of Delft, Vol. 1.

For fuller discussion:

The Cambridge handbook of Visuospatial Thinking. Edited by Priti Shah & Akira Miyake, 2005. Cambridge University Press. Cambridge.

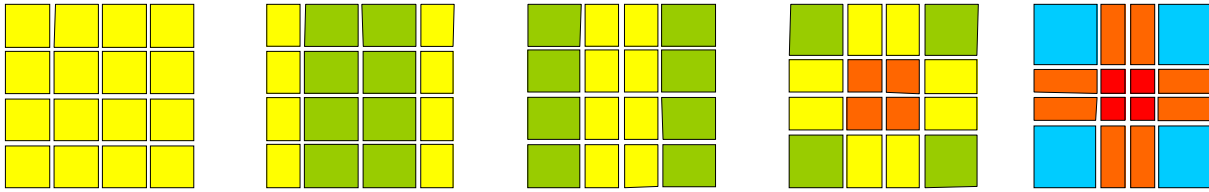
Wayfinding Behavior: Cognitive Mapping and Other Spatial Processes. Golledge, Reginald G., 1999. The Johns Hopkins University Press. Baltimore.

Space is the Machine. Hillier B., 1996. Cambridge University Press. Cambridge.

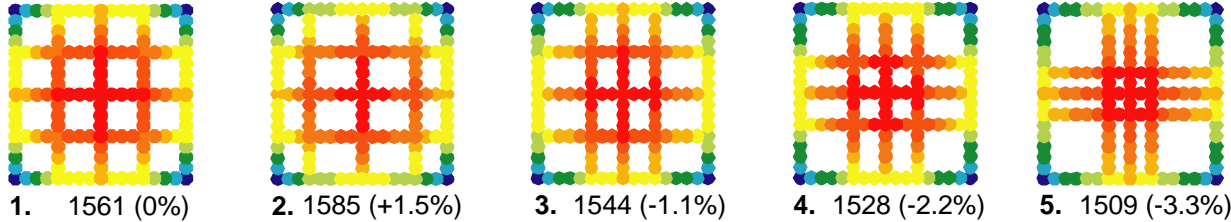
Appendix 5 Urban grain – size, shape and configuration

Case study A

from a regular layout to central intensification

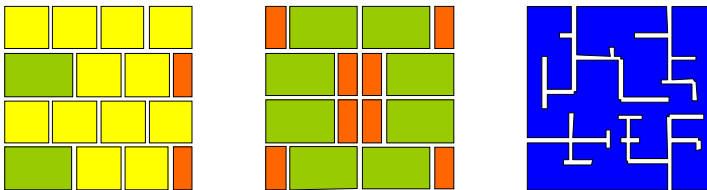


Relationship between urban layout & travel performance (distance/time)

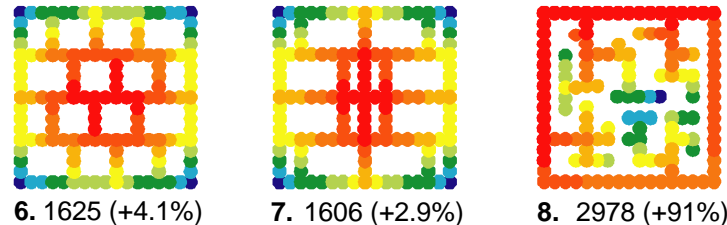


Case study B

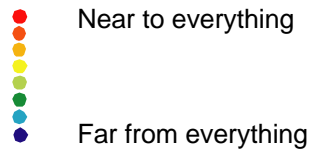
From a connected & distributed grid to a disconnected grid



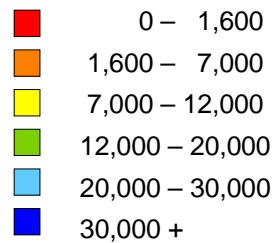
Urban layout travel performance



Travel performance



Block size area (m²)



Images to the left show the impact block sizes and distribution have on metric integration and therefore on pedestrian walking time, in urban areas.

