Accessibility, Urban Design and the Whole Journey Environment

GRAEME EVANS

Accessibility and mobility within the urban environment has been dictated by the design and layout of buildings and road infrastructure. Both, in their separate ways, have created problems of safety and crime which have conspired to limit pedestrian confidence and therefore movement and travel choice amongst particular groups. Benchmarking of accessibility does not tend to reflect everyday journeys and trips taken or desired, and the perceptual barriers felt by many people. This article reports on a five year research study into accessibility, urban design and social inclusion (AUNT-SUE), funded under the EPSRC's Sustainable Urban Environment programme. The development and validation of a street design index and evaluation of routes is presented through a test bed case study based on user consultation with groups experiencing barriers to pedestrian access, 'fear of crime' and therefore to engagement with the transport system and wider social inclusion. This involves the use of GIS-participation techniques and map walks with residents, integrated with digital data analysis and visualization of the whole journey environment. Particular attention is paid to the mobility and journey needs of users, as well as perceptual and safety issues, since these present some of the major barriers to transport access for vulnerable groups.

> Every time you walk to the shops or try to cross the road you are encountering a classic example of bad design. This design failure is the result of an ideology of traffic engineering that put cars first and dictated that different modes of transport must be set apart. (Desyllas, 2006, p. 33)

Modernization, of which road building was a key aspect from the 1950s, has fuelled – literally – the motor car, which today has encroached into every corner of our urban environment. The chances of a 10–14 year old child dying in a road accident doubled between 1955 and 1990. Community safety, accessibility and social inclusion have emerged as particular challenges to the design of the urban environment, raising a wide range of issues affecting mobility and participation in everyday life. Accessibility here relates to the ability to reach a range of social, leisure and employment destinations from home and therefore access to pedestrian and transport systems. While assistive technology research has focused on improvements in product design for individual and home-based application, accessibility has been limited to removing particular barriers such as to wheelchair access (although less than 5 per cent of the registered disabled are wheelchair reliant), e.g. step free stations, low floor buses, dropped kerbs, and ambient factors such as lighting, auditory and visual information and way-finding. This is due in part to the imperatives that drive such product development with a clear target and user group and measurable benefits arising, including commercial application. Accessibility design, on the other hand, is

more of a process, with a multiplicity of stakeholders in the public realm and one that should include: 'all people regardless of age, gender, race or disability, encompassing management, operation and information and relating to all areas – the built environment, transport, graphics, telecoms and products. This is quite different from some iconic perfect and immutable product or design' (Walker, 2005, p. 103).

The urban environment and transport system is, however, fragmented in both policy, operational – ownership, statutory responsibilities – as well as design spheres. Or more accurately, transport policy and planning have been isolated from urban policy and planning. This fragmentation is multiplied further in terms of spatial scale and public and private interests. Design-related disciplines with an interest in the urban environment and transport system include: architects, urban designers, street, traffic, highways and civil engineers, as well as product, communications and industrial designers, and professionals with a responsibility for land-use, housing provision, transport and safety – notably town and transport planners, street care teams, the police – crime prevention/architectural liaison officers, safer neighbourhoods teams – and specialist advisers such as access and disability auditors. Defining the field and the scope of accessible transport from an inclusive design perspective is therefore best conceived in terms of the 'whole journey environment', since as Coleman (2003, p. 132) notes: 'A journey can be seen as a chain of individual products and services whose accessibility is only as strong as its weakest link'. In making our travel decisions, we do not differentiate between the elements of the journey but on their perception of the whole journey: 'a broken paving stone under a failed street lamp is a deterrent to walking – it is of no use to say "as much as" or "more than" or "less than" fear of attack; if the environment stops someone from walking, it is not a matter of degree' (Crime Concern, 1997, p. 22). In practice, standards in accessible design tend to isolate particular elements such as the design of building features and their approaches (Disability Discrimination Act – DDA, 1995) not if and how the user actually reached the destination itself, or whether transport is integrated with service delivery, e.g. opening times. Official benchmarks classify a service or activity as 'accessible' if it can be reached at reasonable cost, in reasonable time, and with reasonable ease. 'Reasonable' in this context is not however defined (this same term is also used in DDA legislation) with this value judgement decided by the provider (e.g. facility or transport operator) not the user, let alone those most excluded from travel and transport. Access guidance arising from the DDA legislation gives transport limited coverage – less than one and half pages out of over 100 (Ratcliff, 2007), with a focus on building, workplace and vehicular access.

Community Safety and Barriers to Walking

Particular attention has been paid in our research to perceptual and safety issues, since these present one of the major barriers to access for excluded groups – with over 11 per cent of the general public saying that they would travel more if they felt safer on the transport system (Crime Concern, 2002). While crime and safety within the transport system (on board, at stations and bus stops) has received attention from police and transport operators (e.g. CCTV, security), safety is of more concern and crime a greater barrier to access in the journey *to and from* transport by all people, but particularly women (Crime Concern, 1997). CCTV has also been found to be less effective in actual crime prevention and victim protection, than in reporting and detection – and only significant in crime reduction in car parks with improved lighting and security guards (Welsh and Farrington, 2008). CCTV does, however, account for over 75 per cent of all spending on crime prevention in the

UK, whereas investment in improved environmental design and community safety would more directly address fear of crime and situational crime prevention. More vulnerable groups and those who rely more on walking (i.e. older and younger people) frequently cite the safety factor, including fear of crime, as the highest in determining their travel behaviour. Indeed from our user group surveys, the first barrier to travelling at all, let alone more frequently, starts at the front door, then in the immediate neighbourhood. This includes physical barriers to particular mobility impaired groups, but a range of perceptual and environmental constraints are felt by a much wider population who are effectively excluded from travel, including a high proportion of older people and others suffering social exclusion, including women, women with young children and ethnic minorities. From our surveys with older people, for example, ease of leaving the house and of simply 'getting around' was the most important consideration, with regular mobility their prime need (below).

At the micro-scale, responsibility rests primarily with the street or traffic engineer with the emphasis (or priority) given to vehicular road access and movement, and safety in terms of pedestrian-road/vehicle inter-action, i.e. accident prevention. Crossings and car speed are key limitations to pedestrian access: 'roads are often perceived as barriers to the day-to-day movements of older people ... Road traffic can lead to a perceived danger of travel, which causes feelings of insecurity, anxiety and stress' (WHO, 2002, p. 12). Communities living in more disadvantaged areas are one and a half times more likely to be killed or injured on the roads than those living in better off areas, children under 16 over four times (DfT, 2007), a shocking ratio. These communities are less likely to have access to a car and therefore the pedestrian and public transport system is of greater importance, as is community safety. Cycling, the subject of sustainable transport and healthy living campaigns, has also seen an increase in fatalities and serious injuries (11 per cent up between 2004 and 2007), despite no significant increase in cycling over this period (NAO, 2009). London, where, post-congestion charging, cycling has increased, also has the highest rate of cyclist and pedestrian deaths (17 per 100,000 against an average of 11).

Only recently has the street (as opposed to the road) as a pedestrian environment attracted transport, design and safety attention, as a stimulus to increased walking and pedestrian activity. This has been driven by the twin goals of sustainability through more compact, walkable cities (Cooper *et al*., 2009; Jenks, 1999) resulting in reduced car use, crime and pollution, and the health benefits from increased physical activity countering 'obesogenic environments' (Heath, *et al*., 2006; Handy *et al*., 2002; Lake and Townsend, 2006). Recent efforts to fill this knowledge gap include design guidance and toolkits to measure accessibility at the street level (table 1), and guides to facility design, particularly to meet disability access and related building and planning regulations. The recent Transport Ministry's *Manual for Streets* (DfT, 2007) signalled government's acknowledgement that the pedestrian needed to be at the top of the 'hierarchy of need' in the public realm, drawing on growing good practice in street design and layout schemes. Design guidance referenced in this manual is also generally predicated on new-build or major works. However the vast majority of development is incremental, retro-fitting and infill of existing built environments.

