A Review of **International Best Practice** in **Accessible Public Transportation** for **Persons** with **Disabilities**

Kementerian Pembangunan Wanita, Keluarga dan Masyarakat
Ministry of Women, Family and Community Development

UNDP

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Preface

Persons with disabilities continue to be among the most marginalized groups in any society. While international human rights frameworks have changed many lives, persons with disabilities have not necessarily enjoyed the same benefits.

Over the last three decades, the world has realized that continuing to deny disabled individuals their rights is no longer acceptable. The international community finally responded with the adoption of the United Nations Convention on the Rights of Persons with Disabilities which entered into force on 3 May 2008.

One of the articles of the Convention, which is also the subject of this report, is the core issue of accessibility. Article 9 of the Convention requires countries to identify and eliminate obstacles and barriers and ensure that persons with disabilities can access their environment, transportation, public facilities and e-services, and information and communications technologies. More importantly, the Convention approaches issues of persons with disabilities from a rights-based approach. Hence, Article 9 also speaks about the importance of enabling persons with disabilities to live independently and participate fully in all aspects of life, which will not be possible, if accessibility is not fully ensured.

Recent World Bank estimates indicate that persons with disabilities account for as many as one in five of the world's poorest. Researchers argue that if international targets for poverty reduction are to be achieved, it is critical that specific measures are taken to reduce discrimination and isolation of persons with disabilities. One such measure is the provision of accessible public transport, an important enabler that would improve mobility and, thereby, physical access to livelihood opportunities for persons with disabilities.

This report provides an international overview of the key technical issues on accessible public transportation for persons with disabilities. It begins with a brief description of the prevalence of disability and factors that influence accessibility. It also explains why safe and convenient pedestrian infrastructure is particularly essential for persons with disabilities if they wish to satisfactorily access public transport. It then provides a discussion on design requirements and best practices for vehicles, bus stops and bus and train stations as well as important arguments on the importance of signage and information. The report also illustrates best practices for training courses for transport providers and transport users as these have been among the central elements for making public transport services more accessible. The report also explains how some of the barriers faced by persons with disabilities are often an unintentional result of particular policies of government and transport operators.

The state of the public transport system in Malaysia is currently receiving considerable national attention as it should. Indeed, Malaysia hopes that public transport will become the mode of choice of urban commuters over the medium term. In this context, the government has committed to deliver significant improvements in accessibility and connectivity, both of which are embodied in its key performance indicators. It is hoped that the best practices elaborated in this report will serve as useful inputs for Malaysian policy makers as they address the many challenges of improving urban public transportation through the Government Transformation Program.

Kamal Malhotra
UNDP Resident Representative for Malaysia
10 June 2010

Foreword

We know that creating greater access to public transport can significantly transform the livelihood of persons with disabilities and their families. On the contrary, public transport and the built environment which is inaccessible will pose serious barriers to education, finding employment, accessing health care and considerably limit social and recreational opportunities.

Disabled people have a fundamental right to public transportation and this right has legal basis in the Persons with Disabilities Act 2008. It states that they "shall have the right to access to and use of public transport facilities, amenities and services" and providers of these facilities must ensure that they "conform to universal design" [Article 27(1 & 2)]. Malaysia also has obligations under the Biwako Millennium Framework whose goal is to promote an inclusive, barrier-free and rights based society and more recently became a signatory to the Convention on the Rights of Persons with Disabilities. It therefore has obligations to ensure that State Parties take appropriate measures so that persons with disabilities will have access to public transport and the physical environment.

The concept of universal or inclusive design has emerged as a result of the struggles of persons with disabilities for accessible physical environment and public transport and approaches based on this concept not only benefit disabled persons but also older people, pregnant women, people encumbered with luggage, shopping or other burdens, and parents with young children. Investments in the removal and prevention of architectural barriers are increasingly being justified on economic grounds.