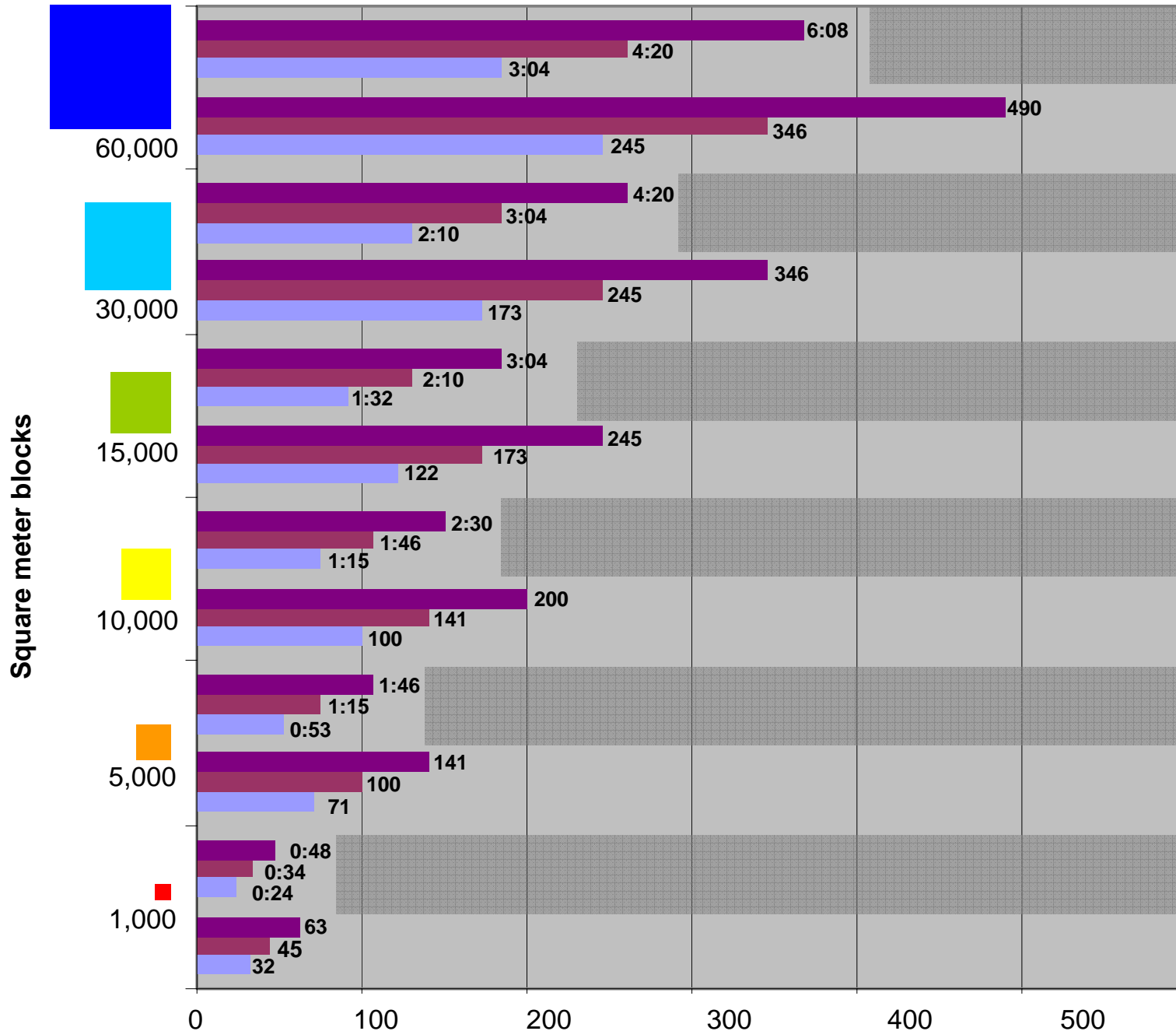
The set of diagrams “A” and “B” represent systems with identical area and road width. What changes is their geometry.

