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AMELIA: Making streets more accessible for people with mobility difficulties

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Abstract

Streets can be made more liveable by ensuring that they are accessible to everyone. This requires the identification of ways to overcome the barriers to access for those who are socially excluded. In order to address these issues, a software tool, AMELIA (A Methodology for Enhancing Life by Increasing Accessibility) is being developed to test the extent to which transport policies can increase social inclusion. This is part of a research project being carried out as part of a large programme looking at 'Accessibility and User Needs in Transport in a Sustainable Urban Environment' (AUNT SUE). AMELIA will be used to investigate how many more people are able to reach various opportunities including shops, medical and welfare centres, employment and leisure facilities. It will be used to establish how many people meet accessibility benchmarks defined elsewhere in the project with and without the policy intervention. Micro-level data based upon street audits has been collected for the city of St Albans in Hertfordshire, including details such as steps, slopes, access to individual buildings and obstructions on the pavement. In the paper, the effect of removing barriers to movement on the street are discussed because, by doing so, streets can be made more liveable.

Introduction

An important aspect of making streets more liveable is ensuring that they are accessible to everybody. This is part of the process of reducing social exclusion. There is a wide range of characteristics that are associated with being socially excluded: for example, having a disability which includes being in a wheelchair, having learning difficulties, and being visually impaired; being elderly; being a member of an ethnic minority; having a low income; being unemployed; not having access to a car; and being a single parent (Mackett et al, 2004). Usually those who are socially excluded are in two or more of these categories. There are many barriers to movement for the various groups (Smith et al, 2006) which transport policies can be adopted to help overcome. The difficulties faced by some of the people who are socially excluded are very micro, for example, obstacles on the pavement which can hinder access in a wheelchair. Hence, micro level details may cause difficulties in the implementation of policies which have been designed at the macro or strategic level (Mackett et al 2007).

Relatively little attention has been given in the literature to walk access, whether as part of a public transport journey (Jones et al, 2006), part of a car journey or as the sole mode. The treatment of walk access in both travel demand models and accessibility models is generally limited. The most common approaches either approximate access on foot (to a bus stop or rail station, for example) using a straight line (as the crow flies) distance or make use of road centre line data. Neither method takes into account walking conditions. Handy and Clifton (2001) highlight the importance of footway characteristics for pedestrian accessibility, particularly in respect of persons with disabilities and suggest that lack of generally available data on pedestrian infrastructure has hampered efforts in this field.

There have been a few attempts in the past to incorporate characteristics of the pedestrian environment into access and accessibility tools. Church and Marston (2003) suggest this can be done through measures of relative accessibility, which highlight the inequalities of access between peoples of differing abilities. Axelson et al (1999) developed a method for assessing sidewalk accessibility, involving collecting and analysing field data on a number of footway features based on disabilities legislation. The results highlight the extent to which an area meets legal requirements but say nothing about the ability of individuals to navigate the area. Other work which focuses on people with mobility impairments include the MAGUS project (Matthews et al, 2003), and the U-Access routing tool (Sobek and Miller, 2006). Both aim to help identify accessible routes for those with physical disabilities. At the strategic level there are two notable pieces of work: Reneland (2005) who has incorporated a number of variables describing footway characteristics into 'ArcTVISS' for examining accessibility by a variety of modes (including walking) in Sweden; and Jones et al (2006) who use time penalties to take crossing time, gradients and street lighting levels into account in their WALC tool for measuring pedestrian access to local bus and rail stations.

These issues are being explored in a research project being carried out in the Centre for Transport Studies at University College London (UCL) as part of the work programme of the AUNT-SUE consortium (Accessibility and User Needs in Transport in a Sustainable Urban Environment) (see http://www.aunt-sue.info/). In the UCL part of the programme, a software tool, AMELIA (A Methodology for Enhancing Life by Increasing Accessibility) is being developed to test the extent to which transport policies can increase social inclusion. As part of the design process for AMELIA, the database is being explored to see the extent to which barriers to travel can be identified, and how these might be addressed. In this paper, methods of analysing how streets can be made more accessible to those with limited mobility are discussed.