The Government Transformation Program under Prime Minister Dato' Sri Mohd Najib Bin Tun Haji Abdul Razak has included amongst its six National Key Result Areas, one specifically addressing the upgrading of urban public transportation in the medium term. It is therefore timely that the Government of Malaysia adopts and enforces accessibility standards for planning of public transport, public facilities and infrastructure.

The United Nations Development Programme (UNDP) in collaboration with the Government of Malaysia embarked on a project which aims to support the development of a fully accessible public transportation system for persons with disabilities. Although the project was carried out in the State of Penang, much of the findings and recommendations are also applicable to the rest of Malaysia.

As part of the project, this report documenting "A Review of International Best Practice in Accessible Public Transportation for Persons with Disabilities" is published. This report reviews the current best practice for accessible public transport and draws heavily from leading publications on the subject.

The achievements of the accessible public transport project including this report would not have been possible without the valuable support and contributions from various organizations. The UNDP was instrumental for initiating this project by providing technical assistance. The National Steering Committee comprising of the Ministry of Women, Family and Community Development,

the Economic Planning Unit, Prime Minister's Department, the Ministry of Transport and the Penang State Economic Planning Unit monitored the progress of project and kept it on track. Relevant government departments and agencies, private sector, non-governmental organizations and user groups enthusiastically participated in the project. To all of them who have contributed to the success of this project, I would like to express my heartfelt thanks and gratitude.

I hope that this report and the best practices documented here would be a useful resource for the local government, transport providers, transport planners, professionals in the building industry and all those involved in one way or another with improving public transportation.

Senator Dato' Sri Shahrizat Abdul Jalil
Minister of Women, Family and Community Development
in Conjunction with the Report
21 May 2010

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UNDP also would like to thank TRL Ltd for giving permission to the author to quote extensively from Overseas Road Note 21 *Enhancing the mobility of disabled people: Guidelines for practitioners,* published by the Department for International Development (DFID) and TRL.

Many sources of advice on accessible transport are cited in this review. All sources are acknowledged, and wherever possible, web sites are given from which the documents cited can be obtained. Any errors in using materials from these documents are the responsibility of the author.

Executive summary

1. Introduction

This report was commissioned as part of the 'Transport for Persons with Disabilities: Support of the Development of Accessible Transport in Penang' project which is a collaboration between the United Nations Development Programme (UNDP) and the Ministry of Women, Family and Community Development, Malaysia.

In many countries, people with disabilities and the elderly are more likely to be among the poor as their livelihoods and economic opportunities are limited as they are often excluded from basic necessities such as education and employment, health care, social services as well recreational activities because they face barriers to accessing transport services. Accessible transport is an important factor in reducing poverty as it can facilitate the participation of people with disabilities and the elderly in economic, social and political processes. Moreover, an accessible transport system promotes independence and choices for people with disabilities and the elderly.

While many countries have policies and guidelines requiring that these challenges be addressed, effective responses and implementation are often very limited largely because there lacks in-depth data and studies carried out on the mobility needs of the disabled and the elderly. Furthermore, more often than not, limited resources are allocated to design, plan or develop barrier- free transport systems.

Accessible transport is about making transport systems and services easier for people to use. Accessibility can be improved by removing any feature that creates a barrier for a particular group of people. It is necessary to consider the types of impairment or disability experienced by particular passengers, and the barriers that the system causes for people with those impairments.

The importance of making systems and products easy to use for as many people as possibly through universal or inclusive design was recognised when the European Conference of Ministers of Transport stated that "Accessibility is increasingly recognised as a key element of a high-quality, efficient and sustainable transport system. Indeed all of us as users of the transport system benefit from easier access to buses, trams, trains, planes and ships. The economic benefits of better accessibility for transport operators and service providers are also becoming progressively clear" (ECMT, 2006).

This report outlines best practices from several countries on how to design and develop accessible transport and infrastructure. Some of these best practices will require long term planning and considerable resource allocation – however many of these practices can be easily implemented over the short term period to overcome some of the structural challenges of transportation and infrastructure that are currently inaccessible.