Case study A shows the effect of grid intensification on travel performance for regular grids. In relation to option 1, which is used as a base, option 5 shows the most noticeable improvement in terms of distance/time efficiency, through grid intensification towards the centre.

Case study B displays the effect that the complexity of the spatial layout has on performance (distance/time). In comparison to figure 1, figure 8 increases dramatically, meaning that the fragmented configuration has a strong impact on performance.

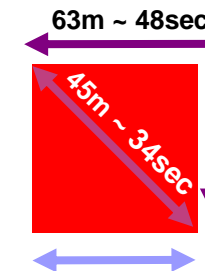
The configuration of the urban layout determines the level of visual access and the complexity of the spatial layout. These will have an impact on ease of movement and navigation, which influence levels of movement flow and co-presence.

Appendix 5 Urban grain – block size and walking time



Transport for London – Public Transport Accessibility Level (PTAL) consider walk speed to be 4.8 km/h, or 80 m/min, or 1.33 m/s. Cyclist are considered to be travelling, on average, twice pedestrian speed.

The table on the left shows the relation between block size and walking distance.



- 32 m x 32 m = 1,000 m²
- 71 m x 71 m = 5,000 m²
- 100 m x 100 m = 10,000 m²
- 122 m x 122 m = 15,000 m²
- 173 m x 173 m = 30,000 m²
- 250 m x 250 m = 60,000 m²

- Demi-perimeter
- Diagonal
- Side

- Metres
- Minutes

Appendix 6 Ease of movement – spatial accessibility – legibility analysis

Introduction

Accessibility can be defined as the ability and degree of ease that people have when moving around in their environment. This includes physical accessibility, as for elderly and disabled people, those with young children, or those encumbered with luggage and shopping. It also includes larger scale accessibility such as the availability of routes to and from different parts of a city – which has been shown to play an important role in channeling and facilitating urban movement and exchange. Block size, grain, character, connectivity, and directness all contribute to the accessibility of a place.

Although it is often easy to determine accessibility from a single given location to any other (we often do this in our head when giving directions), it becomes extremely difficult to determine accessibility from tens of thousands of different origins and destinations, as is the case in real urban environments.

Past research has found that despite the wide range of origins and destinations within a city, there is a relatively stable movement pattern. This suggests that the pattern of journeys used by most people most of the time is relatively tractable and predictable. When viewed from this perspective, it becomes clear that what is most important is not the specific origins and destinations pairs, but the character and pattern of the journey flows themselves. This is exactly what accessibility analysis measures.

The balance between accessibility and other factors is critical to the success of well functioning urban spaces. Where the coupling between urban form, accessibility, land use, and transport is out of balance, the fit between accessibility and movement levels can be out of balance; often resulting in the potential for socio-economic disorder. When this is the case, space syntax analysis incorporates other variables such as frontage quality, land use, ownership status, exposure, and social data such as crime rates and aesthetic preference. Together these can be valuable tools for prioritising the best course of action for community action and physical action plans.

Space syntax journey simulation

SSx performs 'journey simulation' and route choice analysis which takes into account the route choice strategy and preference of most pedestrians, cyclists and drivers.

These analytical techniques have been demonstrated to be a robust way of assessing accessibility of the urban structure and grain and, in doing so, indexing the ease of movement for most of the people in an area most of the time. This index is often referred to as 'spatial accessibility'. An understanding of spatial accessibility can then be used to establish a robust hierarchy of routes within the public domain movement network.

Spatial accessibility analysis methods

Spatial accessibility analysis in Croydon Town Centre was performed using the public open space line map (presented earlier) as its basemap. This map of public open space in Croydon was analysed in two ways:

1. 'Closeness' was calculated, which simulated travel between origin and destination pairs using a "least change of direction" heuristic. This process sums up for each segment or line the least angle route distance between all locations in the city, creating a 'closeness' map. In a basemap having k segments, then the number of trips simulated is $\frac{1}{2}(k*k-1)$.
2. 'Betweenness' or 'choice' analysis was also simulated. This measure calculates the level of passing movement on each segment while simulating 'closeness' movement. This reveals the resulting traffic passing a street but going somewhere else using least change of direction. The measure is called 'the centrality of that segment' and captures the route hierarchy of the system.

