Institute of Transport Studies
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Working Paper 252

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ERGONOMIC STANDARDS FOR PEDESTRIAN AREAS FOR DISABLED PEOPLE:

Literature Review and Consultations

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ABSTRACT

As part of the project for the Transport and Road Research Laboratory concerned with the development of design guidance for pedestrian areas and footways to satisfy the needs of disabled and elderly people, a thorough examination of the literature was required. In addition the literature search was to be complemented by a wide-ranging series of discussions with local authorities, organisations representing the interests of elderly and disabled people, and other interested agencies. This Working Paper sets out the findings of this exercise.

The objective of the literature review and the consultations was to identify the key impediments for elderly and disabled people when using pedestrian areas and footways. The current guidelines and standards relating to footways, pedestrianised areas and access to buildings were to be identified and their adequacy commented upon, as were the conflicts such recommendations raise between various groups of disabled people and with able-bodied people. The consultations were intended to provide greater insights into what the literature highlighted, and to suggest possible solutions.

The literature review produced over 400 key references and a list of 35 impediments. A more detailed examination of the literature and the consultations reduced this list to six key impediments namely: parking; public transport waiting areas; movement distances; surface conditions; ramps, and information provision.

The type and scale of problem created by the above impediments for various groups of disabled and elderly people are discussed, together with their measurement and assessment. The type and adequacy of existing design standards and guidance relating to these impediments are also outlined.

CONTENTS

Ergonomic Standards for Pedestrian Areas for Disabled People:

Literature Review and Consultations

1. INTRODUCTION

1.1 The Institute for Transport Studies was invited by the Transport and Road Research Laboratory to submit a research proposal, with costs, aimed at establishing suitable "Ergonomic Standards for Pedestrian Areas for Disabled People". The project commenced on 1st July, 1986 and was split into two parts, with Part One involving four months' work over the period to 31st December, 1986 and Part Two due to finish on 30th April, 1988. A series of Working Papers were to be produced which would form part of the final report. The subjects of the Working Papers would be:

1. Literature Review and Consultations
2. Methodology
3. Results of Interviews
4. Results of Observation Exercise
5. Results of Analysis

This Working Paper comprises the literature review and consultation elements of the project.

1.2 The main objectives of the Study laid down in the design brief by the Transport and Road Research Laboratory were:

a) To produce a guide to good practice for the design and maintenance of footways and pedestrianised areas;

b) To provide, where possible, recommended standards for design and maintenance.

The good practice guide and the recommended standards were to be primarily aimed at disabled people and the elderly, but the requirements of the able-bodied were also to be considered as were conflicts between the needs of different groups of user. The economic implications of implementation and maintenance were also to be detailed.

1.3 The objectives of the literature review and consultation exercise were as follows:

a) <u>The Literature Review</u>

i) Identify problems experienced by disabled and elderly people when using pedestrian areas and footways.

ii) Identify existing design standards and guidelines for good design.

iii) Identify conflicts and conflict resolution.

iv) Examine ideas and concepts that have been implemented in practice.

b) <u>The Consultation Process</u>

i) Identify key problems and obtain insight into their ramification.

ii) Identify conflicts and conflict resolution.

iii) Discuss the adequacy of existing standards and guidelines with representatives of the various disabled groups.

iv) Identify and discuss possible solutions to particular impediments.

1.4 This Working Paper is structured as follows. Section 2 provides some background details and ideas upon this subject. Section 3 details the approaches and their underlying assumptions used in meeting the objectives of part one of the study. Section 4 contains the main body of results of part one of the study, and Appendices A and B provide a comprehensive set of references.

2. BACKGROUND INFORMATION

2.1 In a study carried out by the Independent Commission on Transport (1974) it was concluded that "the problems of public transport are little more than an irritation for many people. For the elderly, however, they can mean hardship. Even those who can afford a car may find driving increasingly tiring and dangerous. But in most cases the old have not alternatives. They rely on public transport, walking and friends for practical needs, to get their pension, to visit the doctor ... and for avoiding the greatest danger in old age, isolation."

2.2 This problem of isolation is an important one for elderly and disabled people. It has been pointed out "that social contact is desirable, particularly for old people, who have fewer opportunities to meet and talk with other people than those who work" (Hopkin, 1978). However, if mobility difficulties are experienced, these may prevent the elderly person from taking part, or reduce the frequency of travelling to that activity, regardless of how desirable participation may be (Hopkin, 1978). In the same study it was also noted that "the location of facilities needs to be taken into account, as location can affect the ease with which facilities are reached, and hence the participation in activities at certain types of destination."

2.3 The above clearly illustrates the importance of social contact for the elderly (and hence also for disabled people) and that this contact involves not only travel <u>within</u> a destination area (e.g. pedestrian area, shopping store) but also travel <u>to</u> that destination area. This must be related to the growing acceptance of the concept that all areas should be made accessible to the whole population (H.U.D., 1975; National Consumer Council, 1981; Lyon, 1983), and this, in turn is related to the aim of assisting in the integration of disabled (and elderly) people within society as outlined in the International Year of Disabled People Leaflet (1981).

2.4 There is much evidence to indicate that these disadvantaged people desire to fully use the facilities provided in areas that are 'pedestrianised' (Central Council for the Disabled, 1969; Institute of Public Administration, 1975; Goldsmith, 1976; Brock, 1978; Rosenbloom, 1982). Consequently, any interference in the ability of people to carry out essential or desirable activities in such areas is, as Hopkin (1978) points out, likely to create serious problems. This is compounded by the loss of essential local services such as post offices, and chemists which increases the need for disabled and elderly people to use a pedestrian area.

2.5 The importance of the above is given added impetus when it is realised that around 20% of the total population in Britain is 'demonstrably disadvantaged' in some way (Lyon, 1983). Furthermore, since the proportion of elderly is likely to rise from the figure of 14.9% of the population in 1984 to 15.5% in 1996 (Hardy and West, 1985; Social Trends, 1986), this proportion of demonstrably disadvantaged is likely to rise also. GLAD (1986) found that some 7% (465,000) of Londoners using public transport were handicapped, and that although a large number of 'transport-handicapped' people were elderly, particularly women, there were also a considerable number of handicapped younger people using public transport.

2.6 It is important to outline the wide variety of impairments that exists within this disadvantaged population and to clarify the meaning of the various terms used. The World Health Organisation (1986) distinguishes between impairment, disability and handicap. Impairments can be defined as lacking part or all of a limb, or having a defective limb, organ or mechanism of the body (Morris, 1971). It is, in other words, the actual physical condition of the individual, such as blindness. Disability is the loss or reduction of functional ability, whilst handicap is the resulting disadvantage or restriction of activity caused by the disability. Many impairments do not inhibit people from living a 'normal' life, and hence our concern is not directly with impairment. Primarily we are concerned with disability rather than handicap, as we aim to produce guidance that can help to overcome the barriers or impediments that the environment can present to disabled people. This, of course, is directly connected with alleviating handicap.

2.7 Although our concern is with disability, it is necessary to consider the background figures of the number of people with impairments. There are a number of categories of impairment, the main ones of which are outlined in Table 2.1, together with their percentage of the total impaired population. These categories cover 88.4% of the total impaired population. There is also the International Classification of Impairments list, used by GLAD (1980) in indicating the division of impairment within 'transport-handicapped' people in London (Table 2.2). This shows that sensory impairments, hearing and ocular, and cardio-respiratory impairments are found more amongst older people, whilst the young are more likely to have psychological impairments.

2.8 In 1966 it was estimated that approximately 3.4 million people in the UK suffered from some impairment (Harris, 1971). However, as indicated above, not all impairments are handicapping. Hence it is usual to break down impairment into the following four main categories.

a) Very severely handicapped - These require special care and are virtually immobile.

b) Severely handicapped - These need considerable support.

c) Appreciably handicapped - These need some support.

d) Impaired - These need little or no support for normal everyday activities.

Of the people in the three categories requiring support (categories a - c), something like 0.5 million are essentially housebound because of their condition (categories a and b). Of the 0.75 million falling into the appreciably handicapped category and who might be able to take advantage of improved facilities in pedestrianised areas, they fall into the impairment categories shown in Table 2.3 (Harris, 1971).

2.9 When considering disabled people as a group it has to be recognised that they cover a wide spectrum of abilities. It is for this reason that the term 'the disabled' is often misleading and potentially controversial (Guardian, Letters, August 1986). Whilst discussing all people with a disability - as far as this is useful - the term 'the disabled' may have some relevance. A more suitable term, however, would seem to be that of "disabled person or people", as this has been found to be most acceptable in our discussions with organisations representing disabled people.

Table 2.1

Impairment Category	% of Impaired Population
a) Diseases of central nervous system	10.7
b) Diseases of the circulatory system	14.7
c) Diseases of the respiratory system	8.5
d) Diseases of the sense organs (incl. blindness)	8.3
e) Diseases of bones & organs of movement	35.4
f) Injuries or amputations	7.2
g) Senility	3.6
	88.4

Source: Harris, 1971.

Table 2.2

Impairment: By Age

	All	All Under pension age	Pension age or over
Sample Size	379	161	218
Area of Impairment	%	%	%
Intellectual	2	4	*
Other psychological	11	17	9
Language	1	1	*
Balance	9	9	10
Hearing	4	1	6
Ocular	8	5	10
Cardio-respiratory	23	17	26
Other visceral	9	3	9
Skeletal	45	43	46
Disfigurement	3	2	4
Generalised, sensory and other	8	9	8

Source: GLAD, 1986.