AMELIA

AMELIA is a user-friendly policy-oriented interface to a GIS (Geographical Information System). It is designed around the overarching policy objective of increasing accessibility for those who are socially excluded. This objective appears in many local transport plans (LTPs) in Britain in various forms (Mackett et al, 2004). In order to implement this, it is necessary to define some policy actions. AMELIA requires data on the population in the group being considered (the elderly, those in wheelchairs and so on), the nature of the facilities that they wish to reach (shops, jobs, health facilities and so on) and how they can travel there. AMELIA can then be used to see how many of this group can reach the opportunities as a result of a variety of policy actions. In order to assess whether a policy action is effective it is necessary to use benchmarks to see how many members of the group meet certain criteria with and without the intervention represented by the policy action.

Practitioners working in different fields use a variety of benchmarks or standards to measure the accessibility of opportunities, and to identify geographical areas that are deemed to be relatively inaccessible (Jones and Wixey, 2005). The UK Department for Transport, for example, has developed a set of national accessibility indicators based on the percentage of the population (or an appropriate sub-group) who can reach key destinations within specified time thresholds (Department for Transport, 2005b). However, these are simply functions of national figures representing what the overall population currently does and say nothing about what individual users can actually access given their constraints or what they actually need or want (Handy and Niemeier 1997; Oppenheim 1998).

Work carried out in the context of the AUNT-SUE research project reveals that indicators concerned with the time taken for daily access to destinations such as work, education, health and so on, may be suitable for some socially excluded groups (for example, the unemployed, the carless, young people and so on), but may be inappropriate for elderly persons (Solomon and Titheridge, 2006). Analysis of the Great Britain National Travel Survey statistics for 1998-2001, together with a bespoke survey of people in Hertfordshire and focus groups in the North of England (Titheridge and Solomon, 2007), made it clear that rather than being concerned with the saving of small amounts of time on ‘necessary’ journeys, older people are concerned with having purpose, activity, and social contact in their lives confirming that mobility is crucially important to their quality of life (Banister and Bowling 2004; Gilhooly et al 2002; Metz 2000).

As well as having benchmarks, some criteria need to be specified in detail in order to implement policy actions, for example, a minimum width for a whelchair or maximum gradient for a person of limited mobility. Whilst there are many documents identifying the mobility needs of people with various characteristics in general terms (for example, Smith et al, 2006), exacts values have to be specified in order to implement a policy. There are a number of sets of guidelines that do this (for example, Department for Transport, 2005a) but even these cannot be completely specific because the local environment will influence what can be done in some cases, for example, the number of crossing points required on a road. Hence, AMELIA will offer users default values based on official guidelines where they exist, but these can be varied if the users wishes. In other cases, it is often a case of ‘the more the better’, so the user will be able to try out policy actions in various locations. It is planned to intoduce costs associated with various policy actions, so that the user can see the financial implications of various bundles of policy actions or can explore the best way to spend a limited budget by finding the combination that maximizes the number of people whose accessibility increases.

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It should be recognised that AMELIA can only be used to address issues associated with physical aspects of accessibility, such as street design and bus service provision. It cannot handle intangible aspects such as language barriers.

The application of AMELIA

The design of AMELIA requires an area to be defined for testing the tool and local authority involvement in the design process. The county of Hertfordshire, which is the county immediately north of London, has been chosen for this purpose. This research is being conducted in co-operation with Hertfordshire County Council (HCC). HCC has produced an LTP (Local Transport Plan) which has nine objectives to help achieve its vision of the future of transport in Hertfordshire over the next 20 years. The vision statement in the LTP starts with the phrase ‘To provide a safe, efficient and affordable transport system that allows access for all to everyday facilities’ (Hertfordshire County Council, 2006, page 42). This puts inclusion right at the heart of the vision. The objective specifically concerned with accessibility states: ‘To develop a transport system that provides access to employment, shopping, education, leisure and health facilities for all, including those without a car and those with impaired mobility’ (Hertfordshire County Council, 2006, page 43).