The simulation of metric and geometric 'closeness' and geometric 'betweenness' in Croydon Town Centre allowed us to determine which streets and blocks were most accessible to others, as well as which routes were more likely to experience traffic and which were not.

To do this, the choice measure was used to establish a hierarchy of routes in Croydon Town Centre. This was coloured up using a scheme to represent most likely use hierarchy, with routes comprising the highest levels of most direct journeys coloured in red, orange, and yellow. Routes which carried less journeys were coloured greenish-blue and blue.

Where observations of existing movement levels are available, the relationship between simulated and observed movement levels can be statistically compared to determine the exact degree of 'fit' between them. Empirical studies have shown that these simulations conform to real movement with up to 80% accuracy in most cases – especially in well structured urban environments where accessibility, land use, and transportation nodes are in synergy with ease of movement.

In cases where movement data is not available, as was the case in Croydon, simulated journeys alone can be used to identify approximate movement levels and route hierarchies based on their robust history of use and comparative cases. This was the case in Croydon, where 'choice' was used to estimate movement flows throughout the town centre.

Appendix 6 Movement, pausing, body and mind, pleasure and function

Route choice factors

A great majority of journeys involve locomotion, navigation and way finding components in varying degrees. Locomotion is a physical capacity while navigation and way finding are more mind capacities and competencies.

Identifying route choice hierarchy requires understanding how these different components impact on path selection behaviour and result in route choice preference patterns.

Layout complexity is “informational” depends and is retrieved in part from the situational context and is a function of both local and more global geometric relations.

Route choice preferences are also affected by attributes such as sense of safety/security and pleasure (see *By Design* and *Safer Place*).

Key performance indicators (KPI)

Locomotion ease: proximity KPI

A generalised metric distance is used to assess it.

Way finding ease: legibility KPI

A generalised geometric distance indicator is used to assess it.

Safe, secure KPIs require a different set of indicators (see *Safer Place*).

Pleasure KPIs require a different set of indicators (see *By Design*). Coherence, complexity, legibility, mystery are “informational” qualities of the environments that contribute to people’s preferences of particular physical environment sequences.

Physical immediate environments appreciation is supported by understanding ‘coherence’ (i.e. making sense, environment easy to organise and structure), complexity (i.e. to encourage involvement, environment with enough in the present scene to keep one occupied), in the longer term, qualities of ‘legibility’ (e.i. Environment suggesting they could be explored extensively without getting completely lost) and ‘mystery’ (i.e. environment suggesting that, if they were explored further, new experience could be acquired). An overall objective would be encouraging progressive disclosure

Appendix 7 National policy context

Introduction

This section visits a number of policies, in each case setting out the positions specifically related to pedestrians, cyclists, and the public realm design.

DfT – *Walking and Cycling: an Action Plan (2004)*

Pedestrians should be given higher priority in highway and transport planning, and in most cases should be on top of the transport modal hierarchy, followed by cyclists, public transport and private vehicles.

The objectives of the Department for Transport related to walking and cycling include:

- creating places that people want to walk and cycle in
- providing high quality facilities for safe walking and cycling
- influencing travel behaviour through education, training marketing and promotion
- monitoring success through better targets and indicators.

ODPM – *Planning Policy Statement 1 (PPS 1) : Delivering Sustainable Communities (2005)*

Development plans should promote development that creates socially inclusive communities, including suitable mixes of housing. Plan policies should:

- ensure that the impact of development on the social fabric of communities is considered and taken into account
- seek to reduce social inequalities
- address accessibility to jobs, health, housing, education, shops, leisure and community facilities – for all members of the community and in terms of both location and physical access
- take into account the needs of the entire community, including particular requirements relating to age, sex, ethnic background, religion, disability or income
- deliver safe, healthy and attractive places to live
- promote health and well-being by making provision for physical activity.