This Executive Summary follows the structure of the full report. Each section of the summary corresponds to the section of the report with the same number and title.

Many documents are used as sources of best practice, and are referenced in the main report. A small number of principal references are given at the end of this Executive Summary.

2. Elements of accessibility

2.1 The prevalence of disability

The United Nations Convention on the Rights of Persons with Disabilities and its Optional Protocol was adopted on 13 December 2006. Article 1 includes the clause "Persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others." In 1980, the World Health Organisation published *International Classification of Impairments, Disabilities and Handicaps* (ICIDH). This publication described impairment in medical terms as any loss of psychological, physiological or anatomical structure or function. It regarded disability as any limitation or loss of functional ability deriving from an impairment.

In making transport systems accessible, disability described in functional terms is usually a more useful measure than medically based impairment. Thus, the inability to climb steps higher than 25cm can be caused by many different medical impairments, but it is the functional limitation that must be considered in the design of a transport system.

In Europe, 12 to 14% of the population are disabled. The percentage of people with disabilities increases with age. In Britain 5.6% of those aged 16 - 59 are disabled. This figure rises to 28% of those aged 60 - 74, and to 53% of those aged 75 and over. Sixty-nine percent of those with disabilities have locomotive disabilities, 41% hearing disabilities, 24% seeing disabilities, 21% intellectual functioning disabilities. Many people have multiple disabilities. Disabilities vary greatly in severity; 7% have the most severe disability (can only walk a few paces) to 35% with the least disability.

2.2 Factors that influence accessibility

Accessible transport must provide much more than vehicles that can be used by a person in a wheelchair; it also requires knowledge, ability, financial means and confidence. Staff training, positive attitude and the willingness to help can overcome many deficiencies of vehicle, infrastructure or supply of information.

The term 'accessibility' is used in two senses. First, policies and regulations can create barriers for disabled people. This may be a regulation that bans passengers who travel in wheelchairs from deep underground metros, because of the difficulty of evacuating them in an emergency; or a health regulation that bans dogs, including guide dogs, from shops, hotels and restaurants. These examples demonstrate that even as measures are designed to improve some situation, caution must be exercised so that these measures do not erect barriers unintentionally for the disabled.

The term 'accessibility' is used in a second and different sense by transport planners. This is to describe the time or cost it takes to reach various destinations from a given origin. This aspect of accessibility is important for everybody, including people with disabilities, and there is a developing technique for mapping the accessibility provided by public transport and individual car travel.

3. The road and pedestrian environment

Safe mobility is necessary for pedestrians to access public transport and also for independent local mobility.

3.1 Problems experienced by pedestrians

Aspects of the pedestrian environment that cause difficulties for people with disabilities include features, such as hills, narrow or uneven sidewalks, and crossing roads, which affect everyone, though people with disabilities are more affected. Other features, such as crowds, kerbs and steps, affect mainly people with more severe impairments.

Infrastructure for pedestrians needs to provide routes that are direct, continuous, safe, convenient and attractive. Paths and sidewalks should be comprehensive, and provide for the journeys that people want to make, including routes through residential areas.

Traffic and crossing roads affect all pedestrians. Sources of high risk for older pedestrians, and where they find it difficult to cross roads, are:

1. Crossing busy two-way streets;
2. Crossing major roads, particularly with fast traffic;
3. Intersections with heavy traffic, particularly where there is no centre refuge; and
4. Complex situations, where vehicles can come from several directions where traffic is allowed to turn across pedestrian routes at light-controlled crossings.

Measures to improve pedestrian safety include:

- Separate the pedestrians from vehicles, for example by providing a sidewalk;
- Pedestrian only areas where possible;
- Reduce traffic volumes, by directing traffic away from areas of high pedestrian activity and from residential areas;
- Reduce traffic speeds;
- Provide pedestrian crossings;
- Provide street lighting; and
- Improve infrastructure:
  - Adequate footpath widths;
  - Bollards to stop parked vehicles blocking sidewalk or to narrow traffic lanes;
  - Traffic calming to reduce vehicle speeds;
  - Speed tables at pedestrian crossings, across side roads, at junctions;
  - Provide median pedestrian refuges; and
  - Kerb extensions to minimise time on road while crossing.