These concepts have to be translated into action. This involves defining policy actions to overcome barriers to movement. Table 1 shows some examples of the barriers to mobility on the street that have been identified in the AUNT-SUE work and possible policy actions. It can be seen that the six general barriers have, in most cases, been divided into more specific ones. This is necessary in order to identify suitable policy actions. The specific aspects relate to a conflict between the characteristics of the people involved, such as inability to step up to a particular height or being in a wheelchair, and the micro-environment, such as the height of the step or the existence of an obstruction. The purpose of AMELIA is to present the user with a set of possible policy actions given the characteristics of the population and the local environment, and then to quantify and map the effects of the policy actions to help the user make a judgement as to the most effective.

A database is being set up for Hertfordshire. Macro-level data based upon the local authority's information systems and other sources such as the 2001 Census of Population, are being assembled for the whole county. Micro-level data based upon street audits, including details such as steps, slopes, access to individual buildings and obstructions on the pavement are being be incorporated into the database. These more detailed data are only for the city of St Albans since it is not feasible to collect such data for the whole of Hertfordshire.

The detailed data for St Albans were collected on the street using the following equipment: an inclinometer for measuring the gradient of slopes, a tape measure for measuring short distances, such as between obstacles on the pavement and the kerb, and a measuring wheel for measuring longer distances, such as the width of roads. Data were collected on the following: buildings, characteristics of the footway, road crossings, bus stops, car parking and features. Each item was given a unique numerical code within its category. The codes were marked by hand using coloured pens onto A3-sized maps printed out from the Ordnance Survey Land-Line Plus database which is being used in the GIS.

The information on buildings was for buildings that members of the public access, but not private ones or those that only employees access. For each building the following was recorded: the unique reference number, the street address, the function of the building (shop, bank, café, and so on), the name of it, and the access (level, slope, ramp, or steps, including the number of steps, or the height if it was a single step). According to the inclusive mobility guidelines (Department for Transport, 2005a), a ramp is a pathway with a gradient of more than 5 degrees.

Table 1 Examples of barriers to walking and possible policy actions to overcome them

Barriers to walking		**Possible policy actions**
General	**Specific**	
Change of level	The existence of steps	• Provide ramps • Provide escalators • Provide lifts
	Steps that are too high	• Ensure steps are of appropriate height
Concern about finding the way	Difficulty finding the way for people with visual impairment	• Provide tactile paving • Provide colour contrast paving • Highlight bollards, steps, subways, signposts for the visually impaired
Difficulty crossing the road	Lack of a safe place to cross the road	• Provide more pedestrian crossings • Introduce traffic calming
	Lack of dropped kerbs	• Provide dropped kerbs
	Dropped kerbs that are too steep	• Reduce gradient on dropped kerbs
	Difficulty seeing pedestrian signals at crossings	• Provide audible signals at pedestrian crossings
	Insufficient time to cross at pedestrian crossings	• Extend of pedestrian green phase on road crossings
	Pedestrian crossings unsuitable for wheelchair users	• Make pedestrian crossings suitable for wheelchair users
Difficulty moving along the pavement	Narrow pavements	• Provide wider pavements
	Obstructions on the pavement	• Remove obstructions that make pavements narrow
	Poor quality pavements	• Provide better quality pavements
Difficulty walking a long distance	Lack of places to sit when walking	• Provide seats
	Lack of public conveniences	• Provide public conveniences
	Facilities located too far from home	• Locate new healthcare facilities and major new food stores in places highly accessible by walking, cycling and bus
Fear	Concern about crime hotspots	• Reduce street crime • Provide CCTV (closed-circuit television) in appropriate locations
	Concern about walking after dark	• Improve street lighting