Additional guidance, specified in PPS12 and in line with PPS1, is set out in the following three companion good practice guides.

DETR/CABE – *By Design: Urban Design in the Planning System (2000)*

Successful towns have certain objective characteristics in common. New developments should strive for these characteristics, which include:

- *Quality of the public realm* – places with attractive and successful outdoor areas
- *Ease of movement* – places that are easy to get to and move through
- *Legibility* – places that have clear image and are easy to understand
- *Diversity* – places with variety and choice
- *Continuity and enclosure* – places where public and private spaces are clearly distinguished
- *Character* – places with their own identities
- *Adaptability* – places that can change easily.

Appendix 7 National policy context

ODPM/Home Office/CABE – *Safer Places: the Planning System and Crime Prevention* (2004)

There are seven attributes of places which are particularly relevant to safe movement in sustainable communities and should be taken into consideration:

1 Access & movement – places with well-defined routes, spaces and entrances that provide for convenient movement without compromising security

2 Structure – places that are structured so that different uses do not cause conflict

3 Surveillance – places where all publicly accessible spaces are overlooked

4 Ownership – places that promote a sense of ownership, respect, territorial responsibility and community

5 Physical protection – places that include necessary, well-designed security features

6 Activity – places where the level of human activity is appropriate to the location and where it creates a reduced risk of crime and a sense of safety at all times

7 Management and maintenance – places that are designed with management and maintenance in mind, to discourage crime in the present and the future

ODPM – *Planning and Access for Disabled People: a Good Practice Guide* (2003)

All parties in the planning and development process should recognise the benefits of inclusive design and endeavour to bring it about.

Inclusive design produces environments that can be used by everyone, regardless of age, gender or disability. It is made up of many elements, such as societal and individual attitudes, the design of products and communications, and the design of the built environment itself. It recognises and accommodates differences in the way people use the built environment and provides solutions that enable all of us to participate in mainstream activities equally, independently, with choice and dignity.

An “accessible environment”, on the other hand, can be used by disabled people but is not inclusive in nature. “Accessible design” often leads to separate facilities for disabled people, such as platform lifts or ramps to one side of a stepped entrance (whereas “inclusive design” provides a single solution for everyone).

People are very different in their needs, and in the way they use the built environment. An “inclusive environment”, recognises and accommodates these differences while attempting to keep in step with character and identity of a place.

ODPM – *Planning Policy Statement 6 (PPS 6) : Planning for Town Centres* (2003)

It is essential that town centres provide a high-quality and safe environment if they are to remain attractive and competitive.

Policies for the design of development for main town centre uses, regardless of location, and for development in town centres, should promote high quality and inclusive design, in order to improve the character and quality of the area in which such development is located and the way it functions.

ODPM – *Planning for Town Centres: Guidance on Design and Implementation Tools* (2005)

Built form

Developments should:

- normally be orientated so that they front the street
- respect building lines of the existing urban environment and, where appropriate, build up to the edge of the curtilage
- maximise the amount of active street frontage
- avoid designs which are inward looking and which present blank frontages
- provide level access from the public realm

Developments should be encouraged that employ innovative layouts to maximise the use of a site; where appropriate to local context, multiple levels should be encouraged.

Designs for buildings and shop fronts should integrate with local contexts.

Roofscape design should be carefully considered within the wider context, minimising any adverse visual impact of rooftop servicing.

Appendix 7 National policy context

ODPM – *Planning for Town Centres: Guidance on Design and Implementation Tools (2005)* – *Cont.*

Public realm and access

Through their planning and design policies and proposals, local planning authorities should create high-quality streets and public spaces. Street furniture and signs, if not well designed and co-coordinated, can cause visual clutter. Local planning authorities should work in partnership with other stakeholders, including the local highway authority, on the provision, rationalisation and maintenance of street furniture, signage and paving, to improve the streetscape and produce high-quality, accessible and coherent pedestrian environments. Pedestrian links between the primary shopping area and the wider town centre should where possible be strengthened, in particular with adjoining areas of secondary shopping importance, where links with the primary shopping area are often of critical importance.