Table 2.3

Impairment Category	Total in Category	Total Appreciably Handicapped	Appreciably Handicapped %
a) Central Nervous System	360,000	34,000	9.5
b) Circulatory System	492,000	61,000	12.4
c) Respiratory System	284,000	18,000	6.3
d) Sense Organs (incl. Blindness)	277,000	20,000	7.1
e) Organs of Movement	1,187,000	616,000	51.9
f) Injuries & Amputations	243,000	16,000	6.7
g) Senility	122,000	3,000	2.1
	2,965,000	768,000	

Source: Harris, 1971.

2.10 Various methods have been proposed for classifying disabled people in order to highlight the variety that exists between them, some indication of which can be seen in Table 2.4. In considering such categories it has to be recognised that individuals often suffer multiple disabilities, as well as having differences in severity. Furthermore, it is necessary to be aware of the problems produced by any form of categorisation, namely that it may not only be unreflective of the range of ability of people, but may also be viewed as being counter-productive to the main aim of most disabled people - to be 'accepted' within society. However, it is recognised that some form of categorisation is necessary if meaningful and useable results are to be obtained, but that this should be based upon carefully considered and widely discussed assumptions.

Table 2.4: Summary of Disability Categorisations from the Literature

H.U.D. (1975)	STEN (1981)	BLOHMKE (1965)	MIDDENDORF (1980)	FALCUCCHIO (1980)	LYON (1983)
Temporary Impaired	Persons with walking	Permanently dependent	Inability to walk	Wheelchair (Elderly	Elderly
Activity Impaired	difficulty (walk ICO	upon wheelchair	Inability to negotiate	Wheelchair (Non-	Wheelchair bound
Mobility Impaired	M. without rest and	Using artificial leg,	changes in elevation	Elderly)	Mothers encumb-
(not compensated	need handrails)	brace, etc.	Inability to stand	Severe difficulty	ered
by aids)	Wheelchair bound	Visual handicap	Inability to sit down/	in climbing stairs	Blind
Mobility Impaired	Weak-sighted	Deaf	stand up	(Elderly)	Deaf
(using mechanical		Brain or nervous	Inability to reach	Severe difficulty	Pregnant
aids)		injury	Inability to use hands/	in climbing stairs	CSDP
Manual Impaired		Old age handicap	fingers	(Non-Elderly)	Voluntary disabled
Visual Impaired			Inability to lift	Minor difficulty	Temporary disabled
Audial Impaired			objects	in climbing stairs	Reflected disabled
Mental Impaired			Inability to see	(Elderly)	
			Inability to hear	Minor difficulty	
			Inability to speak	in climbing stairs	
			Susceptible to faints	(Non-Elderly)	

2.11 The terminology and criteria used in identifying and classifying disabled people is variable and usually reflects the concern of whoever is drawing up the definitions. Thus, there is a distinction between those approaches which are 'compensatory' and which rely on medical definitions, and those which are 'rehabilitative' and define the functional requirements necessary to achieve certain ends. In addition there are those which rely upon a 'performance level', with people being considered handicapped if they cannot attain levels that are achievable by the 'normal' or 'average' person.

2.12 It was considered that the compensation approach was not a suitable means of classifying people since any medical definition of a disabled person would embrace a wide range of functional disabilities, each of which may or may not handicap the person in a pedestrian area. The rehabilitative approach would, in essence, involve the development of a list of functional requirements that disabled people would need to be able to satisfy in order to overcome particular barriers. However, this approach needed assumptions to be made on what individuals with various sorts of disability could actually do within the environment of a pedestrian area.

2.13 It seemed, therefore, that the performance level approach - with suitable modifications - would provide an acceptable means of classifying disabled people. The details of such a classification approach will be outlined after some of the assumptions underlying the development of the approach are described. Firstly, it does not seem sensible to relate performance levels to the 'average' population as this could provide a potentially biased standard or form of guidance, although recognition needs to be made that disabled people wish to be integrated with this 'average' population. However, the concept of a performance level approach would seem useful both in classifying disability and offering guidance, if some idea of performance (or more accurately inability to perform) could be outlined. Therefore the categorisation framework outlined later aims to categorise people in relation to the key factor which is preventing them from performing as ergonomically satisfactorily as possible in the pedestrian area environment.

2.14 Secondly, by suggesting a performance orientated classification, it would seem necessary to provide a performance orientated form of guidance although it was recognised that consideration of the guidance format would probably be an on-going activity throughout the project. Accepting that both standards and guidance should be a flexible statement that would change as opinions, attitudes and empirical knowledge altered, then it can be further assumed that these standards and/or guidelines should indicate measurable or assessable objectives rather than the means of achieving such objectives. Finally, it was recognised that not everyone with a disability would have the handicap created by the layout or the design of a pedestrian area completely removed. Consequently, policy decisions would have to take this into account.

2.15 Taking the above three points together (performance guidance, assessable objectives and policy decisions), it was decided to produce a 'double-edged' form of guidance. On the one hand, there would be the evidence from our empirical studies which would indicate the percentage within each of the specified disabled categories who could overcome certain ranges of the specified design features or factors. This evidence could be used by other local authorities if they felt unable to identify their disabled population in the manner used at the test-site. On the other hand, local authorities could decide what percentage of people within each specified disabled category they would cater for after having identified the profile of their own disabled population.

2.16 Finally, it has been concluded that categorisation of disabled people is appropriate. Whilst categorisation can be viewed as being unreflective of the diversity of disability, it is considered to be a workable approach that can, in practice, cover a reasonable range of disability diversity and severity.

3. THE APPROACH

3.1 It was agreed with TRRL that the first phase of the project would consist of a review of the existing literature and standards. The findings of this review were then to be discussed with various organisations and individuals. The result of this was to be a report on the current state of knowledge, existing standards and guidelines, including a statement on key impediments on which the research should be focussed.

3.2 A formal literature search was carried out using IRRD in 1986. A detailed search of journals and sources outside the scope of IRRD was also carried out and this produced additional articles. The Social Science Citation Index and the Index Medius were also interrogated. A number of local authorities, as well as planning, transportation and medical consultants, were also consulted in order to identify work that had not been formally published or listed. The detailed bibliography obtained is set out in Appendix A.

3.3 Meetings were held with a large number of organisations, a detailed list of which can be found in the Appendix B. The main purpose of these meetings was to ascertain what the key problems of disabled people were considered to be, both from the representatives of disabled people and from local authorities and other bodies. It was also hoped that the adequacy of existing standards and current guidelines would be commented upon, and possible solutions to some of the impediments identified.

3.4 The approach used in the meetings was broadly as follows, with allowance being made for different emphases depending upon the organisation being consulted. Firstly, the problems associated with pedestrian areas were identified and their significance discussed. Secondly, suggestions on possible solutions to these problems were asked for, as well as comments upon existing or developing mobility aids. Thirdly, comments upon the existing guidelines and standards for various design features was obtained. Finally, suggestions upon appropriate literature and research field studies were requested.

3.5 At an early stage in the project a close working relationship with Leeds City Council was established. This was in the form of discussions with various officers, support from members, and provision of facilities and services. Ultimately it was also to provide a useful sounding-board for the appropriateness of the resulting recommendations and guidance. Alongside this formal relationship a series of 'experimental' and brainstorming workshops were set up involving local organisations such as Shape-Up-North, YANA, and disabled and research organisations. These sessions were not intended to produce recorded or quantitative results, but rather to influence the manner in which the research was approached and reported. In this respect the sessions involving first hand experience of a disability, albeit temporarily and artificially, proved extremely useful for the research team and Leeds City Council Officers.

4. RESULTS

4.1 Introduction

4.1.1 This Section identifies the problems highlighted during our discussions and examination of the literature. It includes the extent and severity of each of the problems, the means by which the problems or impediments can be studied and measured, and the guidance that exists on how to overcome them and the barriers they create. The aim is to indicate the reasons for selecting the key impediments adopted for study, and the study approach adopted.

4.1.2 The original list of problems identified after our preliminary discussions and a cursory review of the literature, and presented in the original submission to TRRL, is outlined in Table 4.1. The Table also indicated the severity of each problem for the three groupings of disabled people examined, namely people using wheelchairs, those with walking difficulties, and the visually impaired. From this list it was considered that the following presented significant problems for all three groups:

1. Parking
2. Public transport
3. Movement distance
4. Surface condition
5. Crossing roads
6. Location, design and type of furniture
7. Steps at kerbs
8. Stairs/Ramps
9. Handrails
10. Information provision

4.1.3 This preliminary identification of problems was followed up by more detailed discussions nationwide and a more comprehensive examination of the literature, as set out in Section Three. This led to the identification of the more extensive list of problems set out in Table 4.2, and an increased understanding of the interaction and conflicts between the various impairments.