3.2 Guidelines and standards for pedestrian footways

BEST PRACTICES

Surface quality Firm, even surfaces are important to people using sticks, crutches or wheelchairs, and for people with walking difficulty.

Crossfall Crossfall should only be provided where absolutely necessary for drainage purposes. Where crossfall needs to be provided, it should never be steeper than 2.5% (1 in 40). Change in crossfall over a length of 610mm should not cause one wheel of a wheelchair or one leg of a walker to leave the ground.

Width Footways and paths should ideally be at least 2000mm wide in areas with moderate to high pedestrian traffic. At obstacles and pinch points, the absolute minimum width should be 1000mm.

Height Clearances of at least 2100mm should be provided to prevent visually impaired people from hitting overhanging branches or signs.

Simplicity of layout Footways should be designed as straight and simple as possible, with benches, poles, rubbish bins etc. to the side, out of the way.

Tactile guideways and tactile surfacing Sometimes visually impaired people need guidance in a pedestrian area, especially if the footway crosses larger open spaces. A continuous tactile guideway in the direction of pedestrian travel can provide this guidance. At any point where pedestrians can leave the safety of the footway without crossing a kerb, such as a ramped kerb at a street crossing, a tactile surface should be used to warn visually impaired pedestrians.

Gradient A gradient of 8% (1 in 12) is the absolute maximum that may be used in pedestrian areas; a limit of 5% (1 in 20) is preferable.

Maintenance The walkway must be kept clear of rubbish, dirt, street works, parked cars and other obstacles. Street works should be guarded by a continuous, rigid barrier (not plastic tape) along the entire perimeter.

Rest areas Along frequently used pedestrian ways, seating or other places to rest should be provided at regular intervals, typically every 50m.

WHERE TO START?

The most common barriers are bad surface quality and obstructions in the form of poles, kerbs, parked vehicles or traders. First steps in providing adequate pedestrian facilities should therefore include:

- Surfacing footways with an all-weather material (asphalt or concrete);
- Installing kerb ramps where the footway crosses streets, driveways and so forth;
- Ensuring that street signs and street furniture are located in such a way that provides an adequate clear width and height that is continuous along the footway; and
- Ongoing enforcement to keep parked cars, vendors, and rubbish out of the clear width.

3.3 Guidelines and standards for street crossings

Street crossings are important elements of the pedestrian environment. Disabled pedestrians are particularly vulnerable because they often move more slowly.

BEST PRACTICES

Crossing design The recommended minimum width of a street crossing is 1200mm. Where the pedestrian has to cross many lanes of traffic, centre islands are extremely helpful because they reduce the distance the pedestrian has to walk on the road at one time without protection. The safety of a crossing can be significantly improved by extending the footway out across any parking lanes. This serves the triple purpose of reducing the width of roadway to be crossed, slowing vehicular traffic and improving the ability of pedestrians and drivers to see each other.

Kerb ramps Kerb ramps should be used wherever footways cross roads. The ramp should have a minimum width of 1200mm, and at crossings the ramp should be as wide as the crossing. The

maximum gradient should be 8% (1 in 12) on the ramp itself and 9% (1 in 11) on the flared sides. Where possible, the bottom of the ramp should be installed flush with the roadway.

Traffic signals If a traffic signal is used, the red phase should keep traffic stopped for about 12 seconds for a 7.5m crossing. Signals that can be activated by the pedestrian using a push button box are useful, particularly at mid-block crossings. A large diameter (up to 50mm) raised button that can be activated by a closed fist will be usable by most people. At signalised intersections, audible signals can be very useful to visually impaired pedestrians.

Tactile warning surfaces Tactile surfaces at the edge of street crossings warn visually impaired pedestrians they are about to step on to the road.