Design guidance generally, including crime prevention and safety, has tended to focus on access and layout of buildings, notably *Secured by Design* (ACPO), *Buildings for Life* (CABE), *Design Quality Indicator* (CABE/CIC), *Active Design* (Sport England), and also open space (CABE Space). However, the more complex pedestrian journey and transport access has not undergone the same level of inclusive design analysis. Wider community and user involvement in these professional

Table 1. Selected toolkits for street design and accessibility.

Toolkit Source	*Aim*	*End-user involvement*	*Method*	*Input*
Link and Place Jones *et al*. (2007)	Planning and Design of urban street as a *Link* – a place that users should pass through as quickly and conveniently as possible; and *Place* – as a destination in its own right – equally important. Aims to meet varying needs of street users and encourage active stakeholder engagement.	Stakeholders are involved ('key'), which takes into account priorities such as bus routes and may also vary by time of day or day of week. The guide offers practical tools and approach to this.	Step 1 matrix assigns up to 5 categories to *Link* and 5 for *Place* for each street/segment. Step 2 develops a Street Plan, a design brief for the area, setting out priorities. Step 3 involves a review of key streets in the area against the ideal set out by the design process, and identification of areas for change.	Labour intensive – a matrix must be drawn up to include each street and sub-segment. Then street plans, giving the ideal design, followed by an evaluation of critical streets to see how well they fit this design. Multiple iterations may be required.
Spaceshaper CABE www.cabe.org.uk	Toolkit for public engagement, for use by anyone – whether a local community group or a professional - to measure the quality of a public space before investing time and money in improving it.	User group (self selected, e.g. friends group) led by a trained facilitator. Data analysis relies on algorithm/model.	Questionnaire plus workshop to obtain information on the quality of a public space. This assesses 8 aspects: access; use; other people (how it caters for different needs); maintenance; environment; design and appearance, community (its importance to local people); how the space makes you feel. Uses spider diagrams to collate the results from the questionnaire.	Relatively little effort beyond the time taken to fill in the questionnaire and conduct the workshop and site visit. Further effort required to collate the results obtained. Further iterations can be undertaken with the same or different groups.
Pedestrian Evaluation Review System (PERS) TRL (2007)	A systematic process to assess the pedestrian environment. Establishes the relative quality of different pedestrian routes and provides an opportunity to review at a detailed level the opportunities for improving individual links and crossings.	Transport agencies and local transport authorities involved with the development and validation. Not end-user based.	Audit framework to assess the links, crossings, routes, public transport waiting areas, inter- change spaces and public spaces used by pedestrians. Relies on the collation of comments and scores on a range of parameters to assess the pedestrian environment.	All routes of interest need to be audited. Expert judgement based.
Community Street Audit (Street and Social Space Audit) Living Streets (2002)	Evaluates the quality of public space and identifies issues of the people who use the streets and determine what needs to be done to improve areas and routes.	Local participants guided by facilitator. Feedback provided to participants.	Facilitator takes people out to look at how places work on foot. No questionnaires, but observation and conversation encourages a fluid, natural response to the street environment. Can be carried out by members of the public, local stakeholders or by consultants who wish to assess the existing walking conditions of the local street environment.	Organizing walk, prepare mapping and recording material (also cameras). Providing feedback to participants.
Within reach Accession Modelling Department for Transport www.accessiongis.com	Wide reaching accessibility GIS based software tool. Used to map current accessibility levels and to consider the effect of options for improvements. Criteria can be added: frequency; road speed; delay for wheelchair start/ end times.	Accession is designed so that data can be shared within partnerships and users, but data is not end-user or consultation based.	Mapping of population, transport and local services and models access and catchments. Suggests most data can be collected from national sets but local knowledge is beneficial. Requires effort to learn how to use program.	Data on population characteristics to identify areas where people with specific needs are located, and on the location and availability of services, e.g. doctors, dentists, schools etc and local public transport.

guidelines and toolkits is also weak, with an overemphasis on physical environmental and street features leading to prescriptive design standards, but less consideration of safety and other perceptual barriers or the needs of particular excluded groups (including hard to reach, non and infrequent users), as opposed to special interest groups. Comprehensive community profiling and mapping is not a feature of these approaches, with the exception of the Accession model promoted by the Transport Ministry that relies on limited national Census and other official (e.g. deprivation) data, but which again does not target perceptual fear of crime and local knowledge factors that, as we have found, determines accessibility within the urban environment, and to transport. Pedestrian evaluation systems have also been found to be inadequate in assessing design against crime within the transport system (TfL, 2008).

Accessibility as a feature of sustainable development and 'Sustainable Communities' (ODPM, 2003) is also expressed in terms of quality of life (QoL) measured through a basket of over thirty QoL indicators applied at a local level (DETR, 1998). These include access to services indicators represented by journey (walking) times to a predetermined destination such as a local GP or park, but from our user consultations these do not reconcile with the everyday destinations undertaken or most desired (table 2). What is also common between these physical design audit and planning standards is the absence of user involvement in their specification, or the recognition that travel and mobility needs and behaviour vary according to demographic make-up, at different times, and for different environments. As Ekblom (2006, p.3) observes in the case of Crime Prevention Through Environmental Design (CPTED): 'the efficacy of CPTED can be reduced by demographic factors and socio-economic factors. Social conditions may nurture fear, reduce the inclination to intervene and result in the withdrawal of people into the home'. What emerges is that the interaction between local residents, other users (workers, visitors) and the local environment requires a fine grain level of analysis which might also inform higher scale urban design and planning of the street and transport system.

User Perspectives

In transport accessibility measurement, public transport standards (PTALs) (TfL, 2003) use average travel journey times/distances between two points, i.e. from point of interest (POI), origin or destination, to service access point (SAP), i.e. a bus stop. These are then combined with the frequency of service or waiting time to make up the average 'access time'. In London, for instance, an acceptable POI to SAP is estimated at a maximum of 8 minutes (or 640 metres) to a bus top and 12 minutes (960 metres) to a rail (including light rail, underground) station. This is based on a walking speed of 4.8 km per hour (or 80 metres a minute). Such standards take no account of walking abilities, environmental 'street' factors, or *a priori* perceptual and personal barriers to travel. Nor whether the local public transport actually serves the journey need (i.e. route/destination). From our user surveys, for example, trips that involve multi-mode and interchange usage (e.g. two or more buses) present particular difficulties for older people and others with multiple mobility issues, notably pushchair and wheelchair users.

As the first step in specifying accessible design from a user perspective, several focus group sessions were held with groups with specific mobility needs and those experiencing potential transport exclusion, e.g. young people, mothers with toddlers/single parents, registered disabled, ethnic minorities, including elders and youth (SEU, 2003). These sought to evaluate the travel activity, aspirations and barriers to access, which could then be compared with transport planning standards and quality of life indicators. Focus groups were held in contrasting locations

and communities in northern and southern England, including Rotherham, Liverpool, Camden (north London) and Hertfordshire. A key finding from the older groups consulted was an assessment of their regular travel needs, and these were consistent across the locations and groups involved (see table 2).