Data collected on footways included obstacles to movement, width where it was narrow enough to pose a possible problem, the material, and its condition, and the gradient where it was steep enough to pose a possible problem. Data collected on road crossings included the location, the width of the road at the crossing, the width of the island, if there was one, the type of crossing (zebra, pelican, toucan, school, unmarked or other), and the material. Bus stops were recorded in terms of location, the type and number of seats, whether or not there was a shelter, the routes served and the information provided. Data on car parks included the location, the type (off street or on-street, and in the former case whether it was ground level, underground or multi-storey, and the latter case, marked or unmarked bays), capacity, restrictions, cost of parking, length of permitted stay and operating hours. The final data set collected was on features, which included telephone boxes, letter boxes, cash dispensers and seats, which were recorded in terms of type and location. Location was recorded on the map using a unique reference number.

In this paper the results are presented in terms of access to some key facilities in the city centre of St Albans with and without barriers to movement. They will also be considered in terms of access from car parks since this is the commonest means of arrival in the city centre.

The AMELIA GIS database

A GIS database was compiled for St Albans using the digital data from the Ordnance Survey Land-Line Plus data as the base. The building polygons were extracted from it and populated with the data collected in the field as attributes. The buildings were further grouped into different category levels based on the Ordnance Survey Points of Interest (POI) classification scheme (Ordnance Survey, 2006). The location data for car parking and features were mapped as point features and linked with their attributes. Using the footways and crossing data collected, a detailed pedestrian network layer of the link-node structure was created by manually digitizing the pavements and crossings using the Land-line data as a backdrop. Once digitized, the network data were subject to further editing to include nodes at all decision points such as crossings and intersections. The links representing footways and crossings were used to store the respective attribute information collected, which could be modelled for network analysis purposes as the cost of traversing a particular link or as a barrier. Zonal data from the Census of Population 2001 were added into the GIS for use in accessibility analysis of specific groups of people. Figure 1 shows the GIS layers modelled for the centre of St Albans as an example of the GIS.