4.1.4 The problem issues identified are outlined in more detail below, and are split into four parts, namely:

a) 'Access to an area'
   4.2 parking
   4.3 public transport

b) 'Movement into an area'
   4.4 crossing roads
   4.5 movement distance
   4.6 surface conditions and type

c) 'Mobility within the area'
   4.7 furniture/obstructions
   4.8 steps and stairs
   4.9 ramps and kerbs

d) 'Interface with services and facilities'
   4.10 information provision
   4.11 toilets

Table 4.1

Design Features	Disabled Group		
	Walking Problems	Wheelchair Bound	Visual Disability
a) Kerbs	V	V	V
b) Steps/Stairs	V	V	V
c) Ramps	V	V	M
d) Over- and Under-passes	V	V	M
e) Surface Type inc. Condition	V	M/V	V
f) Surface Gradient	V	V	M
g) Movement Distance	V	V	M
h) Rest Areas/Seating	V	L	M
i) Furniture	L	M	V
j) Building Interface	L	V	V/M
k) Visual Cues	L	L	V
l) Parking Facilities	M	V	M
m) Public Transport	M/V	V	M/L
n) Crossing the Road	V	V	V
o) Escalators	M/V	V	M/V
p) Lifts	L	L	L
q) Toilet Facilities	M	V	M/L
r) Handrail Provision	V	V	M/V

Key

V - Very important
M - Medium importance
L - Low importance

TABLE 4.2

Potential Problem Aspects Identified by the Groups Visited

Problem Aspect	CPA	Arthritis Care	RADAR	GLAD	DLF	ACE	Leicester City
1. Parking			o	o	o	o	o
2. Walking Distance	o	o			o	o	o
3. Seating/ Rest Areas	o	o	o		o	o	o
4. Furniture				o			o
5. Slopes/ Gradients		o	o		o	o	
6. Ramps/ Stairs		o	o			o	o
7. Lack of Pelicans		o					
8. Short Green Phase on Crossings	o	o					
9. Inaudible Tone on Crossings		o					
10. Kerbs		o	o	o		o	o
11. Underpasses	o						o
12. Uneven Surface	o	o	o		o	o	o
13. Camber			o			o	o
14. Building Interface		o		o	o		
15. Public Transport Interface	o		o	o		o	
16. Signing	o	o	o	o	o	o	o
17. Lighting	o			o			
18. Escalators	o						
19. Lifts				o			
20. Toilets	o	o	o	o	o		
21. Lack of Consultation		o		o	o	o	
22. Effect upon Family and/or Helper		o				o	
23. Design for Change			o		o	o	
24. Inconsistency of Approach				o		o	

Continued ......

Table 4.2 Cont/d

25. Translation for Ethnic Minorities				o			
26. People as the Problem		o		o			
27. Omission of Seriously Disabled	o		o			o	
28. Access to Essential Services	o		o			o	
29. Greater Dependance upon Walking	o						
30. Drainage Gratings					o		o
31. Phased Introduction						o	o
32. County Council Policy						o	
33. Shared Use						o	o
34. Position of Button/ Control on Pelican Crossing							o
35. Position of Control/ Button on Pelican						o	o

A. Access to an Area

4.2 Parking

4.2.1 A major problem highlighted in our discussions and in the literature was that of parking provision and location. The problems created under this heading have several facets:

1) There is little readily available guidance on the amount of provision to make for disabled drivers and passengers in terms of number of spaces. In general the capacity and usage characteristics of roads/carriageways determines the overall number of spaces allocated. Where provision is made, the design of the space is often inappropriate.

2) Although there is guidance on the dimensions of parking bays, consideration is not always given to the 'finishing' touches of the bay. This includes access to the car from the side adjacent to the stream of traffic, high kerbs, and bays which are too narrow.

3) Parking spaces are often too far away from desired destinations. This is often exacerbated when pedestrian areas are extended.

4.2.2 The extent of such problems, even without detailed empirical evidence, is considered to be widespread. The fact that between 450-500 pedestrian areas existed in Great Britain in 1982 (Leech, 1982) indicates the potential for such problems to arise. In addition, approximately 800,000 orange badges are on issue, and hence a substantial number of such holders are unable to make full use of the facility. The problems created for disabled people when attempting to park create a particular severe limitation on access to pedestrian areas and town centres in general, and are thus seen as a major mobility handicap. The exclusion of Orange Badge holders from pedestrian areas can result in facilities being outside the mobility range of many disabled people.

4.2.3 The aspects of the parking problem that are of prime interest are the number of spaces provided, their location and their design. It is recognised that there is a close inter-relationship between these aspects and other characteristics of the environment that cause problems or barriers, such as surface condition and slope, and kerb type adjacent to the parking bay. However, it is necessary to select those aspects that are central to the aim of developing guidance to overcome parking problems for disabled people.

4.2.4 Guidance exists for the design of the parking bay. The width of a car bay varies from 3000 mm (Bails, 1986) to 4110 mm (Veterans Administration, n.d.), depending upon the type of user and the location of the bay. Likewise, the length varies from 4800 mm (IHT, 1986) to 8000 mm (HUD, 1975) for parallel parking, and between 6413 mm and 7000 mm for angled parking (HUD, 1975). More detailed discussions of parking bay design can be found in Winslow (1977), HUD

(1975), Jones (1977), Harkness and Groom (1976), Bails (1986) and IHT (1986). The key point to draw from these guidelines is the range of dimensions that exist for similar parking bay arrangements and the lack of reference to any empirical work to justify the standards adopted. This aspect was raised in our discussions as being needful of correction, although there was some acceptance of satisfaction with the BSI standards (DLF).

4.2.5 The number of spaces to be provided for disabled drivers has been dealt with by various authors, although a key point arising from examining such sources is that site-specific conditions are often critical in determining the amount of provision made. HUD (1975) suggested that at least two spaces per parking lot or one space per 20 cars, whichever is greater, should be a minimum provision. Winslow (1977), however, suggested that 1% of the total parking spaces should be relocated for disabled people, whilst Jones (1977) gave a more disaggregated method for calculating the required number of parking spaces (Table 4.3).

Table 4.3

Total No. of Available Parking Spaces	No. of Parking Spaces for Disabled Drivers
0-100	1 for each 25 or fraction thereof
101-200	4+1 for each 50 or fraction thereof over 100
201-500	4+1 for each 100 or fraction thereof over 200
501-1000	2% of total
over 10	20+1 for each 100 or fraction thereof over 1000

4.2.6 The IHT (1986) guidelines recommend that for off-street public car parks having more than 60 spaces, 4% of the spaces should be reserved for orange badge holders, with a minimum of two. They emphasize that on-street parking is very much dependent upon local circumstances and outline the various options available for developing parking with regard to the orange badge scheme. A point emphasised both in the IHT guidelines and at the CEH conference on 'Pedestrianisation and the Orange Badge Scheme' (CEH, 1986) relates to the issue, use and enforcement of the orange badge scheme. Problems encountered have been widely discussed (JCMD, 1986; CEH, 1986; DTp, 1986) and recommendations on how to reduce them produced.

4.2.7 The final problem is that of the location of spaces, and in particular their distance from desired destinations. The National Swedish Institute for Building Research (1972), recommends 50 m on an uncovered route; 100 m on a partial covered route or one with a roof; and 200 m in areas where the environment is completely protected or enclosed. HUD (1975) recommended that 100 ft (33 m) should be the maximum distance of a parking area to related buildings or destinations. Bails (1986) sets out a more disaggregate set of distinctions based upon disability and age. These range from 30 m for a 90 year old physically disabled person in a wheelchair or using a walking frame, to 280 m for a 70 year old physically disabled person using a wheelchair or walking stick. It should be noted that Bails recommendations are, in part, based upon field tests. The uncertainty associated with the range of standards was highlighted several times in our discussions.

4.3 Public Transport

4.3.1 Several studies have stressed that there are many disabled and elderly people do not have access to a car and are thus reliant upon public transport or walking (GLAD, 1986; Feeney, 1981; Bailey and Layzell, 1981; Manouk et al, 1978; Borg, 1984). GLAD found that at least 7% (465,000) of Londoners have problems when using public transport, of which 95,000 are unable to use a bus, 155,000 unable to use the tube and 110,000 unable to use British Rail. Manouk et al (1978) found that approximately 63,000 people using public transport in the Tyne and Wear MCC had a mobility problem. Clearly then, using public transport creates problems for a large number of people.

4.3.2 The GLAD studies (1984, 1986) found that the elderly and women formed the main groups of disabled people using public transport, together with a substantial number of younger people. It was found that the proportion of handicapped people using public transport was 2% up to 44 years of age, 14% at pension age, but over 60% at 80 years of age and above. Women were found to be four times more likely to be handicapped than men between the ages of 35-49 and 80% more likely at 75 years of age and above. It was also shown that people living alone were more likely to have problems in using public transport than those in larger households; ranging from 27% in one person households to only 8% in four or more person households.

4.3.3 There would appear to be four broad problem areas for disabled and elderly people when using public transport. Firstly, there is access to buses and bus stops at the 'home' end of a journey. Secondly, access to and egress from the bus or public transport vehicle itself. Thirdly, the location and type of drop-off and pick-up facility at the shopping centre or attractor end of the journey. Fourthly, the psychological aspects associated with the above three stages and the provision of information and form of communication prior to, during, and after a journey. More extensive discussions of these problems can be found in Winslow (1977), Manouk et al (1978), Darnborough (1981), Dunstan (1981), Harvest (1981) and IHT (1986).

4.3.4 Guidance exists for all of these problem areas, although the degree of detail varies. To overcome the problems inherent in the location and type of bus stop facility at the 'home' end of a journey taxicard, dial-a-ride and other forms of transport have been developed. Details of the operation and effectiveness of these schemes have been studied by GLAD (1986), Oxley (1984), Bruce (1987), and Falcocchio (1982). It is clear from these sources, however, that any proposal needs to be carefully tailored to the needs of the intended consumers. GLAD (1986), in fact, stressed the importance of consultative role in determining the distribution of routes, frequency of bus stops, and the safety and ease of making the journey to the bus stop.