While national benchmarks focus on GP/hospital and town centre access, as well as sports facilities, the most frequent trips by older people were to local amenities such as post office and green grocer. This is confirmed in studies of older people (King *et al*., 2003), where park, restaurant and church also ranked as frequent destinations. However, government accessibility indicators do not include food shopping. Busy (traffic, pedestrians, shops, signage etc) centres may also be a turn-off to some older people (and adults with young children), particularly the frail, dementia sufferers and those lacking confidence and mobility. Cunningham and Michael's (2004) review of studies in this field also found that the most consistently significant factors were *safety* and *aesthetics*, and to a lesser extent, micro-scale urban design (e.g. pavements, lighting). There is, however, a relationship between safety, aesthetics and the design and layout of the environment and routes, and how they are perceived and used. The recommended approach from this review is the use of objective measures in combination with user evidence to 'provide a richer more accurate picture of environmental influences on physical activity' (*Ibid*., p. 442), and one that therefore should involve the community in order to ensure that their perspectives are considered.

It is increasingly accepted that: 'matters such as community safety, accessibility, sustainability, quality of life are key concerns within the public realm and are significant elements within the urban design agenda' (City of Edinburgh Council, 2003, p.7). However, while the availability of accessible transport/public facilities and local job opportunities forms the backbone of accessibility planning and sustainable communities strategies (ODPM, 2003), without a well-designed public realm that supports origin to destination journeys, such strategies are likely to fail to deliver long-term accessibility and social inclusion goals (Lucas, 2004). Extensive research evidence (Azmin-Fouladi, 2005) now suggests that good urban design can contribute to an inclusive journey environment in three key aspects by helping to:

Table 2. Benchmarking of older people's (minimum) travel needs.

Activity	*Frequency*	*No. of journeys*	*National accessibility indicator*
Food shopping	Weekly	2	Percentage of households and households without access to a car within 15 and 30 minutes of a major centre by public transport.
Comparison shopping	Monthly	2	
Social or recreational activity	Weekly	2	Percentage of the population within 20 minutes travel time (walking) of different sports facility types.
Structured day time activity appropriate to need	Weekly	2–10	–
Post Office	Weekly	2	–
Medical trip or visit	Monthly	2	Percentage of households and households without access to a car within 15 and 30 minutes of a GP by public transport (30 & 60 minutes of a hospital).

Source: Solomon and Titheridge, 2006.

1. Enhance the quality of the public realm – including transport interchanges and the pedestrian environment – creating a sense of identity/community by animating the edges of the routes and creating vibrant public spaces.

2. Minimize the psychological barriers to accessibility, e.g. fear of crime, by reducing opportunities for physical and social incivilities and risk.

3. Reduce physical barriers to accessibility by providing permeable public spaces, pedestrian friendly landscaping and useful, well-designed street furniture and amenities, e.g. seating, lighting, public toilets, cycle parking/routes.

In order to identify design-related barriers, the quality of the physical environment must therefore be thoroughly analysed. An urban design street audit or index (Street Design Index – SDI) has therefore been piloted to include aspects that contribute to accessibility, and which could then be used for modelling and developing a GIS-based tool for urban design and accessibility analysis. This is outlined here in terms of the research methodology, reconciling the difficulties in street auditing for urban design and accessibility interaction, and illustrating the features and attributes that have been selected. The data collection method within a test bed area is then described with data analysis and design improvements arising.

Design Index for the Inclusive Journey Environment

The aim has been to develop a transferable index for accessibility (Azmin-Fouladi, 2007*a*, *b*). In creating the SDI, drawing on relevant literature and guidance (CABE, 2000, 2001; Living Streets, 2002; Essex CC, 2006; Colqohoun, 2004; ODPM, 2004), criteria were selected that can be measured and also to provide a set of defining attributes, rather than generalized descriptions which are not helpful in detailed design specification. Where such definitions as in the case of intangible factors were absent, based on observations and in consultation with other researchers, they were defined more concretely. The auditing itself was conducted in two stages. Firstly the macro-elements, as outlined in table 3.

Secondly, detailed categories are considered and conceptualized (see table 4). As is emphasized in *Better Places to Live* (CABE, 2001), the individual elements of buildings, landscapes and their interface, have a key role in determining the overall quality of an area. However, auditing all these elements for a wide area is time consuming and impractical. Thus after identifying sections of public spaces and routes within our test bed area which exhibit negative qualities,

Table 3. Macro elements of urban design audit.

Land-use: office, residential, commercial, occupation/usage, temporal, mixed-use Windows Active frontage	Reflecting natural surveillance and animation
Walls/boundaries Set-backs	Reflecting territoriality/sense of ownership/access, control
Public space: graffiti, vandalism, fly-tipping, litter and other problems	Sense of ownership, community cohesion, urban/ street management
Street furniture: seats, bins, bollards, tree grilles, railings, signposts	Amenities, variety, streetscape, barriers and obstacles

Table 4. Categorization of urban design elements for street auditing.

Concepts/aspects		*Elements/Variables/Cases/Values*	*Attributes*
Natural surveillance	Windows (*eye on the street*)	Both sides (numbers) One side (numbers) No windows/blank walls/bushes and green areas	Lots of windows, some windows, no windows, no ground floor windows
	Activities on the footway	Shops, places of business (frontage)	Curtilage: Narrow <1.5 m, absolute 1.5 m, accepted 1.8 m, desired 2 m
		Gathering places (benches /children's play area)	Public park, as part of walking environment; communal, front garden
		Street market (occasional activities)	
	Broken windows	Graffiti /vandalism Boarded-up buildings/broken windows Rubbish/general cleanliness	
General image	Territoriality	Setbacks	Front garden, parking curtilage, access to lower ground, planter >10 m wide
		Demarcation of public/semi-public/ private	<1.5 m, >1.5 m
		Enclosure/continuous building frontage, proper height-width ratio	<1.5 m, >1.5 m height
	Fear-based route configuration	Entrapment (width of the footway) Blocked prospect /open sightline	
	Special features	Bushes and grown up plantations	<1.5 m, >1.5 m (bushy), planter
		Local characteristics/identity Landmarks and historical buildings/ features	Listed building, Conservation Area
Physical Barriers	Accessibility to buildings	Level entry Ramp Step(s)	Level entry, ramp, step, steps Change of surface, change of level

micro-elements such as design of railings, treatment of boundaries and appearance of shop fronts were examined thoroughly. Some of the features considered to be most influential include:

- design and arrangement of boundary walls/railings/plantings;
- planting (trees, planters, grassed areas, flowers and borders);
- banners and signs (interpretative, instructive, informative and directional);
- lighting (pavement, pedestrian, highway, security, building and feature);
- public art and features (permanent & temporary works, fountains and graphics);
- shop fronts (thresholds, glazing, stall risers, signs, banners and shutters);
- advertisements (hoardings, kiosks and banners, signage);
- safety and security (emergency equipment, CCTV, gates and grilles);
- elements that signify identity and character (cultural, vernacular, community markers).

Over twenty indicators representing the prime macro-elements were identified and

Table 5. Elements and attributes for street design audit.