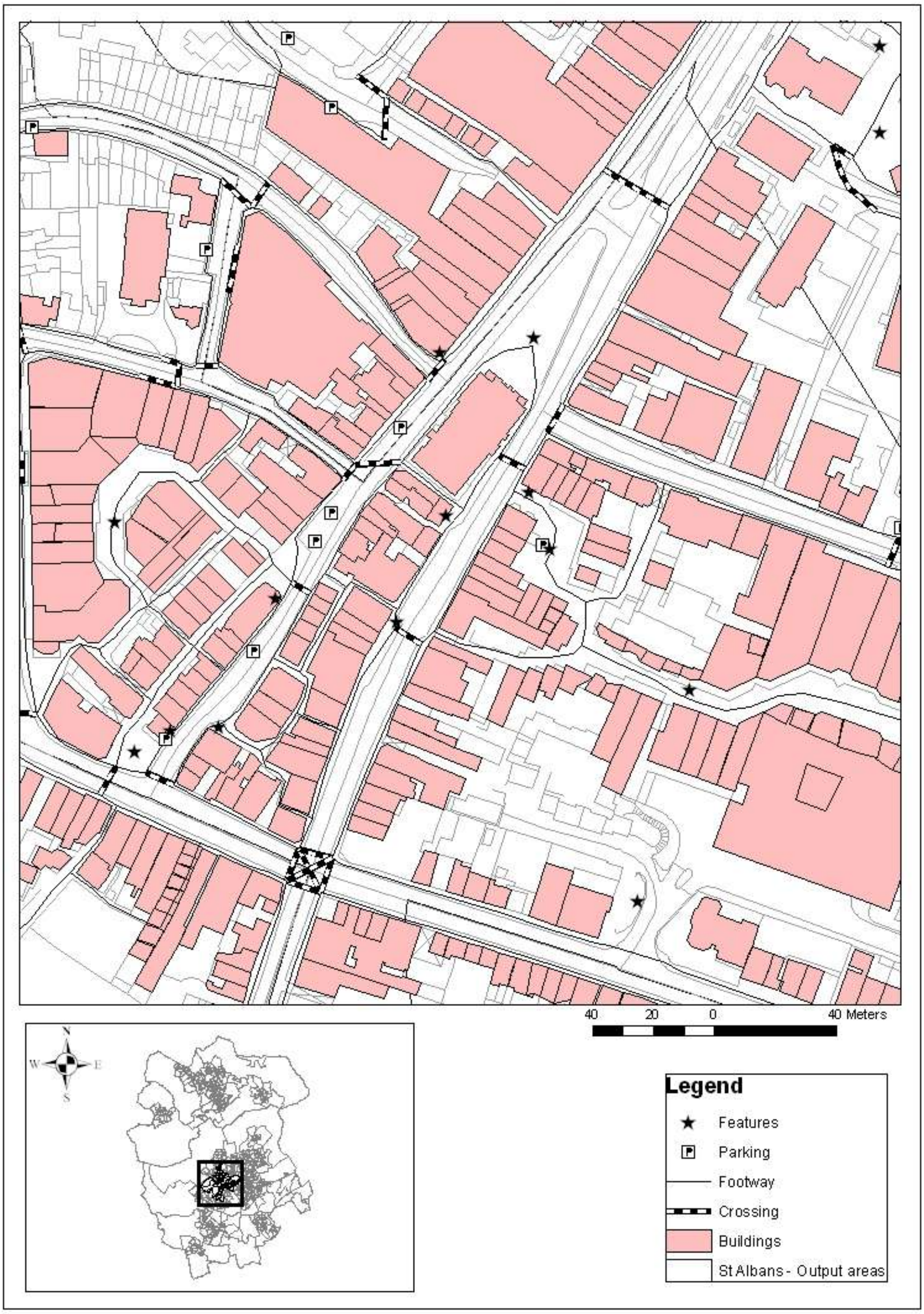

Figure 1 GIS layers, for the centre of St Albans
Note: The small map shows the output areas from the Census of Population 2001 used as the residential areas used for the figures in Table 2.

Analysis

Data have been collected for the city centre of St Albans in Hertfordshire. Despite the very good levels of access in St Albans there are still difficulties moving about. It is not possible to reach some key points in the city centre from all parts of the city centre without finding crossings lacking dropped kerbs, or with steep gradients on them, or pavements with obstructions which make it too narrow for some people to use them. Many of the buildings offer level access, but over half of them involve using either a ramp or one or more steps, which may be difficult for many people. The worst example found was the police station with fifteen steps and a notice saying 'Unfortunately we are unable to provide level access at this Station. Your nearest station with level access is Hatfield Police Station, St Albans Road, Hatfield, Herts, AL10 0EN'. This is a distance of over 9 km, which would be rather difficult for anyone in a wheelchair without a car.

In the first part of the analysis being presented here, accessibility is considered in terms of the number of people prevented from reaching opportunities because of barriers to movement and the change in the number of opportunities can be reached if the barriers are removed. Three types of barriers are considered:

- Crossings without dropped kerbs;
- Footways with an effective width of less than 1000 millimetres;
- A dropped kerb with a gradient of more than 5 degrees.

To show the possible impact of these barriers to the 1436 people aged 60 or over living the city centre, the effects of the barriers to three key places in St Albans are shown in Table 2. The key places are the Old Town Hall, which is in the centre of the city and is adjacent to the street market and the major shops, the City railway station, from where trains go to London, and the City Hospital.