Table 4.4

Difficulties in Using Buses

Base: 248 (All those who can use buses, but only with difficulty or help)	All finding this a problem	Cannot do without help
Getting to or from the bus stop	54%	20%
Waiting for the bus to come	71%	11%
Knowing which bus to catch	18%	9%
Getting upon the bus	64%	31%
Getting to a seat	55%	18%
Sitting on the bus	13%	3%
Buying a ticket	9%	6%
Knowing when to get off	15%	9%
Getting up from the seat	44%	12%
Getting to the platform to get off the bus	58%	20%
Getting down off the bus	61%	28%

Source: GLAD (1986).

4.3.5 The interface with public transport, including travelling on the vehicle, has received much attention. The problems created by both bus, train and underground services have been well documented (Robinson, 1981; US DoT, 1973; GLAD, 1986; Feeney et al, 1979). GLAD (1986) provide details on the extent of some of these problems, as can be seen in Table 4.4. Our consultations with other groups have confirmed many of the points, as well as highlighting the suitability or unsuitability of existing designs and operational characteristics.

4.3.6 Guidance exists on many aspects of this issue, with the work by Mitchell and Frye (1984) being a useful summary, particularly in respect of the design of buses for ambulatory disabled people. The results, it should be noted, were based upon field tests, including studies by Oxley and Benwell (1983) and Oxley and Benwell (1985). The results of these studies produced the following recommendations. Firstly, the step height onto a bus should be 200 mm or less, as this was the critical threshold above which problems increased significantly. The steps in a flight should also be of equal height, with a tread of 350 mm. Handrails were identified as important aids, with a horizontal railing of 850-900 mm continuous from the bus entrance to the seating reserved for disabled people being a recommendation. It should also be large in diameter (32 mm) and non-slip. Finally, the bus needed to stop within 300 mm of the kerb if it was not to create difficulties for disabled people.

4.3.7 Our consultations also highlighted the need for smaller and shallower steps onto buses, lowering the step, and minimising the gap between platform and step on trains (GLAD). Raising staff awareness of disability during their training was also suggested as a means of reducing the barriers to getting on and off vehicles and in using the service generally (RNID, GLAD). As Mitchell and Frye (1984) noted, the time penalty in allowing all elderly and disabled people to sit down on a bus only added 30 seconds to a 60 minute journey.

4.3.8 Both Robinson (1983) and the US DoT (1973) illustrate some of the problems related to public transport waiting or drop-off areas, which they divide into physical and operational barriers. These are summarised in Table 4.5.

Table 4.5

Barriers Associated with Public Transport Waiting Areas

Physical Barriers	Operational Barriers
Long stairs	Employee assistance
Long walks	Information clarity and dissemination
Poor fare collection facilities	Length of stops too short
Poor posting of information	Crowd flow non-directed
Poor crowd flow designs	
Insufficient seating	
Little interface with other modes	
Lack of shelter	
Platform incompatible with vehicles	

Source: Robinson and Carter (1981) and US DoT (1973).

4.3.9 The extent and severity of the problem can again be illustrated from the work carried out by GLAD (1986), where it was found that 71% of people who could use buses found waiting for the bus difficult. This, in fact, was the most commonly cited problem. Mitchell and Frye (1984) also indicated the extent of the problem when waiting at a bus stop through the work of Feeney et al (1979) and Hopkin et al (1978), with 51% of disabled people finding it difficult to wait at bus stops. In the case of trains and underground services, actually finding the platform was a major difficulty (35% of people using the underground found it difficult and 19% found it impossible; 38% of people using trains found it difficult and 15% impossible).

4.3.10 Our consultations elaborated upon the difficulties experienced in waiting areas of public transport services. LBDRU stressed the often inappropriate design of seating, although it was recognised that there were conflicting interests involved in their design and siting. CPA emphasised the need for clear signing in such areas, a point also highlighted by the RNID who linked this with appropriate training for staff.

B. Movement into an Area

4.4 Crossing Roads

4.4.1 There are three aspects to consider when examining the problems that disabled and elderly people face when crossing a road. Firstly, there are the problems encountered at overbridge/subway crossings. Secondly, there are problems encountered at signalised, Pelican/Zebra and uncontrolled crossings. Thirdly, there are problems faced when crossing the carriageway at non-designated crossing points.

4.4.2 Subways were particularly cited as problems during our discussions, especially for the elderly who found them unfamiliar (CPA). The severance effects of overbridges has also been well illustrated in the literature by De Leuw (1981). At controlled crossings the length of the green cycle was also raised as a problem (Arthritis Care, CPA), particularly lack of proper understanding of the operation of such facilities, by the elderly. The usefulness of these facilities was recognised, however, so much so that the need for more such crossings was emphasized (Arthritis Care). A final problem mentioned on Pelican crossings was the location of the button and control box and the design of these features. The inconsistency in height of the box and button, and uncertainty as to where the pole was located (left or right) were frustrating for blind and partially sighted people (LBDRU).

4.4.3 There is a wide variety of guidance on the above problem situations, and a more detailed discussion can be found in IHT (1986), Netherlands Ministry of Transport (1986), Lyon (1983) and Jones (1977). Some of the key points are, however, highlighted below. The design of subways and overbridges encompasses many design features for which standards already exist, for example handrail provision and ramp and stair design. Of further consideration, however, is the extent to which a person changes level, with the aim being to minimize such change. To this end subways are more suitable, provided there is adequate headroom. A sill also needs to be provided along subway walls, and changes in texture and colour should be provided on both subways and overbridges at the top and the bottom of all stairs and ramps. More detailed coverage can be found in De Leuw (1981), HUD (1975) and IHT (1986).

4.5 Movement Distance

4.5.1 The distance that many disabled and elderly people can walk or move is limited, and this can create a major barrier when attempting to gain access to a particular area. Acceptable walking or movement distance is not a constant variable, however, since it is related to the weather condition, the amount of cover, the circumstances of the individual, and the route characteristics. It is a widespread problem, however, with Grady (1977) noting that 78% of people with an impairment had difficulty in walking, with accessing bus stops a particular problem raised. Bailey and Layzell (1981) found that 97% of disabled people and about 45% of elderly people in Wealden and Coventry had difficulty in walking. Falcocchio (1982) provides a more disaggregated set of data about the capability of wheelchair users to cover various distances, (Table 4.6).

4.5.2 The distance that people are able to walk is particularly acute for the ambulatory disabled, such as those suffering from arthritis/rheumatism, stroke/paralysis and heart/circulatory conditions. Hence it is a severe problem for people who hold orange badges, as the criteria for holding such a badge relate to their ability, or rather inability, to walk or move around. The fact that about 800,000 orange badges are currently on issue gives an idea of the size of the population affected by problems related to walking distance. The general tendency of towns to pedestrianize, and later extend such areas, can exacerbate these walking-distance related problems.

Table 4.6

Task	Ability to Perform Task			
	With little or no difficulty (%)	With much difficulty (%)	Only with assistance or not at all (%)	Number of respondents
A. Using a well maintained sidewalk				
1. Going uphill				
c. 300 ft	16	6	78	32
100-300 ft	11	7	82	28
50-100 ft	18	7	75	28
< 50 ft	24	3	73	30
2. Going downhill				
c. 300 ft	35	-	65	31
100-300 ft	37	-	63	27
50-100 ft	37	-	63	27
< 50 ft	37	-	63	27
3. Level surface				
c. 1200 ft	38	7	55	29
600-1200 ft	43	3	54	28
< 600 ft	58	-	42	31
B. Going without a sidewalk				
c. 1200 ft	16	7	77	31
600-1200 ft	14	4	82	28
< 600 ft	14	3	83	30
C. Using sidewalk or path which is poorly maintained	3	9	88	34

Source: Falcocchio (1982)

4.5.3 The particular aspects raised as being important during our consultations were the physical distance to be moved, the time taken, and route characteristics and conditions. The last aspect will be dealt with in Section 4.6. It is obviously difficult to provide guidance on the former without empirical data, which is lacking in the literature, and it is equally difficult to detail guidance on how long disabled people can move around for. This is of particular importance with regard to Orange Badge holders and the time restrictions placed upon them when parking on yellow lines.

4.5.4 During our discussions some possible solutions or means of ameliorating the problems emerged, although the concern was still to get people as close to the pedestrian area as possible, and preferably as close as goods vehicles (Arthritis Care). Shop mobility was suggested as one means of overcoming some of the barriers created by distance, but ACE stressed that this option can only be a partial solution. The provision of adequate seating at appropriate locations and distances along key routes was seen by RADAR as a straightforward means of assisting people. GLAD suggested that making use of other people may be worth considering, such as in taking goods to cars and bus stops, although it was stressed that the details of this would need careful consideration. Another suggestion worth noting would be the inclusion of information on distances in freely available booklets (Arthritis Care, GLAD).