Elements	*Attributes*
Access to building	Level entry, ramp, step, steps, Entry phone
Footway width	Narrow <1.5 m, absolute 1.5 m, accepted 1.8 m, desired 2 m (Essex CC, 2006)
Windows	Lots of windows, some windows, no windows, no ground floor windows
Setbacks	Front garden, parking curtilage, access to lower ground, planter>10 m wide
Railing, Fence	<1.5 m, >1.5 m height
Boundary plantation	<1.5 m, >1.5 m (bushy), planter
Boundary wall	<1.5 m, >1.5 m
Alleyways	Length, width, lighting, closed, permeable (back gates)
Land use	National Land Use Database (NLUD) land use classification, OS POI
Open space	Playground, sports pitch/court
Building storeys	Numbers
Shop curtilage	Ground floor/street level
Blank wall	Length, height, graffiti, overlooked
Greenery	Park, public as part of walking environment, communal, front garden
Soft boundaries	Change of surface, change of level
Hard boundaries	Barbed/razor wire, wire-mesh
Street furniture	Seating, gate, bollards
Parking	Off-street, on-street/bays, meter/CPZoned
Graffiti, Vandalism	Visible, dereliction (e.g. broken window, fly tipping)
Void/vacancies	Boarded-up buildings, empty shops, unused private land
Cycle lane	On-street, pedestrian lane
Width of the street	Pavement to pavement, pavement to island, zebra/controlled crossing

assessed (see table 5). These elements were captured in an observational audit and mapping of test bed sites – the Somerstown and Elm Village neighbourhoods in the London Borough of Camden (St Pancras Ward) – which had been the subject of traffic calming (similar to Home Zone pilots, Biddulph, 2008) and crime (burglary) prevention interventions, see below.

The above elements were recorded onto a hard copy ordnance survey (OS) map (1:500 scale), and subsequently transferred into GIS digital map format, creating a rich database resource for spatial analysis and visualization, and subsequent consultation (figure 1).

Contextual data were also collected for the area, and visualized in 2D and 3D formats, including land use, building heights, recorded crime (property, street/vehicle crime), Ordnance Survey's 'Points of Interest' (POI), e.g. amenities, retail, transport, as well as socio-economic and demographic profiles drawn from the 2001 Census, 2004 and 2007 Indices of Multiple Deprivation (IMDs) and Experian demographic, lifestyle data – see examples in figures 2 to 4. By using a wide range of available data, this baseline mapping can be undertaken for other areas at various scales of geography, and in a comparative framework. These spatial data have also provided the baseline for street audit and resident surveys and a reference for the findings from user surveys, where variations between primary and secondary data often arise around local perceptions and experience regarding safety, social and amenity factors (below).

This community mapping revealed low car ownership and pockets of poverty surrounded by better-off neighbourhoods, a mixed morphology of housing/building types, a high proportion of children and young people (and primary and secondary schools, churches), as well as older/retired people, and from census analysis, high economic inactivity and poor health, and a multi-cultural community including long estab-

Figure 1. Urban design factors.

lished and more recent migrants (e.g. Irish, Bangladeshi and Somali). The travel horizons of unemployed residents who were seeking work were very parochial, limited to the immediate neighbourhood and adjoining localities. Transport provision (bus, tube, rail) is, however, in close proximity (if not accessible to many residents), but located outside of the area itself. While schools and some community facilities exist within the neighbourhood, most food and other shopping (e.g. supermarkets) and activities were also located outside of the area (figure 2).

Street crime (robbery and snatch theft) and road safety also worsened at the edge of the area (figure 3), which served as the main pedestrian access to bus and other transport. Recorded street crime peaked at rush hour times (not at night), highlighting the disadvantage of residential areas close to major transport and commuter flows.

This has been exacerbated by construction and heightened security in and around station areas – due to anti-terrorism measures, new station and adjoining developments, closure/ removal of litter bins, public toilets and seating – which together have effectively displaced crime and anti-social activity (e.g. drug dealing, prostitution) and environmental problems (litter, parking, street urination), and transferred these to adjoining neighbourhoods. This creates for some older

Figure 2. Retail and food amenities (POI, OS).

Figure 3. Street and vehicle crime density.

and vulnerable groups (e.g. ethnic minorities) an enclave or 'ghetto' effect, limiting travel outside of the residential neighbourhood. Vehicle theft and damage and bicycle theft were concentrated within the residential area itself, but again on the perimeter of the neighbourhood where most cars were parked on the street and in proximity to shops and large institutional buildings with poor natural surveillance. Bike theft has shown a particularly high increase in several central London boroughs, including Camden and neighbouring Islington, since the introduction of congestion charging and a consequent increase in cycling to work. Bike stands and safe bike storage have not increased or improved to cope with this increase in demand and the opportunity for thieves to steal high value bikes for resale.

Primary data collected from this test bed area were geo-coded into a GIS database and mapped. In order to analyse the quality of the public realm for the inclusive journey environment, attributes of each element were ranked with negative and positive values (table 5 above). For example, areas/routes that have a low level of natural surveillance are drawn based on the combination of the following six variables: No window; No ground floor window; Blank walls; High fences; Boundary wall/plantation >1.50 m; Setbacks of >10.00 m, see figure 4(*b*).

By using the GIS modelling technique combined with photos, spatial and observational data were layered to determine key routes and areas with potential personal security/fear of crime problems - figure 4.

This same approach has been applied to the quality of urban design within the area, where elements that contribute to a negative environment can include a lack of 'enclosure' (inadequate relation between

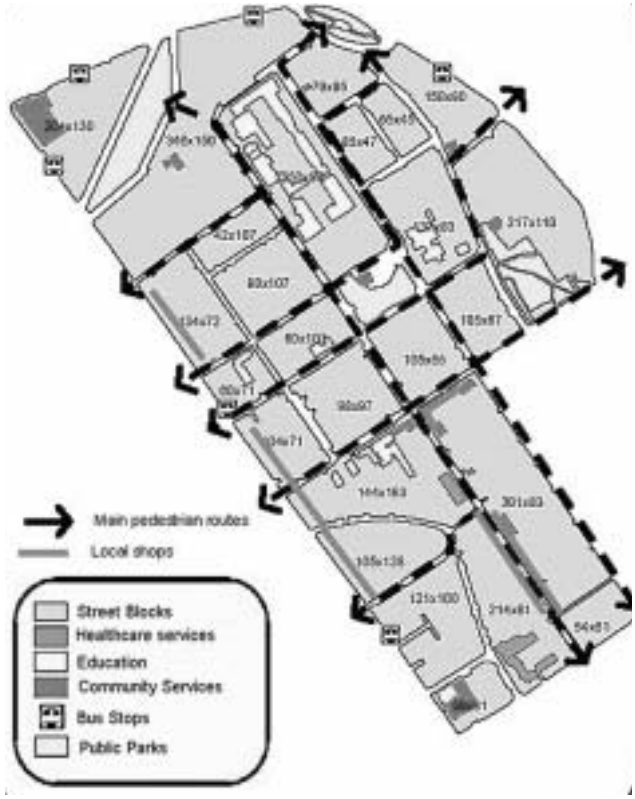


Figure 4(*a*). Permeability and ease to movement.