Local authorities should seek to improve access to and from town centres by all modes of transport, but in particular pedestrian access from the main point of arrival (such as bus or railway stations or car parks) to the main attractions, such as the primary shopping area. Improving the pedestrian environment of a town centre, including areas beyond the primary shopping area, can make a significant contribution to its overall attractiveness and competitiveness. Guidance on managing public spaces in town centres is given in *Managing Urban Spaces in Town Centres*.

Local authorities should:

- seek to improve the quality, convenience and safety of access on foot, by bicycle and public transport in an inclusive way, including where appropriate, consider drawing up and implementing a strategy for improving pedestrian routes to and within the town centre; and
- closely integrate proposals to improve accessibility with improvements to traffic management and the management of car parking.

Parking

Large amounts of surface level parking are likely to detract from the overall appearance of a development and its surrounding area and are unlikely to maximise the development potential of available land.

Car parking and service areas should be carefully located within a development so as to minimise visual impact. Car parking should normally be located to the rear, underneath or, where appropriate, above new development.

Where surface car parking is proposed, this should be conceived within the overall landscape proposals for the development and link into the wider area. Multi-storey car parking should also be carefully designed and be well integrated with its surroundings.

Pedestrian access, security, lighting, signing and publicity, management and maintenance are all important design considerations. Where rooftop car parking is proposed, lighting should be designed sensitively to minimise the level of light pollution to the surroundings.

Landscape

The treatment of hard and soft landscaping within a development is of considerable importance and should be considered from the outset of the design process to ensure that it complements the architecture of proposals and improves the overall quality of the existing townscape. Townscape views into and out of larger sites should also be carefully considered from the start of the design process.

Appendix 8 Regional policy context

TfL – *Walking Plan for London (2004)*

<http://www.tfl.gov.uk/streets/downloads/pdf/walking-plan-2004.pdf>

A general vision for transforming London into one of the world's most walking friendly cities by 2015 as directed in the Mayor's Transport Strategy. Five indicators of walkability are defined by the "5 C's" – *Connected, Convivial, Conspicuous, Comfortable, and Convenient.*

The Plan also encourages local authorities to develop their own walking strategies which are well integrated into local transport strategies. The Plan maintains that in order to meet its target of a 10% increase in number of journeys made on foot per person by 2015 there must be a systematic improvement of the physical environment in which people walk. Further objectives are identified:

Improving co-ordination and inclusiveness in the Walking Plan development

Improving street conditions including streetscape development and access

Improving all development proposals by ensuring designs maximise pedestrian access and convenience while minimising crime risk..

Improving safety and security through good street design.

Timely delivery of Plan and monitoring including a walkability index.

GLA – *The Mayor's Transport Strategy (2001)*

http://www.london.gov.uk/approot/mayor/strategies/transport/trans_strat.jsp

In order to achieve the Strategies central objective of reduced congestion, all forms of sustainable and efficient transport choices are encouraged.

Specifically, conditions for walking and cycling need to be improved and their integration and interchange with public transport.

The Strategy seeks to improve accessibility to all aspects of travel for all Londoners.

TfL – *Creating a Chain Reaction: The London Cycling Action Plan (2004)*

<http://www.sustrans.org.uk/webfiles/county/London%20Action%20Plan%20FINAL.pdf>

Cycling is an integral part of overall transport strategy for London. The target is a minimum of an 80% increase in cycling between 2001 and 2011 and a 200% increase by 2025.

London Boroughs will responsible for much of the Plan's implementation including planning and building new cycle schemes. The Plan also encourages the design of roads that are considerate of cyclists so their needs are addressed equally with those of pedestrians and motorists. Also important is new development and regeneration to minimise the negative impact on cycling and give greater priority to cyclists.