4.5.5 The guidance available from the literature on appropriate movement distances appears to be based, in part, upon the recommendations made by the National Swedish Institute for Building Research (1972). The recommended mobility ranges from parked cars to destinations within the pedestrian precinct were:

a)	unprotected routes	50 m
b)	routes protected against rain by a roof	100 m
c)	routes completely enclosed against bad weather	200 m

4.5.6 HUD (1975) also recommended movement distances from parking bays to buildings or destinations, with the recommendation being 100 feet maximum (30.5 m). For movement distances to and from public transport they recommended a maximum of 300 feet (91.5 m). The reason for the distinction is not clear. Jones (1977) also provided details on appropriate movement distances, and related them to gradient. Thus, the maximum distance between a parking area and a destination when the gradient is less than 1:20 should be 200 feet (61 m), and a maximum of 100 feet (30.5 m) when any part of the route is greater than 1:20 or has a ramp.

4.5.7 Bails (1986) outlines a series of recommended walking distances on horizontal surfaces, and relates them to seat spacing. The results are predictions based upon able-bodied and disabled elderly people's capabilities, and the resulting proposals are part of what he terms 'Age Span Design'. His proposed maximum walking distances range from 30 m to 280 m, which he stresses need to be verified in the field. The corresponding seat spacing ranges from 20m to 200 m. A more detailed picture can be seen in Table 4.7.

Table 4.7

	Seriously Impaired or Confused				More Able-Bodied		
<u>Age Design</u>							
Physically Fit	95	90	85	80	90	85	80
Phys. Disabled	90	85	80	75	80	75	70
<u>Critical Mobility Aid Used</u>							
Ambulant							
Wheelchair User							
<u>Design Feature</u>							
Max horizontal walking dist. (metres)	30	45	60	110	110	220	280
Min rest area seat spacing (metres)	20	25	32	75	65	130	200

Source: Bails (1986)

4.5.8 The conclusion that can be drawn from the guidance offered on this aspect, is that there is a lack of empirical verification of distances that various groups of disabled people can move under different conditions.

4.6 Surface Conditions and Type

4.6.1 The condition and width of the surface over which people must move is important. On narrow footways, for instance, crowding can cause manoeuvering difficulties for disabled people, particularly those using wheelchairs. Blind people can also be confused by the movement of people on a crowded footway; by having sound cues obscured, and being unable to reach location cues. This can lead to a loss of their sense of direction.

4.6.2 Irregular or loose surfaces can cause major difficulties for people, especially those who use walking aids, or wheelchairs (Jones, 1977). Such surfaces (e.g. sand or loose dirt) can affect balance and/or hinder progress. Surfaces which are made up of jointed material (e.g. brick setts and paving slabs) can also cause difficulties, particularly to wheelchair users. Moving across the joints can cause pain to people with complaints arising out of constantly sitting, or headaches and/or dizziness arising out of the bumping caused to people with spinal injuries. Surfaces which are cracked or uneven at the joints or over any part of the material, can be a serious hazard to anyone using a pedestrianised area. This is especially true for ambulatory disabled people, but they are also barriers for wheelchair users through catching the wheels or casters of the chair. These points were all echoed by the disabled organisations consulted, as was the effect of slipperiness, crossfall and differences between materials.

4.6.3 It should be stressed that the above problems affect a large section of the population, and not just elderly and disabled people. The National Consumer Council (1987), for instance, has estimated that approximately 3 million people in Britain trip and fall on damaged footways, with 500,000 requiring medical attention. Sheffield City Council (Causey Campaign, 1986) also found that of 222 complaints received via a questionnaire, 110 of these were about hazardous paving stones and kerbstones. Furthermore, of 83 accidents reported relating to pavements 77 were due to uneven or broken paving stones. Falcocchio (1982) further illustrates the severity of these problems by finding that 88% of wheelchair users could only use a sidewalk or path that was poorly maintained with assistance or not at all.

4.6.4 The aspects of this issue that are of major concern can be identified, but their measurement or assessment is much more difficult. The key characteristics that cause problems are as follows:

1. Width (dimensions)
2. Crossfall
3. Gradient
4. Slip resistance (a function of the materials used)
5. Gaps between materials
6. Height between materials
7. Inadequate drainage
8. Lack of suitable maintenance

4.6.5 Characteristics 1, 2 and 3 are easy to measure, and in consequence there are several sources of standards and guidelines, although there is a lack of detailed field-testing of the data. Width information is usually provided by minimum (or acceptable) one-way and two-way dimensions. The minimum width for one-way movement is normally given as 1200 mm (Bails, 1986), (HUD, 1975), (Netherlands MoT, 1986), (Goldsmith, 1976). Jones (1977), however, suggests that 900 mm is acceptable, although he does indicate that where the incidence of wheelchair users is high this should be 1500 mm. The minimum width for two-way movement ranges from 1200 mm (Jones, 1977, with the above cautionary note), through 1500 mm for Bails (1986), and between 1650 mm (minimum) and 1800 mm (preferable) from HUD (1975), and 2000 mm by Goldsmith (1976). Clearly there is some uncertainty as to the most suitable width of footways for two-way movement.

4.6.6 Crossfall is another aspect upon which guidance exists, although there are interesting differences between commentators. Jones (1977), for instance, recommends a crossfall of no greater than 1:50, and without crowning. This standard is also recommended by Netherlands MoT (1986).

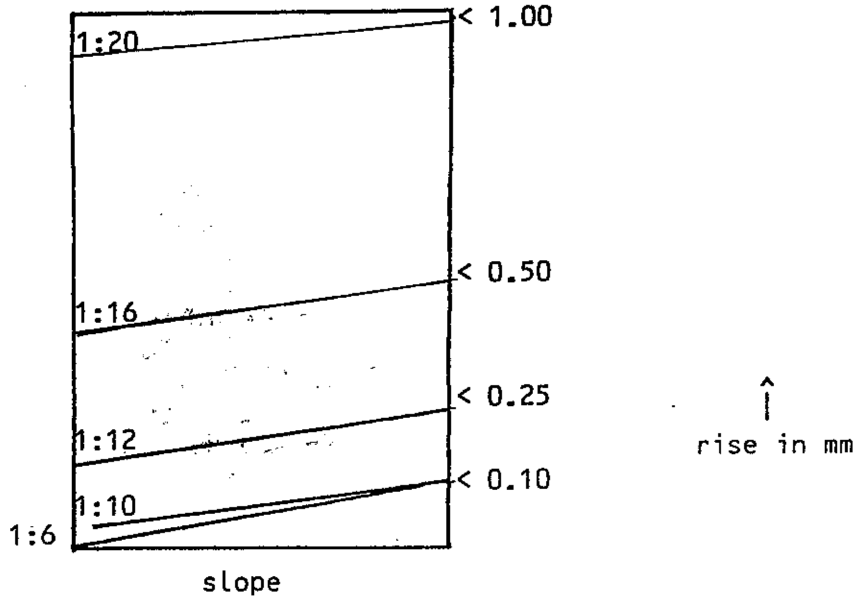
HUD (1975), meanwhile, recommend that for every one foot there should be one-eighth of an inch crossfall for drainage, equivalent to 1:96. Bails (1986), however, produces a much more disaggregated set of guidelines that range from 1:40 for a 70 year old physically disabled person, who is either a wheelchair user or user of a single cane, to 1:65 for a 90 year old physically disabled person who uses either a wheelchair or zimmerframe.

4.6.7 The gradients of footways and pedestrian areas is a more involved issue, with site conditions being a critical determinant in satisfying suggested standards. This point needs to be borne in mind when considering the following guidelines and standards.

4.6.8 The IHT (1986) recommended that the general maximum gradient to be aimed at was 1:20, but with an absolute limit of 1:12. This was with respect to new developments. This slope of 1:20 is, in fact, suggested by many sources (see Table 4.8), including Jones (1977), and Netherlands MoT (1986). However, the Netherlands MoT provides slightly more disaggregated advice (as do Goldsmith (1980) and HUD (1975)) as seen below in Table 4.8.

Table 4.8

Recommended Maximum Slopes



Source: Netherlands MoT (1986).

4.6.9 The slip resistance (characteristic 4) of various materials has also been the subject of several studies and consequent advice. The work of Sieger (1948) and Harper (1951, 1961) provided the basis for the expected friction coefficients for different materials under various conditions (Table 4.9). The conclusions were, however, for able-bodied people.

Table 4.9

Material	Friction Coefficient	
	Leather Sole	Rubber Sole
Granite, dry	.42	.78
Granite, wet	.41	.6
Marble, dry	.38	.8
Marble, wet	.22	.15
Concrete, dry	.38	.78
Concrete, wet	.1	.2

Source: Sieger, 1948.

4.6.10 Bails (1986) has suggested, however, that the minimum coefficient of friction for surfaces should be 0.4. Greater Manchester Council (1982) suggest that to minimize the hazards to ambulant disabled people the surface should have a skid resistance value of not less than 60.

4.6.11 The data on slip-resistance is closely allied to existing design guidance on materials for use on footways and pedestrianised areas. Clearly the consideration of acceptable materials for a pedestrian area or footway is an important element in the design process.

4.6.12 The choice of material requires an awareness of the consequences of such a decision, such as construction, implementation and maintenance implications, as well as the psychological and physiological factors. Both RADAR and ACE agreed that cobbles were a major hazard, with ACE also indicating tiles as a material to avoid. Brick setts were viewed by ACE as an acceptable material if the infil was satisfactory, and black top surfacing was also viewed as acceptable although problems with frost were raised. Bails (1986) also suggested that cobbles be avoided, as should loose gravel.