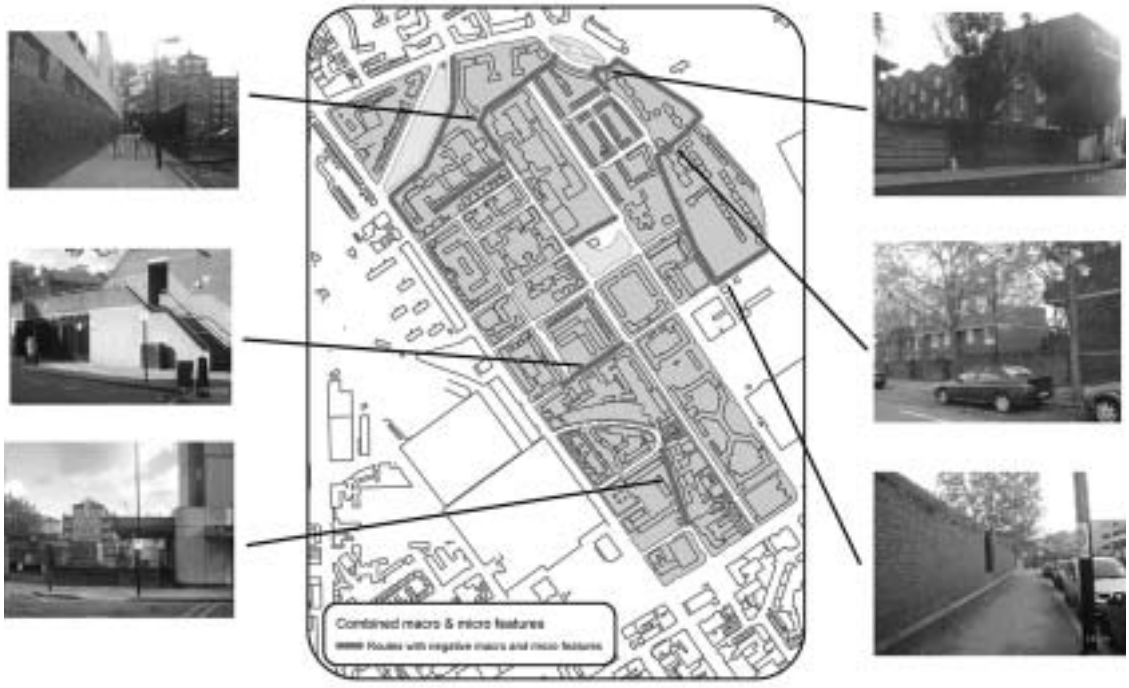


Figure 4(*b*). Problematic routes to local transport and amenities.

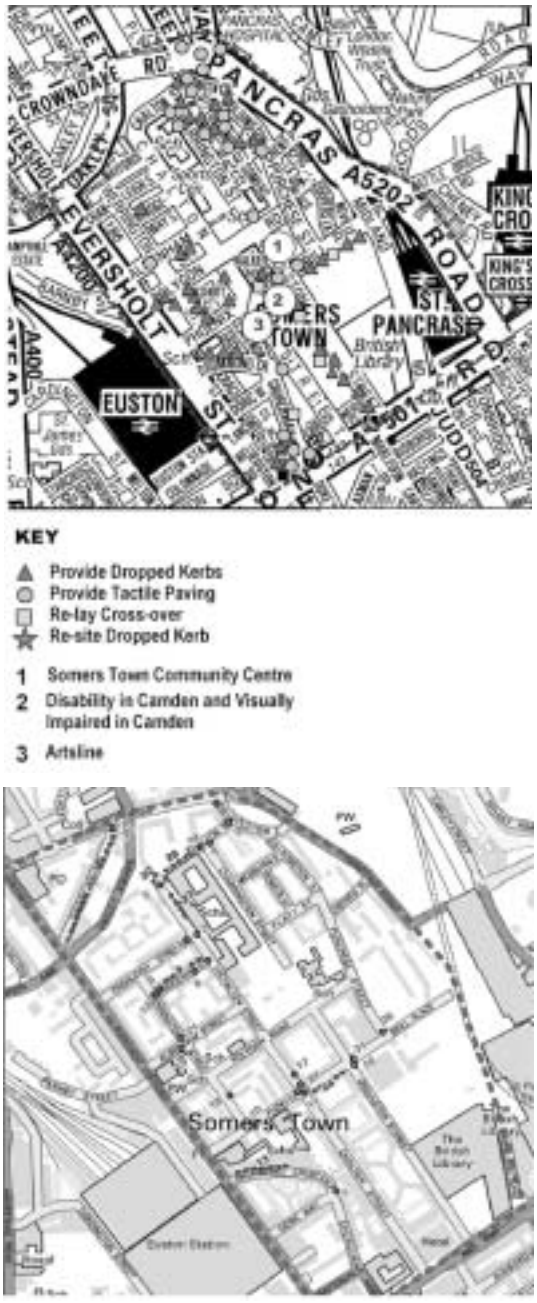


Figure 5. Somerstown Accessibility Scheme Initial and Detailed Audits (in TfL, 2007).

building height and street width), abnormal setbacks and 'dead frontage' (Azmin-Fouladi, 2005). By overlaying negative features, a new layer is created. These and other aspects can be further analysed by examining micro-elements where specific problems are identified, and where barriers are expressed by participants in user (resident and first-time visitor) surveys.

The street audit and mapping model has also been adopted by the regional transport authority in their *Guidance to Local Authorities for Submission of Local Accessibility Schemes* (TfL, 2007, pp. 8–9). Here, using the street design audit and mapping, street improvements were undertaken in response to access problems and user consultation through local community access points, e.g. Sure Start, disability, pensioner and residents/tenants groups. Prior to the street improvement scheme initiated by the local authority (London Borough of Camden), an initial list of measures was identified based on site visits by borough and research officers (figure 5).

Once funding had been granted, a new audit was carried out to reflect changes in the local environment since the baseline, and to include the input of some elderly and disability groups in the borough. In the latter case, conflicts emerged between wheelchair users (preferring step-free kerbs) and the visually impaired who require the kerb to differentiate pavement from road (by guide dog and stick). This was not taken into account in the street layout improvements, which has necessitated retro-fitted legibility and traffic calming interventions to be reversed by the local authority at additional cost. This could have been avoided if a more inclusive design and street audit process had been undertaken prior to the improvement scheme, which had been influenced by general design guidance (above) promoting 'permeability', without considering the impact on different ability and user groups.

GIS-P Community Mapping

Following the comprehensive street audits and digital data analysis, leading to the creation of the Street Design Index, small group meetings and postal questionnaire

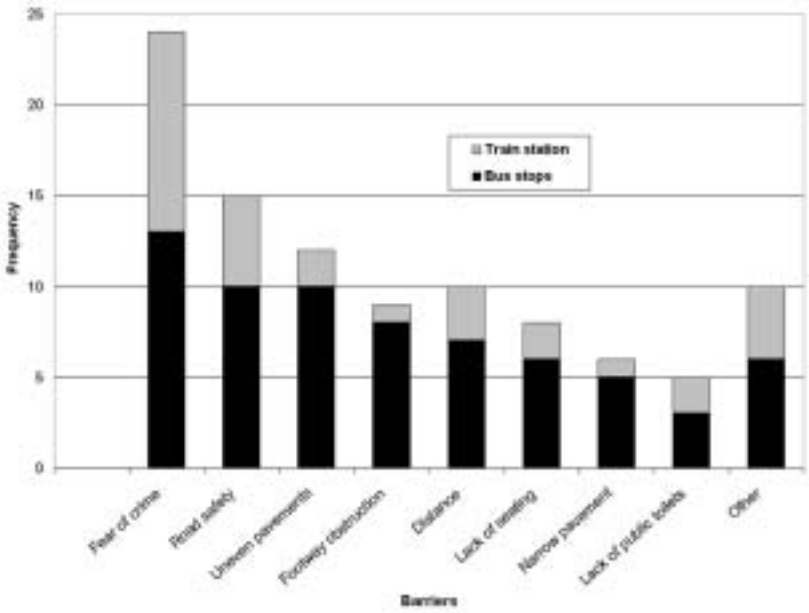
surveys were also conducted with residents, and accompanied map-walks organized with participants as an experiential exercise to consult on their predetermined journeys. The use of questionnaires in residential neighbourhoods produced a more representative sample and comparative data, aided by the support of residents/tenants association and publicity in the estate newsletter. This also afforded analysis by household type, tenure and formation, location, age, gender etc. Limitations to pedestrian access and more frequent journeys included 'fear of crime' and 'road safety' as prime barriers, as well as problems with walking surfaces and amenities, with specific problem features and areas annotated on maps. These participant comments were overlaid with problematic streets, routes and features delineated from the prior street audit which showed close correlation, but also divergence (figures 8 and 9).