Table 2 Number of residents of St Albans city centre aged 60+ who have barriers to walking between where they live and key locations

Obstruction	**St Albans Old Town Hall**		**St Albans City railway station**		**St Albans City Hospital**	
	No	%	No	%	No	%
Crossings without dropped kerbs	273	19	272	19	273	19
Footways with effective width <1000 mm	424	30	424	30	424	30
Dropped kerb gradient > 5 degrees	797	56	1436	100	1353	94
All of the above	1252	87	1436	100	1353	94

People in wheelchairs may not be able to cross the road without a dropped kerb. Furthermore, people who need dropped kerbs to make a journey, need them at every crossing that they use to reach their destination. Also, they need them not to be too steep. The figure of five degrees being used here, is based on guidance in the inclusive mobility guidelines (Department for Transport, 2005a). The width of the footway is also an issue. For illustrative purposes, a minimum width of 1000 mm is being considered here. Nineteen percent of the people aged 60+ cannot reach any of the key places if they need to use dropped kerbs at road crossings. This is the obstruction that affects the smallest number of people. The effective width of the footway is the obstacle that affects the second largest number of people, with 30% of the elderly people unable to reach the three key points if they are unable to pass through a gap of less than 1000 mm. The obstacle that causes the largest obstruction is dropped kerbs with a gradient of over 5 degrees. 56% of the population would not be able to reach the Old Town Hall if they cannot manage dropped kerbs which are steeper than 5 degrees, 94% would not be able to reach the hospital and none of them would be able reach the station. If people cannot manage to overcome any of the obstructions, most of them would not be able to reach the Old Town Hall (87%) and the hospital (94%), and none of them could reach the station.

This analysis shows that, despite the high levels of accessibility in the city centre, there are some obstructions. In particular, there are many dropped kerbs at crossings, but there are problems with the gradient of some of them. Width restrictions on the footway stop some people from reaching key points in St Albans.

Whilst some people may be able to reach the city centre by foot (or live there), many others will need to arrive by mechanized modes, either bus or car. In the interests of brevity, only car access will be considered here. Table 3 shows the percentages of the various types of building within various distances of car parks taking into account the three barriers to movement discussed above. This means that, for example, 26 per cent of eating and drinking facilities are within 50 metres of a car park, and 58 per cent are within 100 metres of one. To some extent, this is a measure of dispersal, with attractions and education and health having the most facilities within 50 metres of a car park. Clothing and accessories shops have the greatest number within 100 metres, but commercial services have the greatest number of building within 150 metres and 200 metres. The type of building which tend to be least well served by car parks within 50 metres is public facilities (libraries, places of worship, council offices, and so on). Because there are only four motoring shops and one is within 50 metres of a car park and the other three are all more than 200 metres from one, the values do not change. The attractions are at the same level of 50 per cent for three of the distance bands, implying that half of them are well served with car parks close by, and half are not.

Table 3 Percentage of various types of buildings in St Albans' city centre accessible within distance bands from car parks taking into account barriers to movement

Building Class	**Distance (m)**				**Total no. of buildings**
	50	100	150	200	
Eating and drinking	26	58	65	72	113
Commercial services					
Legal and financial	32	57	78	84	37
Other commercial services	31	58	79	85	97
Attractions	33	50	50	50	6
Sport and entertainment	25	44	50	56	16
Education and health	33	50	60	69	48
Public facilities	10	17	33	40	30
Retail					
Clothing and accessories	32	64	77	83	84
Food, drink and multi-item	23	47	63	77	30
Household, office, leisure and garden	28	55	72	76	123
Motoring	25	25	25	25	4
Total	28	54	69	75	588

If the three barriers to walking are removed (Table 4), the number of buildings within 50 metres increases to 39 per cent. When the barriers are removed, the access to public facilities has the largest increase, increasing to 23 per cent within 50 metres of a car park and 60 per cent within 200 metres, while for motoring shops (of which there are only four) there is no change. The most accessible types of building are those housing attractions and clothing and accessories shops with about half of the buildings within 50 metres of a car park when the barriers are removed.