4.6.13 An important aspect relating to surface condition is the gaps and heights between materials, an aspect which was particularly emphasized in our discussions (LBDRU, ACE, RADAR). Both the discussions and literature stressed the need for such differences to be minimized, but field tested data are lacking. Bails (1978) does, however, recommend maximum permissable departures, based upon his 'Age Span Design' predictions. These range from 4 mm - 8 mm as the maximum height departures from the surface, and between 2.5 mm and 4 mm for the gaps between pavers. Jones (1977), HUD (1975) Harkness and Groom (1976) indicate that joint widths of up to 13 mm (1/2") are acceptable. It needs to be recognised, however, that these latter recommendations are not based upon any stated field work and appear to be a 'desk top' guide.

C. Mobility within the Area

4.7 Furniture/Obstructions

4.7.1 Any item of street furniture can be both an obstacle and an amenity, depending upon circumstances. Examples include signs, lighting poles, mail-boxes, telephone kiosks, benches and rest facilities, planters, advertising frames, newspaper stands, bollards and rubbish bins. The location of these items needs careful consideration, as does their design.

4.7.2 Items which are supported by poles or pylons, or which project from walls, can be hazardous to blind people and sighted people alike. Whilst blind people can locate poles with their cane or guide-dog, projections at chest or head height cannot be identified as easily. This also applies to overhanging vegetation.

4.7.3 A commonly cited problem was the lack of resting areas and seating along pedestrian routes (LBDRU), particularly as many elderly and disabled people need to rest frequently when walking. Jones (1977), for instance, quotes the need for some pedestrians to rest after less than one minute walking or wheeling. Cover for such rest areas is also lacking in many instances. In addition, resting areas are sometimes located in the stream of pedestrian traffic, causing discomfort and unease for all concerned. The facilities located at these rest areas can also be inappropriate with benches being uncomfortable, having no arm-rests, lacking drainage design, and with insufficient space for wheelchair users.

4.7.4 The location of street furniture is often decided without appropriate consideration of pedestrian circulation patterns, thus causing potential problems for blind and partially sighted people. In particular, moveable furniture, such as 'A' frames and newspaper stands, can be hazardous for blind people who have memorised their routes.

4.7.5 There are many characteristics of street furniture to consider when assessing the problems they can cause, but they can be summarized into two broad categories: location and design. The latter is obviously more amenable to more precise recommendations and standards, whilst the former will be dependent upon more general and flexible design concepts.

General Considerations

4.7.6 The IHT (1986) recommended that an 1800 mm obstacle-free footway width should be maintained, although the Netherlands MoT (1986) has suggested that 1200 mm is adequate. This 'guide-line' recommendation is particularly important for blind and partially sighted people. The Netherland MoT (1986) manual suggests that this 'guide-line be provided using orientation devices if there is a total width of more than 10 metres.

Seats/Benches/Walls

4.7.7 Seating and seating areas can take a variety of forms but some general guidelines both on location and design, can be identified. It is generally accepted that seating and rest areas should be provided at regular intervals; that they should not interfere with pedestrian flow; and that they should be provided with some form of seating as well as space for wheelchairs. Actual values for the above are, however, more variable.

4.7.8 The recommended distance between seating varies between 100 m in 'central areas' to 200 m in 'outside central areas' (Netherlands MoT, 1986). Bails (1986) has produced more disaggregated and field-derived figures which range from 20 m for a physically disabled 90 year old using either a wheelchair or a zimmerframe, to 200 m for a physically disabled 70 year old using a single walking stick. So as not to interfere with the flow of pedestrians it has been suggested that seats should be located at least 1200 mm from the main flow (Netherlands MoT, 1986), and that the space provided for wheelchair users should be at least 1200 mm (Netherlands MoT, 1986). HUD (1975), however, claim that a width of 915 mm is adequate for wheelchairs, although this is a minimum value.

4.7.9 Details on the dimensions of seating vary, and sometimes raise conflicts between various types of disability. Both the IHT (1986) and HUD (1975) recommend that seating should have a variety of heights to take account of the differing effects of various disabilities. The IHT suggests a general height of about 450 mm above the walking surface, and 800 mm for a high, narrow, shelf-type seat for people with stiff hips. HUD suggest a general height of approximately 450 mm also, but identify three additional types of seating with seat heights of approximately 450-550 mm, 610-910 mm and 1200 mm. These seats, it should be noted, are 'seat walls' and do not have back rests; which the Netherlands MoT (1986) recommended for disabled and elderly people.

4.7.10 In addition to the height above walking surface, other dimensions upon which guidance is provided is the depth of seat, backrests, armrests, heel depth, and material. The recommended depth of the seat varies. IHT (1986), for example, suggest 500 mm from the front to the back of the seat, as does Goldsmith (1976), whilst HUD (1975) indicate a range from 305 mm (minimum) to 450 mm (maximum). The height of armrests (which should be provided to assist movement into and out of the seat) also varies, with IHT and Goldsmith both indicating a range of 200-250 mm above seat level, as compared to HUD's 150 mm.

4.7.11 HUD also recommend that at least 75 mm overhang be provided to allow space for heels, as this makes for more comfortable sitting as well as assisting in getting out of the seat. In addition, it recommends that at least 600 mm should be provided for extending legs so that this does not interfere with pedestrian circulation. The Netherlands

MoT (1986), however, consider 1200 mm to be a more appropriate dimension for leg room.

4.7.12 Finally, there are various suggestions for appropriate seat materials. Dull and light coloured materials are generally cooler surfaces to sit on when in direct sunlight (HUD, 1975), whilst dark surfaces tend to become hot. The latter are, therefore, better suited to shaded locations. The choice of wood, plastic or stone for seating will depend upon design considerations but several authors stress the need for adequate drainage from the seats, and they should not be too rough or likely to splinter.

4.7.13 An area of difference emerges between the Netherlands MoT (1986) report, and Jones (1977) and HUD (1975). The Netherlands report suggests that the bench or seat site should be raised 100 mm above ground level and contrasted (yellow) with the surroundings, presumably to aid in identifying the item. Jones and HUD, however, recommend that the seat or bench should be at ground level and not raised.

Obstructions to Movement

4.7.14 Bollards are often necessary in pedestrian areas to control vehicles (e.g. to prevent vehicles parking over basement areas). Several sources recommend that these bollards be at waist, rather than knee, height (IHT, 1986; Camden Borough Council, 1980; Netherlands MoT, 1986), with IHT suggesting a minimum height of 1000 mm, and Netherlands MoT suggesting 750 mm. It is generally agreed that some part of the bollards should be colour contrasted with the surrounding area, with IHT, Netherlands MoT, Leicester City Council (1982) and Camden Borough Council (1980) all suggesting ways in which this can be done. It should be noted that the latter two sources were based on small-scale field testing of the designs.

4.7.15 There is some agreement on the amount of clearance needed around or between bollards. The amount generally suggested is a minimum of 900 mm (Camden Borough Council, 1980; IHT, 1986; Netherlands MoT 1986). It is not recommended by any authority that chains be hung between bollards, although HUD (1975) recognize that this is sometimes done as an inexpensive vehicle barrier and hence provide guidance on the height and design of these features. Jones (1977), however, sees little justification for chains as traffic barriers, and recommends that they are not used. HUD (1975) also give detailed advice on railings and fencing.

4.7.16 The location of bins can be either on the footway or as part of a pole or column. The IHT recommend that, when on poles, the underside of bins should be 1000 mm above the walking surface and of contrasting colour, and not in the main stream of pedestrian movement. This advice has been echoed in several other works (Netherlands MoT, 1986; Greater Manchester Council, 1982).

4.7.17 Drainage features can also cause obstacles or barriers to people, even though considerable guidance exists on the design of these features. For the drainage grate, a variety of designs are currently in use in Britain. The Netherlands MoT (1986) recommend that such gratings should have maximum opening dimensions of 20 mm x 20 mm, whilst HUD (1975) suggest that the opening should be 19 mm square maximum, with a bar width of at least 13 mm. An alternative to gratings are drainage gulleys. The general recommendation is that these channels should not be irregular and that they should connect smoothly with the general footway surface (Netherlands MoT, 1980). However, details on the appropriate specifications of such channels is not forthcoming in the literature in terms of field-tested designs.

4.8 Steps and Stairs

4.8.1 Steps and stairs are generally constructed where slopes are too steep for an 'average' pedestrian (Cartwright, 1980), and this is commonly found in the external environment at subways and over-bridges, at entrances into shops and buildings, and between significant changes in level in the area. There have been several studies which have illustrated the extent and form of problems such a design feature can cause (Feeney et al, 1979; GLAD, 1986). The recognition of a single step is quite commonly a problem, especially for people with weak vision not using a white cane. It can also be a problem for people with Parkinson's disease (Oxtoby, 1982). They can also make areas inaccessible for wheelchair users.

4.8.2 The particular aspects that are of concern to disabled and elderly people are the dimensions and number of steps involved, the change in level and gradient to be overcome, supportive characteristics, recognition information, and alternative systems. The first two are clearly amenable to specific recommendations.

4.8.3 Many sources outlining design standards exist. However, the empirical basis for them is often difficult to find. Goldsmith (1976) and HUD (1975) both agree, for example, that the rise and tread should have the same dimensions for each step. They differ, however, on the specifications. Goldsmith indicates a range of 150-165 mm for the rise and 280-320 mm for the tread, whilst HUD indicate 100-165 mm for the rise and 280-370 mm for the tread. IHT (1986), meanwhile, recommend a range of 100-150mm (130mm preferred) for the rise and 300 mm for the tread. Bails (1986) suggests that there should be a difference between a single step and a set of steps in terms of their dimensions. Basically his recommendation is that the rise of a step in a stairway should be lower than that of a single step. He suggests that the rise in a set of steps should range between 50 mm for a 90 year old physically disabled person with a zimmerframe, to 150 mm for a 70 year old physically disabled person with one walking cane.