Some of the Plan's objectives are:

- Introduce quality conditions with the London Cycling Network Plus (LCN+)
- Increase cycle access, safety and priority
- Increase provisions for cycle parking
- Support innovative cycling schemes
- Promote cycle links and interchange schemes
- Optimise the contribution to cycling from other schemes, specifically integrated transport and regeneration initiatives

Appendix 9 Local policy context

The Croydon Plan (2006)

Strategy

The 6 key objectives of the London Plan are:

- To accommodate London's growth within its boundaries without encroaching on open spaces
- To make London a better city for people to live in
- To make London a more prosperous city with strong and diverse economic growth
- To promote social inclusion and tackle deprivation and discrimination
- To improve London's accessibility
- To make London a more attractive, well-designed and green city.

Policies

SP1 The Council will expect development in Croydon to be sustainable. (p.5)

SP5 The Council will safe-guard and seek to enhance the open character of the Metropolitan Green Belt and Metropolitan Open Land. (p.5)

SP14 The Council will promote sustainable transport in planning (p.7)

Sustainable Development

3.2 There are substantial economic and social opportunities to be gained through developing in a way that enhances the environment and gives us a more efficient and attractive local infrastructure. (p.11)

Urban Design

4.3 The Council will seek good urban design that contributes to the achievement of

sustainable development by a number of measures which include: reducing dependence on the car by improving the viability of public transport and other services in urban areas and ensuring that existing pedestrian and cycling routes are reinforced and supplemented. (p.25)

4.24 The success of a development in providing an attractive and safe environment for the people who use it depends on the way it is integrated into its surroundings as well as the design of the spaces within and around it. New open spaces and routes, which may arise from some types of development, such as housing or large commercial development, should have principles of safety, attractiveness and accessibility included at the outset.

UD6 The Council will require that issues of safety and security are an intrinsic consideration in the detailed design and layout of buildings and the spaces around them, helping to deter crime and reduce the fear of crime. In this context, new development will be required to achieve a number of measures including: integration into the existing pattern of pedestrian and vehicular movement. (p.23)

4.38 New development should aim to encourage the use of the public environment by encouraging pedestrian access and movement and reducing dead frontages, so that there is a reduction in the opportunity for crime combined with an increase in natural surveillance. (p.23)

UD12 Planning permission will not be granted for new development unless:

- (i) the detailed design of roads, footpaths and cycle routes ensures the safety of all users, and
- (ii) the layout of the scheme is based on a

series of spaces, rather than a network of roads. (p.29)

4.66 In order to create successful environments, a balance needs to be struck between the movement of motor vehicles, cyclists and pedestrians and a pleasant environment for all users. The safety of pedestrians and cyclists should be given priority with careful use being made of shared surfaces, where appropriate, offering physical improvements to the public realm. Movement networks through and around developments should be designed to serve the built form, rather than dominating it, and not at the expense of good layout design. (p.29)

Open Land & Outdoor Recreation

SP5 The Council will safe-guard and seek to enhance the open character of the Metropolitan Green Belt and Metropolitan Open Land. (p.55)

RO6 Development within or conspicuous from the Metropolitan Green Belt or Metropolitan Open Land will not be permitted if it would harm their visual amenity (p.62)

6.51 Where justified, enhancement of the network of public rights of way is also a consideration. Development proposals can offer the opportunity to seek improvements to the existing network and provide new links, but can only be sought for the benefit of the occupiers of the development being proposed. (p.72)

Transport

SP14 The Council will promote sustainable transport in planning decisions by:

- (i) Actively managing the pattern of urban growth to make the fullest use of public transport, and focus major generators of travel demand in the Croydon Metropolitan Centre and other appropriate Town, District or Local Centres, and near to major public transport interchanges;
- (ii) Locating facilities which are accessed daily, near the people that use them in Local Centres so that they are accessible by walking and cycling;
- (iii) Accommodating housing principally within existing urban areas, planning for increased intensity of development for both housing and other uses at locations which are highly accessible by public transport, walking and cycling;
- (iv) Ensuring that development comprising jobs, shopping, leisure and services, offers a realistic choice of access by public transport, walking and cycling;
- (v) Ensuring that strategies in the Croydon Plan and in the Council's annual Local Implementation Plan complement each other and that consideration of Croydon Plan allocations and local transport investment and priorities are closely linked;
- (vi) Using parking policies, alongside other planning and transport measures, to promote sustainable transport choices and reduce reliance on the car for work and other journeys;
- (vii) Giving priority to people over ease of traffic movement and plan to provide more road space to pedestrians, cyclists and public transport in town centres, local neighbourhoods and other areas with a mixture of land uses;
- (viii) Ensuring that the needs of disabled people - as pedestrians, public transport users and motorists - are taken into account in the implementation of planning policies and traffic management schemes,