Focus groups were also held with the use of large scale maps, through the GIS-Participation (GIS-P) technique (Cinderby *et al*., 2006). Here participants – young children and parents, residents, workers and older people (figure 6) – were able to annotate these using text and colour-coded stickers on the local area map, to mark their home and journey routes, problem areas and amenities, and intermediate features such as bus stops and facilities, e.g. public toilets, benches.

The next figures show the combination of street design audit and comments arising from the GIS-P focus group with older residents in Elm Village (figure 6), and from a survey questionnaire of all residents (above). These highlighted both routes and features/sites with which participants had negative associations or experiences, and useful details of journeys undertaken (e.g. local shops, supermarket, cinema), their frequency and problems in the journey chain. These included the resiting of bus stops separating bus services (where once they shared a single stop), inadequate crossings (islands too narrow for safety, controlled pedestrian crossing times too short), treacherous 'designer paving' (sculpted, with weeds/grass growing through) and anti-social behaviour and areas with poor surveillance.

This urban village with mixed tenure – owner occupied, shared ownership and rented – was originally built on new urbanist principles by a social housing developer in the mid-1980s. The estate was the subject of crime prevention interventions in the late-1990s by the local police (Gamman and Pascoe, 2004). Responding to a rise in burglaries and residents' expressed fear of crime, typical crime prevention measures included alley-gating (the closing off of alleyways and installing gates around/behind houses and other properties to reduce burglary access) and setback/doorway closure in order to remove their use for rough-sleepers, drug-dealers and general 'hanging-out'. Both however restrict pedestrian access, close off regular routes and reduce quality of space and function between internal and external spaces, as well as generally having poor

Figure 6. GIS-Participation groups mapping local routes and neighbourhood.



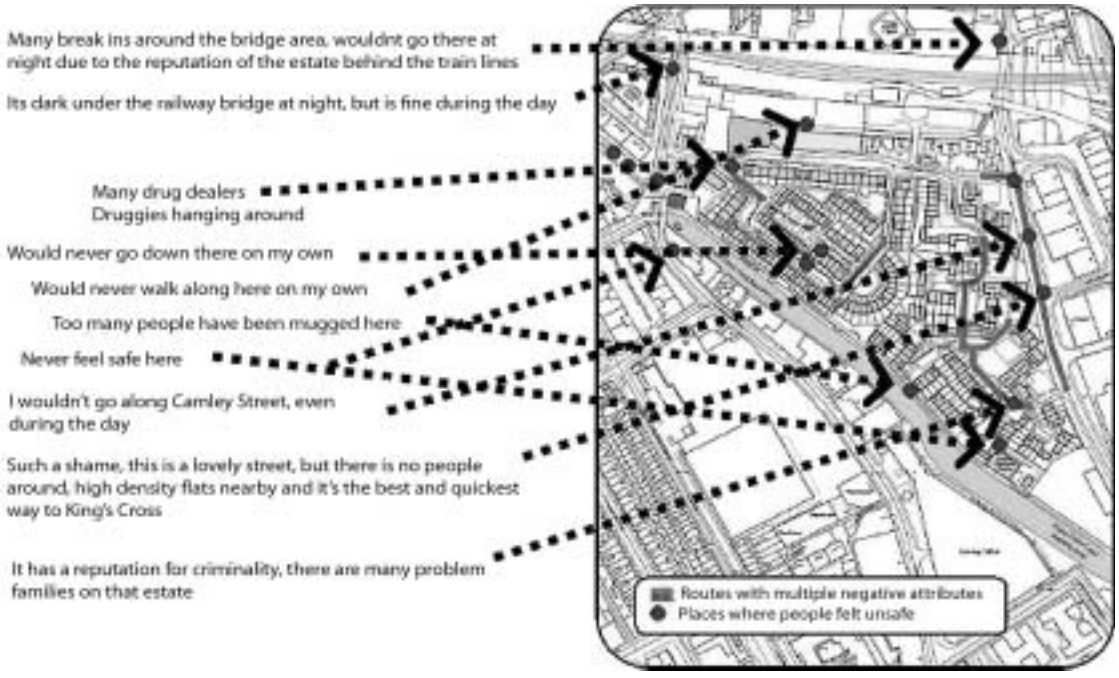


Figure 7. Barriers to accessing local bus stops and station (household and GIS-P surveys).

aesthetic quality. As Gamman and Pascoe (2004, p.11) observe in this and other cases: 'some gates were not high enough to be entirely efficient. Other gates either do not complement the housing they are supporting or they seem to have a criminal appearance. Ugly gates may reduce actual recorded crime, but for some residents they may also

increase fear of crime'. This has been the case here with displacement of crime/anti-social behaviour, from burglary to street crime and drug dealing, and a consequent rise in fear of crime by some residents.

Fear of crime was also the barrier that was ranked by far the highest by residents, followed by road safety, pavements and distance to amenities (figure 7). The walk to the bus was the most problematic. A growing concern was the effect of new housing development on adjoining infill/brownfield sites which reduced pedestrian access (routes closed or made longer/unsafe) and also reduced views and sight lines. Major alterations to the streetscape present particular problems to older people and dementia sufferers for whom familiarity and landmarks are important for confidence in undertaking regular journeys (Mitchell, 2007).

Participant consultation conducted with focus groups and individuals, using both face-to-face and self-completed questionnaires and annotated maps completed after guided map walks (figure 8), included older people, as well as young (Bangladeshi) men, women, single parents/mothers with toddlers. The results have been used to refine the journey design assessment and GIS-based street visualizations in an iterative design process, and practical design recommendations made. The feature attributes (Azmin-Fouladi, 2007*a*) in particular were validated with end-users (residents groups, visitors), and with professionals with responsibility for the urban, street and transport environments, through a questionnaire with explanatory images from the test bed area. These rated the various factors using a 5-point scale to determine both their inclusion as key barriers in the pedestrian environment and mobility, and their relative importance. This validation and weighting can be re-applied in each test bed and user group situation to reflect local conditions, subjectivities and preferences. This is more flexible than fixed design metrics and standards, where 'one size does not fit all'.

Figure 8. Synthesis of street audit with participant focus groups and map walks.

The annotated maps were then analysed, together with focus group and questionnaire surveys, and mapped data digitized in GIS (figure 8). These were then integrated with spatial data on demographic, land-use, facility/amenity (e.g. bus stops, public toilets), as well as recorded crime data for the area, producing a synthesis between the primary, qualitative information and spatial data. For instance, areas of high street crime density were overlaid with participant's own experience and perspective of safe(r) and unsafe areas (figure 9). These revealed convergence, but also divergence between where recorded crime was concentrated, where street audits revealed problematic routes and areas – and other areas where particular groups felt safe, unsafe or 'feared' crime (and anti-social behaviour). Extension of this GIS-based analysis has included the

visualization of sight lines from particular points or along routes showing the field of vision. Using this method, each relevant feature visible from a specific location has been assigned a weighting, through a process of consultation (above). This weighting contributes towards an overall Index of Permeability for the view point using Isovists, which identify the urban features visible from a specific point, extending the index to create a surface of permeability (Calnan and Ellul, 2008).