4.8.4 Bails also provides recommendations on the maximum number of steps to have in a flight. These range from 4 to 8 depending upon age and mobility aid used. The IHT suggest that there should be a minimum of three steps in a flight, to a maximum of 12.

4.8.5 The change in level of stairs is also of some concern as they can determine the amount of energy expended to surmount the stairs (Bails, 1986), but the empirical verification for such recommendations is not easy to trace. The Netherlands Ministry of Transport (1986), suggest that a flight of steps higher than 3000 mm should be provided with a rest area, although a direct reference to the size of this area is not available. The IHT (1986), on the other hand, suggest a rest area after no more than 1200 mm rise, with this area being 1200 x 1200 mm minimum and 1800 mm being the preferred length. HUD (1975) provide a further variation upon these dimensions with a suggested maximum change in level of 1220 mm if the stairway is unprotected and 1820 mm if it is protected. The suggested rest area dimensions by HUD are 1520 xx 1520 mm, which should be 3050 mm if it leads to an entrance way.

4.8.6 There appears to be general agreement in the literature that the nosing of the step should be rounded, although the dimensions vary from 15 mm (Goldsmith, 1976) to 25 mm (HUD, 1975). Different colours for the rise and tread has been suggested (HUD, 1975; Goldsmith, 1976; Netherlands Ministry of Transport, 1986), as has a white band along the nosing (Scarr, 1983). It is also accepted that steps should be non-slip and allow surface water to drain away, with HUD (1975) providing a figure of 3 mm pitch per 300 mm tread for such a purpose.

4.9 Ramps and Kerbs

4.9.1 The alternative design feature for overcoming changes in level is the ramp. Two ways of defining a ramp can be identified. Firstly, a ramp could be stated as an external slope which has a gradient greater than 1:20 (Netherlands MoT, 1986; IHT, 1986). Secondly, a ramp can be defined as a man-made design element of the external environment, as opposed to a slope which is a natural feature. For the purposes of this work the definition used will be that of a man-made design feature of the external environment, although attention will be concentrated on gradients greater than 1:20.

4.9.2 Ramps have been recognised as both a necessary alternative to steps and stairs (Bails, 1986; IHT, 1986) and as a major problem for elderly and disabled people (Gazeley, 1977; Hopkins, 1978; Wilson, 1980). They can create difficulties for ambulant disabled people in either moving up or down them, or both. This may be because they are too long or too steep or because of the pressure placed upon joints, particularly the knee. Ramps can also be too narrow for use by wheelchairs or lack adequate rest areas and support facilities such as handrails.

4.9.3 There are several aspects of ramps that are amenable to measurement and assessment. The particular elements that will be discussed here are gradient; length of ramp; width; and size of rest area. It is also possible to identify other aspects that need consideration in designing ramps, namely the supportive characteristics to be placed with the ramp and its location.

4.9.4 On first impression the literature appears to provide a level of agreement on the appropriate gradient for ramps. The general purpose figure is 1:12. HUD (1975), for instance, state that an extended ramp should not be more than 1:12, which the IHT (1986) broadly agrees with although they indicate that ramps steeper than this should have handrails on both sides. Goldsmith (1976) also recommends a gradient of 1:12 for an external ramp, although he does produce a set of more disaggregated figures for gradients related to length and type of disability, as seen in Table 4.10.

Table 4.10

Gradient of Ramp for Various Disabled Groups Over Various Distances

	Length of Ramp (metres)		
	0 - 3	3 - 6	6 +
Ambulant disabled	1:9	1:12	1:12
Independent wheelchair user	1:10	1:16	1:20
Wheelchair and helper	1:9	1:12	1:20
Electric wheelchair	1:16	1:16	1:20
All users, preferred max	1:8	1:12	1:12

Source: Goldsmith (1976)

4.9.5 The literature produced slightly more variance upon recommended lengths of ramps than upon gradients. The IHT (1986) recommend that the maximum length for a 1:12 gradient should be 6 metres. If steeper than 1:12 the maximum length should be 3 metres. HUD (1975) suggest that for a 1:12 gradient the maximum length can be 30 feet (9.14 metres). In addition a 5 foot (1.52 metres) clear space at the bottom should be allowed. This figure of 30 feet is common in the American literature, with its basis in the American National Standards Institute (1961) recommendations. Examples of this standard can be found in Mace and Laslett (1974), New York State (1971), State of Maine (1969). Bails (1986), however, provides variations upon these recommendations, with lengths varying from 4.6 metres to 8.1 metres. Camden Borough Council (1980) also produce variable recommendations upon length tied, in this case, to gradient. Thus, the lengths range from 10 metres (1:20), through 7.5 metres (1:15), to 6 metres (1:12).

4.9.6 Lengths of ramps relate closely to the provision of rest areas. In general where lengths exceed the above recommendations, authors state that a rest area should be provided. Thus the IHT (1986) state that rest areas should be at 10 metre intervals, as do Greater Manchester Council (1982). The Netherlands Ministry of Transport (1986) suggest 8-9 metres, with 6 metres preferred. HUD (1975) also suggest 9 metres (30 feet) as the distance at which a rest area should be provided, although this is for 1:12 only. Lower grade ramps have no specified maximum length.

4.9.7 The dimensions of the rest area also vary, usually as a result of the assumptions adopted on the dimensions of wheelchairs and, but not always, their users. Thus, the Netherlands Ministry of Transport (1986) recommend a width and length of rest area of 1500 mm, with a minimum width of 1200 mm. The IHT (1986) agree with this minimum width, and also allow it to be applied to the length of the rest area. However, they do recommend a preferred set of dimensions of 1800 mm. HUD (1975) suggest similar dimensions to the Netherlands with a 5 foot square area (1520 mm). Bails (1984), meanwhile, suggests a minimum landing area of 1200 mm in length.

4.9.8 Advice on ramp width is also subject to noticeable differences. IHT (1986) suggest 1800 mm in order to allow wheelchairs to pass, with a minimum of 1200 mm for short lengths. HUD (1975) suggest a similar width for passing, namely 6 feet (1828 mm), but allow a one-way width for an unspecified distance of 3 feet (914 mm). Both these authors relate passing dimensions to wheelchair users. Bails (1986) does the same when recommending 1500 mm as the required width for wheelchairs to pass, as do Greater Manchester Council (1982).

4.9.9 As IHT (1986) point out, the provision of dropped kerbs can be the most beneficial single improvement for people with a mobility handicap. Despite this they can create problems and hazards for disabled people and other users of an area. In many instances kerbs can be difficult or impossible for wheelchair users to negotiate (Jones, 1977; GLAD), either because of their angle, the lip at the bottom of the ramp, or their narrowness and placement of bollards close to them. If the kerb is not clearly marked it can create a hazard, particularly for blind and partially sighted people. Their location can also be hazardous, for example providing little orientation advice to blind users when placed on a corner.

4.9.10 There are several aspects to consider when examining dropped kerbs. These include their purpose and location; the appropriate design of kerb; gradient; length and relationship to footway width; and width. A more detailed consideration of these aspects is to be found in Bails (1986).

4.9.11 Jones (1977) suggests that wherever footpaths or footways intersect with other footpaths or footways, parking areas, driveways, or streets, a portion of the surfaces should be blended to a common level to allow smooth passage for wheelchair users, people with prams and pushchairs, and so forth. The IHT (1986) specify such intersections in more detail, and include pedestrian crossings, signalised junctions, junctions with high pedestrian activity, and other points where access is needed (e.g. car parking areas). HUD (1975) also suggest that dropped kerbs or ramped kerbs ought to be considered midway along long streets. The IHT (1986) also suggest means by which such locations can be identified, as does Bails (1986). A wide variety of kerb ramp designs exist, and although terminology differs between authors, three aspects can be identified that enable the categorisation of a particular kerb ramp design. This can be seen in Table 4.11.

4.9.12 Recommendations vary between authors as to what is an appropriate gradient for a dropped kerb, although recognition is made that the immediate surroundings can be an important influence. The IHT (1986), for instance, recommend a maximum gradient of 1:12 when an angled dropped kerb (see Table 4.11) can extend back a minimum of 1800 mm across the footway, and a maximum of 1:10 in more constrained sites. This is reflected by Greater Manchester Council (1982) and Jones (1977). Jones, however, permits the introduction of a 1:8 gradient if there is no other possible way of overcoming the constraints of an existing sidewalk condition".

4.9.13 HUD (1975) and Netherlands MoT (1986) permit an even steeper gradient of 1:6 for a dropped kerb. Bails (1987) considers this to be a dangerous recommendation, however, with field tests showing that this can cause tipping and slipping of wheelchairs. Bails (1986), in fact, recommends that the steepest kerb ramp should be between 1:13 and 1:20 depending upon the disability being catered for. Parallel ramps are often able to have these flatter grades than angled ramps. However, as Bails (1984) points out, they can create certain problems such as interuption of storm water flow.