Another way to illustrate how accessibility is affected by policy actions is to see the increase in the number of car parking spaces that the opportunities can be reached from if policy actions are introduced as shown in Table 5. Two types of barrier are shown: difficulties crossing the street and difficulty moving along the pavement. It can be seen that currently there are no parking spaces within 100 metres of the Old Town Hall. If more pedestrian crossings are provided then 5 spaces are available within 100 metres. This action and reducing the gradient on dropped kerbs increases the number at the 200 metres but improving the pavements has no effect at this distance. Providing wider pavements has a very small effect on increasing the number of parking spaces within 400 metres, but improving the crossings has a much larger effect, particularly providing more pedestrian crossings and reducing the gradient on pedestrian crossings. It can be seen that there can be synergies between policies since increase the number of spaces within 200 metres is greater as a result of the three policy actions to improve road crossings together than the sum of their individual effects. This analysis suggests that improving road crossings is likely to be much more effective than widening pavements as a way of increasing accessibility in this situation. AMELIA will allow this type of analysis to be carried out rapidly. When the cost of the actions can be introduced into the model it will be possible to see which policy action is most cost effective in increasing accessibility.

Table 4 Percentage of various types of buildings in St Albans' city centre accessible within distance bands from car parks when the barriers to walking are removed

Building Class	**Distance (m)**				**Total no. of buildings**
	50	100	150	200	
Eating and drinking	37	73	81	84	113
Commercial services					
Legal and financial	41	68	92	95	37
Other commercial services	40	76	94	94	97
Attractions	50	50	50	50	6
Sport and entertainment	38	69	81	81	16
Education and health	38	56	71	75	48
Public facilities	23	47	57	60	30
Retail					
Clothing and accessories	49	81	89	89	84
Food, drink and multi-item	37	70	97	100	30
Household, office, leisure and garden	40	69	86	86	123
Motoring	25	25	25	25	4
Total	39	70	84	86	588

Table 5 Number of car parking spaces that can be reached by walking various distances from St Albans Old Town Hall as a result of various policy actions

		Number of car parking spaces accessible within the distance bands			
		50m	100m	200m	400m
	Do nothing	0	0	18	54
	Policy action	Increase in the number of car parking spaces accessible within the distance bands			
A	Provide dropped kerbs	0	0	0	+45
B	Reduce gradient on dropped kerbs	0	0	+3	+142
C	Provide more pedestrian crossings	0	+5	+4	+145
A+B+C	Improve road crossings	0	+5	+14	+171
D	Provide better quality pavements	0	0	0	0
E	Provide wider pavements	0	0	0	+2
D+E	Improve pavements	0	0	0	+2

Conclusions and further work

This paper has presented an analysis of some examples of the effects of the barriers to mobility on the street. This is part of the development of the software tool AMELIA which is designed to show the impacts of transport policy on social inclusion. This analysis has shown that data can be collected to demonstrate that aspects of the physical environment can affect social inclusion, and that these can be represented in a GIS database of the type to be used with AMELIA. This means that it can be used to show how changes to the physical environment can affect aspects of social inclusion.

A number of barriers to mobility on the street have been identified. The impacts of these were examined in terms of how they can prevent people reaching destinations and how their removal can open up opportunities. These effects have been shown in various ways to illustrate the multi-dimensionality of the problems. It should be noted that only a small fraction of the issues concerning social exclusion have been discussed here.

AMELIA is still being developed. Guidance based on the recommended design standards and human characteristics, plus the cost of installation of the infrastructure, are being added. Consultation is taking place with planners from various local authorities about how they might use it, in order to ensure that the interface meets their requirements. The tool will then be tested with groups of people who are socially excluded in some way to explore whether it meets their needs and to see whether it can be designed for use by members of the public. The Environment Department of Hertfordshire County Council is keen to use the AMELIA in public consultation exercises to demonstrate the impact of schemes suggested by the public on social inclusion. This will all contribute to the development of a tool that is easy to use and very accessible, to enable transport planners and others help meet the accessibility needs of those people in society who are excluded in some way, and so lead to a more inclusive society.

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