Some reported factors were functional and physical such as narrow streets, dangerous crossings (islands too small for wheel/push chairs), lighting and poor surveil-lance, while others were social such as noise, pubs/alcohol (e.g. Muslim young men). Fear of crime also depended on prior incidents (including those reported in the local media), reputation (e.g. gangs) and other local community knowledge. This highlights the importance of not relying solely on street/environmental design, movement and crime analysis without participant input and observation. In this sense, space is socially produced, with local knowledge and practice influencing travel behaviour and choice, which may vary across different user groups at different times of the day.

Summary

The case study and visualizations presented here draw together urban design (SDI), digital data analysis (GIS), participant observation and qualitative methods, but owing to brevity, represent a very small proportion of the spatial analysis and features which can be captured through this set of techniques

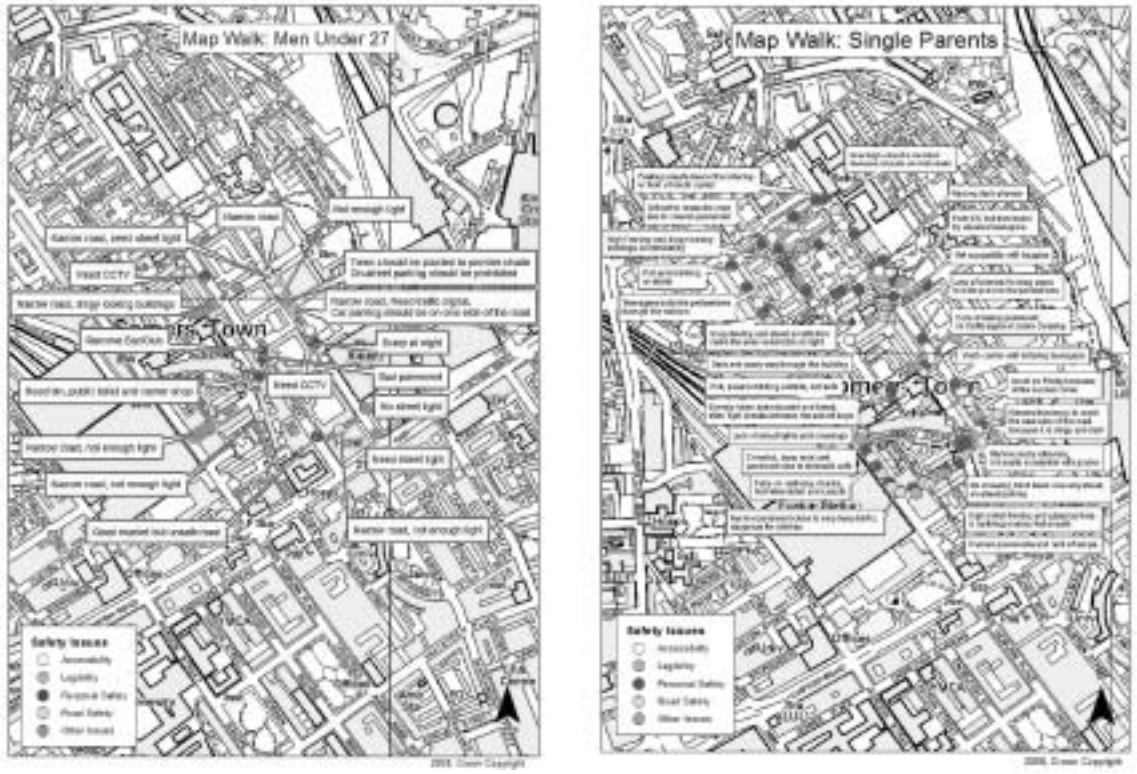


Figure 9. Annotated mapwalks – young (Asian) men and single parents.

(Azmin-Fouladi, 2007*a*; see also www.aunt-sue.info). In particular, the coding of features, routes, areas, densities is best viewed in colour on screen/colour print maps and 3D visualizations (www.aunt-sue.info). Digitizing annotated maps and correlating these with spatial data for feedback in an iterative design process, can also be used for assessing street improvements as well as interventions such as extended transport routes and bus stop location and interchange. Actionable findings have encompassed micro-street maintenance and management (figure 4. above), and more strategic transport and land-use planning using this inclusive design approach. This complements and informs Local Development Framework (borough plan) and Sustainable Community Strategy exercises (DCLG, 2005, 2008), as well as Local Transport Plans which form the basis of government funding of transport improvement, thereby demonstrating greater social inclusion and access in this process (DfT, 2005).

The triangulation of comprehensive mapped digital data, with observational – human and environmental – and systematic street design analysis, combined with user consultation on needs, aspirations and perceptions, is an ambitious process. But we believe this is a required approach given the complexities and 'wicked problems' (Harrison, 2000) that the urban environment presents. One that moves beyond, but also draws upon, the physical access audit, street and place design toolkits and consumer survey regimes, that are currently used in quality of life assessments and performance indicators, and in accessibility benchmarks. In the development of AUNT-SUE, we have been conscious of the limitations and low take up of prescriptive 'toolkits', and developed a multi-criteria and more robust consultative basis which combines and sits more closely with local/transport authority and other stakeholder data, policy and governance resources and programmes. A more inclusive design process and accessible journey environment has been the goal. The whole journey environment and chain may seem a fraught governance scenario, given the range of interests and disciplines responsible for individual elements. However, local authorities, the police and transport agencies (passenger transport executives – PTEs) have the key role and powers in linking the pedestrian, road and urban environment with the transport system, likewise central government ministries with responsibilities for planning, transport and safety.

In order to promote this, a practitioner network has been established, both to validate and exchange knowledge in the application of this accessibility user needs model and to test further the street design index and resulting journey planner in different locations and scenarios. This is important since the relationship between local and neighbourhood streets and transport routes, and between neighbourhoods and adjoining transport facilities is a prime example of poor coordination and land-use integration, and where the whole journey environment requires joining up between local and transport authorities. This includes station interchange areas and approaches, new station based improvement and regeneration areas, and pedestrian routes highlighted from our user led research, which have been the subject of our validation and further test bed research.

The urban design approach outlined here, which provides a menu of spatial factors and visualizations layered to produce combinations of linear and cluster analysis in both 2D and 3D, thus offers a powerful tool which can be used in community consultation and planning; urban design modelling and scenario-building; and in creating an interactive spatial database as a resource for the wide range of users and decision-makers in the urban environment and transport fields. This will hopefully go some way to filling the knowledge gap observed by Boarnet and Crane (2000, p.14) '(it) is not that urban design and transportation behavior are not linked,

or that urban design should never be used as transportation. Rather, we conclude that we know too little about the transportation aspects of the built environment'. In so doing, AUNT-SUE has also sought to bridge the divide between the socio-medical ('evidence-based') and environmental-technological ('deterministic') approaches to access and disability, through the development of an inclusive design approach to the whole journey environment, from a community perspective.

REFERENCES

Azmin-Fouladi, N (2005) *A Collaborative Approach Towards Investigating the Inclusive 'Whole Journey Environment': Literature review*. www.aunt-sue.info.

Azmin-Fouladi, N (2007*a*) Accessibility and user needs in transport, in Thwaites, K., Porta, S., Romice, O. and Greaves, M. (eds.) *Urban Sustainability through Environmental Design. Approaches to Time-People-Place Responsive Urban Spaces*. London: Routledge, pp. 112–118.

Azmin-Fouladi, N (2007*b*). *Designing the Inclusive Journey Environment*. Proceedings of INCLUDE 2007. London: RCA.