Appendix 9 Local policy context

and in the design of individual developments;
(ix) Considering how best to reduce crime and the fear of crime, and seek by the design and layout of developments and areas, to secure community safety and road safety; and,
(x) Protecting sites and routes which could be critical in developing infrastructure to widen transport choices for both passenger and freight movements. (P.115)

9.12 There are a number of methods of overcoming potential traffic generation problems arising from new development, through agreements between the Council and the developer. It may be possible to carry out localised highway works to accommodate generated traffic. However, it would be preferable to reduce the levels of traffic generation through developer contributions to improvements in public transport accessibility and services, new public transport, walking or cycling infrastructure, bus standing facilities in town centres, cycle parking, park and ride schemes, on-street parking controls or other suitable measures. The developer's proposals for reducing the levels of traffic generation will be set out in the Travel Plan and proposed contributions will be secured by a S.106 Planning Obligation and/or a S.278 Agreement under the Highways Act 1980, as appropriate. Potential future availability of public transport will be assessed by considering the contribution that a developer makes through S.106 planning obligations to the improvement of public transport and other committed public transport schemes (e.g. Tramlink extensions and the East London Line extension). (p.118)

9.15 The LIP contains details relating to pedestrian facilities and walking. The LIP promotes walking as a sustainable mode of transport and seeks to improve the safety and

quality of the pedestrian environment.

9.16 To encourage walking it is necessary to improve the existing pedestrian network. This can be facilitated through new on-site facilities and connections to the local pedestrian network as part of developments. (p.119)

T3 In major developments and other developments likely to attract significant numbers of pedestrians, the Council will seek the provision of pedestrian facilities, including facilities to assist pedestrians with disabilities and impaired mobility. (p.119)

T4 In major developments and other developments likely to attract significant numbers of cyclists, the Council will seek the provision of cycling and cycle parking facilities. In considering applications for development, the Council will have regard to the cycle parking standards set out in Appendix 2.

9.17 Major new development should make suitable provision for cycling access to and from the surrounding road network. Where appropriate, the Council will seek developer contributions (in S.106 Agreements) to off-site cycling facilities or infrastructure (see also policy T2). Suitable facilities for cyclists, including lockers, changing and showering facilities, should be provided within larger developments, where their exposure to vehicle emissions should also be minimised.

9.18 New development should provide sufficient, safe and secure cycle parking facilities.

9.19 The LIP contains details relating to cycling and cycling facilities. The LIP promotes cycling as a sustainable form of transport and seeks to improve the safety and

quality of cycling facilities.

9.20 To encourage cycling it is important to provide cycle facilities, parking and connections to the surrounding cycle network as part of developments.

9.21 The LIP contains details relating to the public transport network including major public transport proposals, trains, light rail, buses, taxis and minicabs. The LIP promotes public transport use and an improved public transport network.

9.22 A safe and efficient public transport system integrated with land use is fundamental in promoting sustainable transport choice and reducing the need to travel. Developments which generate high demand for movement should be located in existing centres to take advantage of high levels of accessibility to public transport. (p.120)

T5 Major developments in close proximity to public transport interchanges and termini which will require increased use of public transport will be required to enable or provide those facilities.

9.23 Adequate capacity, quick, easy and safe interchange is essential to integration between different modes of transport. Interchange facilities that are safe, attractive and convenient will assist users and encourage greater use of public transport. Facilities such as the convenient location of bus stops, secure cycle parking, safe and direct access for pedestrians and set down areas for cars and taxis help to promote sustainable transport choice. (p.120)