Table 4.11

Categorisation of the Various Types of Kerb Ramp Design

A. Intention

1. Design
2. Natural (e.g. erosion of kerbstone)

B. Permanency

1. Fixed
2. Removable
3. Temporary

C. Construction Method	Notes
1. Angled Ramp	(Nos. independent of Section C)
(i) Cut-in/Sunken	
a) flared	1. Could use all path width
b) with continuous kerb	2. Could use part of path width
(ii) Built-up/Extended	3. Could be on a corner
a) flared	4. Could be at 90x to path or angled
b) straight	5. Could be staged so that rest areas involved
2. Parallel Ramp	6. Could be textured, such as tactile paving for use at Zebra and controlled crossings (IHT, 1986) and those outlined by Netherlands MoT (1986).
3. Raised Carriageway	

4.9.14 Related to gradient is the length and width of the kerb ramp itself. The Netherlands MoT (1986) recommend lengths of between 600 - 740 mm, whilst Bails (1986) provides a wider range of possibilities of between 600 - 2400 mm. In any case the key determinant of length should be the gradient desired.

4.9.15 The width of the ramp has more variance. The IHT (1986) provide a guideline of 1800 mm, which is significantly more than some other sources. Jones (1977) and HUD (1975), for instance, only recommend a width of 3 feet (915 mm). Bails (1986), on the other hand, provides a recommended figure of 1000 mm for a 'cut-in' angled ramp kerb and 1500 mm for a 'built-up' angled ramp kerb.

4.9.16 A major area of concern is whether a ramped kerb should be flush. The IHT (1986) and Jones (1977) recommend that a dropped kerb should be flush with the carriageway, with some form of indication of its presence for people with a visual impairment. The TRRL textured paving for use at Zebras and Pelican crossings is an example of this. Both

IHT (1986) and GLAD suggest that such surfaces do not cause problems with surface water or detritus.

4.9.17 From discussions with local authorities and disabled representatives it emerged that the achievement of a flush surface can be extremely difficult. Therefore, the tolerance levels are important to identify. A commonly suggested figure for the lip is 30 mm (Goldsmith, 1976; Greater Manchester Council, 1982; Lyon, 1983). However, from field trials in Gothenburg, Ohlson (1981) found that 40 mm was an acceptable compromise, whilst Sten (1981), also in Gothenburg, suggested 20 mm. The Netherlands MoT (1986) suggested either 30 mm or 80 mm as appropriate deviations from the surface. Bails (1987) severely criticizes this latter figure.

D. Interface with Services and Facilities

4.10 Information Provision

4.10.1 An issue which has a major influence on the successful utilization of a pedestrian area concerns information provision. There are two major aspects to this issue. Firstly, there is the pre-journey perceptions, attitudes, expectations and knowledge of a person. Secondly, there are the elements of the journey itself during which information is displayed. These include direction and guidance information, marking of furniture/obstructions, identification information and regulatory/warning information.

4.10.2 It is not clear how many disabled and elderly people do not make journeys because of uncertainty over some aspect of the activity. Work by Bedrar (1977) has suggested that there is a significant number of people affected by such uncertainty. In the discussions with groups representing the interests of disabled people, the problems of information deficiency were stressed, particularly by CPA and GLAD. Elderly people, for instance, are more prone to confusion than many other sectors of society. The discussions with Arthritis Care also raised the problem of dissemination of guides and information to people. It was felt that these guides were often too general and sometimes inaccurate. ACE also mentioned the often haphazard provision and location of signs and maps, as well as the height at which they are placed. Furthermore, it was felt that all too often the signing was not clear, particularly in covered malls. The RNID mentioned that deaf people often do not like to ask for directions and so are dependent upon reliable signing.

4.10.3 Regarding information provision during a journey, several characteristics can be identified on which guidance or standards would be helpful. The list will probably not be comprehensive given the complex nature of people's interaction with and understanding of the environment. The key characteristics would seem to be: dimensions, design, location and purpose.

4.10.4 The approved dimensions of the various road signs of relevance in pedestrian areas and footways are detailed in the IHT (1986) guidelines, as are the approved designs of symbols. Leaving aside these aspects of signs for which recommendations are made, there are still a variety of other, related aspects that need to be carefully considered. The Netherlands Ministry of Transport (1986), for instance, recommended that signs attached to poles should be at least 2200 mm above ground level, and that signs fixed to walls and buildings should be at least 2500 mm. HUD (1976), however, suggest that signs on poles should be a minimum of 2233 mm (7'6") above ground level.

4.10.5 Guidance on the design of signs depends, as mentioned in 4.10.1., upon the purpose of the signs. Many authors stressed the need for the signs to be understandable and legible to all users, i.e. car users, wheelchair users, blind and partially sighted people (HUD, 1975; Netherlands Ministry of Transport, 1986). Various ways are mentioned of doing this, including braille strips along the edge of the sign; tactile letters of bold and simple type with contrasting colours; tactile graphic symbols (not used by themselves as they can confuse blind people); provision of artificial light and/or inclusion within light fixtures; concise and direct information.

4.10.6 There is clear recognition that the readability of a sign is a function of many items (HUD, 1975). One of these is the location of the sign. This is important because if inappropriately placed they could cause an obstacle or hazard. HUD (1976), therefore, recommend that signs are gathered together in unified systems, ideally at naturally gathering areas. However, it is important not to overload people with information.

4.10.7 It is also recognised, both in the literature and from our discussions, that certain information needs to be provided. These include the location of public rest areas which are fully accessible; toilets; car parking; and accessible entrances. ACE also recommend that bus stops and steps be included on signs and maps. Distances should also be given on both maps and signs. ACE also suggested the use of colours on either the movement surface or buildings, as an orientation guide. An example could be red for north-south and yellow for east-west. Work on this has been done in Milton Keynes, Leicester and Boston (Mass).

4.10.8 A slightly different form of information provision relates to the use of guidestrips for people who are visually impaired. The Netherlands Ministry of Transport (1986) distinguish between textured paving and cautionary paving on this issue. HUD (1975), however, raise the point about the appropriateness of cautionary paving because of the wide variety in the nature of footways. Details in the design and layout of such strips can be found in the Netherlands Ministry of Transport (1986) and Temple (1980). It is worth noting, however, that Temple (1980) carried out a comparison of various external textures to see which were most easily detected by the visually impaired. From this study, which was based on field testing with visually impaired people, wheelchair users, and ambulant disabled people, a series of recommendations emerged.

4.11 Toilets

4.11.1 An aspect that can determine whether a journey is made or not is knowledge of toilet provision at the destination or en route. It is not only the location of such facilities that can cause problems, but the design of them can also make them inaccessible. Even when guidelines are used the concern is that they may not be followed as laid down. Goldthorpe (1987) provides ample evidence of this.

4.11.2 There are two major aspects upon which design guidance has been provided in some form and these are the dimensions of the toilet area and facilities, and their location. There is much detail on the former aspect as can be seen in Goldsmith (1976). However, Bails (1986) provides an excellent illustration of the limitations and discrepancies of such standards and guidelines by comparing the various International recommendations, as can be seen in Table 4.12. This indicates the variation that exists for just one aspect of toilet design, namely the minimum size of water closets. A key concern is, therefore, the standardization of such recommendations (GLAD).

4.11.3 It was indicated in our discussions that the detailed design of toilets can be undermined by their inappropriate or uncertain location and provision of information of this location (CPA,). The key recommendations made during our discussions upon this issue were that information prior to the journey on the number and location of toilets for disabled people would be extremely valuable, provided there was confidence that these toilets actually were accessible for all disabled people, and that when people were in a pedestrian area, the toilets available should be clearly signposted and with distances attached. They should also be along an accessible route. These points have been raised in Section 4.10 on information provision.

Table 4.12

Relative Minimum Size of Water Closets

Area (M)	Relative Size	Country
5.04		Canada
4.56		France
3.96		Denmark
3.78		Belgium
3.60		GFR
3.49		Netherlands & Poland
3.30		USA
3.24		Italy
2.92		GDR
2.89		Sweden
2.88		South Australia
2.66		Ireland
2.51		New Zealand
2.45		Israel
2.40		UK
2.25		Switzerland

Source: Bails (1986)

APPENDIX A

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APPENDIX B

Organisations Responding to Requests for Information or Consultation

Access Committee for England
Age Concern
Arthritis Care
British Limbless Ex-Service Men's Association
Centre for Policy on Ageing
Disabled Drivers' Motor Club
Disabled Living Foundation
Greater London Association for Disabled People
Joint Committee on Mobility for the Disabled
National Deaf-Blind Helpers' League
Parkinson's Disease Society
Partially Sighted Society
Redbridge Association for Handicapped People
Royal Association for Disability and Rehabilitation
Royal National Institute for the Blind
The Campaign for Mentally Handicapped People
The Chartered Society of Physiotherapy
The Chest, Heart and Stroke Association
The Disabled Drivers' Association
The Mobility Information Service
The Spastics Society
The Sports Association for the Disabled
The Sports Council
Transport Users Consultative Committee for North East England
Wales Council for the Disabled

The following local authorities were consulted:

City of Bradford Metropolitan Council
City of Newcastle-upon-Tyne Metropolitan Council
City of Sheffield Metropolitan Council
Humberside County Council
Leeds City Council
Leicester City Council
London Borough of Hillingdon
Nottinghamshire County Council

Local contacts included:

Medical Research Unit, Leeds General Infirmary
Occupational Therapy, Leeds General Infirmary
Rheumatology and Rehabilitation Research Unit
Shape Up North
William Merritt Information Centre, St Mary's Hospital
You Are Not Alone (YANA)