Azmin-Fouladi, N., and Evans, G.L. (2005) *Accessibility and User Needs in Transport Design*. Proceedings of INCLUDE 2005. London: RCA.

Biddulph, M. (2008). Reviewing the UK home zone initiatives. *Urban Design International* **13**(2), pp. 121–129.

Boarnet, M. and Crane, R. (2000) *Travel by Design: The Influence of Urban Form on Travel*. Oxford: Oxford University Press

CABE (Commission for Architecture and the Built Environment) (2000) *By Design – Urban Design in the Planning Systems: Towards Better Practice*. London: CABE.

CABE (2001) *Better Places to Live: By Design – A Companion Guide to PPG*. London: Thomas Telford.

Calnan, B. and Ellul, C. (2008) Modelling Perceptions of Street Safety to Increase Access to Public Transport. Paper presented to the Royal Geographic Society Annual Conference, London.

Cinderby, S., Forrester, J. and Owen, A. (2006) A Personal History of Participatory Geographic Information Systems in the UK Context: Successes and Failures and Their Implications for Good Practice. Paper presented to the Royal Geographical Society Annual Conference, London.

City of Edinburgh Council (2003) *Standards for Urban Design*. Edinburgh. Available at www.RUDI.net.

Coleman, R (2003) Living longer, in Clarkson, J. *et al*. (eds.) *Inclusive Design: Design for The Whole Population*. Vienna: Springer, pp. 120–141.

Colquhoun, I. (2004) *Design Out Crime: Creating Safe and Sustainable Communities*. Oxford: Elsevier/Architectural Press.

Cooper, R., Evans, G. and Boyko, C. (2009) *Designing Sustainable Cities*. Chichester: Wiley-Blackwell.

Crime Concern and Transport and Travel Research (1997) *Perceptions of Safety from Crime on Public Transport*. London: Crime Concern.

Crime Concern (2002) *People's Perceptions of Personal Security and their Concerns about Crime on Public Transport: Literature Review*. London: Department for Transport.

Cunningham, G and Michael, Y (2004) Concepts guiding the study of the impact of the built environment on physical activity for older adults: a review of the literature. *American Journal of Health Promotion*, **18**(6), pp. 435–443.

DCLG (Department of Communities and Local Government) (2005) *Citizen Engagement and Public Services: Why Neighbourhoods Matter*. London: DCLG.

DCLG (2008) *Creating Strong, Safe and Prosperous Communities*. Statutory Guidance. London: Department of Communities and Local Government.

Desyllas, J. (2006) The cost of bad street design, in *The Cost of Bad Design*. London: CABE, pp. 33–52.

DETR (Department of the Environment, Transport and the Regions) (1998) *Sustainable Development Indicators – Local Quality of Life Counts*. London: Department for the Environment, Transport & the Regions.

DfT (Department for Transport) (2005) *Guidance on Accessibility Planning in Local Transport Plans*. London: Department for Transport.

DfT (2007) *Manual for Streets*. London: Department for Transport.

Ekblom, P. (2006) *Specification for Rebuilding CPTED*. Design Against Crime Research Centre. London: Central St Martins College of Art & Design.

Essex County Council (2006) *Designing for Pedestrians: A Guide to Good Practice*. Watford: BRE Press.

Evans, G.L., Foord, J. and Aiesha, R. (2009) Urban sustainability: mixed use or mixed messages? in Cooper, R., Evans, G. and Boyko, C. (eds.) *Designing Sustainable Cities*. Oxford: Blackwell-Wiley, pp. 191–217.

Gamman, L. and Pascoe, T. (2004) Seeing is Believing: Notes towards a visual methodology and manifesto for crime prevention through environmental design. *Crime Prevention and Community Safety*, **6**(4), pp. 9–18.

Handy, S.L., Barnet, M.G., Ewing, R. and Killingsworth, R.E. (2002) How the built environment affects physical activity: views from urban planning. *American Journal of Preventative Medicine*, **23**(2), pp. 64–73.

Harrison, T. (2000) Urban policy: addressing wicked problems, in *What Works: Evidence-Based Policy and Practice in Public Services*. Bristol: Policy Press.

Heath, G.W., Brownson, R.C., Kruger, J., Miles, R., Powell, K.E., Ramsey, L.T. and the Task Force on Community Preventative Services (2006) The effectiveness of urban design and land use and transport policies and practices to increase physical activity: a systematic review. *Journal of Physical Activity and Health*, **3**(1), pp. S55–S76.

Jeffrey, C.R. (1969). *Crime Prevention Through Environmental Design*. Thousand Oaks, CA: Sage.

Jenks, M. (ed.) (1999) *The Compact City: A Sustainable Urban Form*. London: E & FN Spon.

Jones, P., Boujenko, N., Marshall, S. (2007) *Link & Place. A Guide to Street Planning and Design*. London: Local Transport Today.

King, W. *et al*. (2003) The relationship between convenience of destinations and walking levels in older women. *American Journal of Health Promotion*, **18**(1), pp. 74–82.

Lake, A. and Townsend, T. (2006) Obsesogenic environments: exploring the built and food environments. *Journal of the Royal Society for the Promotion of Health*, **126**(6), pp. 262–267.

Living Streets (2002). *Designing Living Streets. A Guide to Creating Lively, Walkable Neighbourhoods*. London: Living Streets.

Lucas, K. (2004) *Running on Empty: Transport, Social Exclusion and Environmental Justice*. Bristol: Policy Press.

Mitchell, L. (2007). Neighbourhoods for life: the outdoor environment. *Journal of Dementia Care*, **15**(5), pp. 36–37.

NAO (2009) *Improving Road Safety for Pedestrians and Cyclists in Great Britain*. London: The Stationery Office.

ODPM (Office of the Deputy Prime Minister) (2003) *Sustainable Communities: Building for the Future*. London: ODPM.

ODPM (2004) *Safer Places: The Planning System and Crime Prevention*. London: ODPM.

Ratcliff, M. (2007) *Access and the DDA. A Surveyor's Handbook*. London: RICS.

SEU (Social Exclusion Unit) (2003) *Making the Connections: Final Report on Transport and Social Exclusion*. London: SEU.

Solomon, J. and Titheridge, H. (2006) Accessibility Indicators and the Policy Goal of the Reduction of Transport-Related Social Exclusion. CTS Working Paper 2006/3, University College London.

TfL (Transport for London) (2003) *Public Transport Accessibility Levels* (PTALs) *Summary*. London: TfL.

TfL (2007) *Guidance for Submissions of Local Accessibility Schemes. Prepared for all London Boroughs and Sub-Regional Partnerships*. London: Transport for London.

TfL (2008) Personal communication with John Strutton, Crime & Disorder Partnership Manager. Community Safety, Enforcement & Policing Directorate, Transport for London.

TRL (2007) *Pedestrian Environment Review System* (PERS). Transport Research Laboratory. www.tfl.gov.uk/assets/downloads/businessandpartners/what-is-PERS.pdf and see also www.trl.co.uk/content/main.asp?pid=325.

Walker, A. (2005) Understanding inclusive design, *Access by Design*, **102**, pp. 18–20.

Welsh, B.C. and Farrington, D.P. (2008). *Effects of Closed Circuit Television Surveillance on Crime*. Oslo: Cambell Systematic Reviews.

WHO (2002) *A Physically Active Life through Everyday Transport*. Available at http://www.euro.who.int/document/e75662.pdf. Accessed 5 August 2009.

ACKNOWLEDGEMENTS

Acknowledgments are due to Nastaran Azmin-Fouladi, Ben Calnan, Claire Ellul, Juliet Solomon, Antje Witting and Steve Shaw.