Traffic calming Crossing safety can be improved by reducing the speed of vehicles. Traffic calming measures like speed bumps or pinch points can be very effective. Raising the surface of a crosswalk can be used both to slow down traffic and to provide a level crossing for pedestrians.

WHERE TO START?

Whenever new street crossings are constructed, or existing ones are upgraded, the opportunity should be taken to install at least kerb ramps. Minimum requirements for crossings will usually include at least clear markings; signage and/or traffic calming to warn motorists and slow vehicles; and central pedestrian refuges, especially for streets that are wide, carry traffic in two directions, or carry fast traffic.

3.4 Guidelines on getting into buildings from the street

The basic principles in designing access are the same whatever the specific physical characteristics of the building. The way into the building must be fully accessible and step free. The clear width of the door(s) must be sufficient to allow easy access for anyone, including people in powered wheelchairs, walking with a helper or pushing a double-buggy. Glass doors must be marked with a brightly coloured banding.

4. Vehicle design and operation

Many of the ergonomic and design requirements for vehicles are the same for buses, minibuses, light rail and heavy rail. For public transport, there is a distinction between two different levels of accessibility. The first improves access for those people with disabilities who can walk, but with difficulty, and can climb at least a few steps. These design features often cost very little and can assist over 90% of people with disabilities. They also assist many non-disabled people. The second level of accessibility enables a passenger in a wheelchair to board and travel in public transport. This level of access may improve ease of use for all passengers, as in the case of low-floor vehicles or level boarding from a platform. But if access depends on the use of special equipment such as a lift, most passengers gain no benefit.

4.1 Design and operation of buses

In Europe, the accessibility of buses has been improved through the development of low-floor vehicles. Lower-floor vehicles are gradually being introduced in cities in South America and Asia.

In many developing countries, buses with floor heights of about 1m remain popular due to their suitability to rugged conditions and their low cost. Their entrances and internal layout typically make them difficult to use for many passengers, especially those with less agility. A universal design solution is the use of boarding platforms for special high-floor buses. These increasingly popular 'Bus Rapid Transit' systems largely serve concentrated high-volume corridors in cities.

4.1.1 Best practices – Incremental improvements, but not full wheelchair access

Bus entrance Entrances can be improved through the satisfactory design of steps and the installation of handrails and grab handles. The first step from the ground should have a maximum height of 250mm, and subsequent steps a maximum height of 200mm and a minimum depth of 300mm.

Handrails and stanchions Handrails at the entrance are important, particularly when step heights and depths depart from 'ideal' dimensions. Entrance handrails should extend from a point no more than 100mm from the outside edge of the first step, on both sides of the entrance. Sloping handrails (parallel to the slope of the steps) are better than vertical ones. Where possible, handrails should provide continuous guidance from the entrance to at least one of the priority seats. Handrails should be round, 30mm to 35mm in diameter, and fixed with a minimum clearance of 45mm from the adjacent surface. Inside the bus, vertical stanchions should be no more than 1050mm apart, so people can reach one stanchion from another. Handrails and stanchions should be a colour contrasting with the surroundings, with bright yellow preferred. The same colour should be applied to step edges and bell pushes.

Priority seats Priority seats should be close to both the driver and to the entrance/exit, to ease communication with the driver and to minimise the distance walked in the bus.

Aisles Aisles should be wide enough for all passengers to move freely: a minimum unobstructed width of 450mm is recommended, and 550mm preferred.

Bell pushes Bell pushes are needed to signal a request for the next stop. They should be positioned so that passengers can use the bell while seated.

Signage and information Clear destination and route number displays on the outside of the bus are essential. Route numbers should be at least 200mm high, 300mm preferred, and the destination displayed using lower case letters at least 125mm high. White or bright yellow letters against a black background are most clearly visible.

Driver operation Ease of use can be enhanced by consistently stopping the vehicle close to the kerb and next to the bus pole at stops. The driver should wait until all passengers (and specifically frail, older and disabled passengers) are seated before starting to move from a stop.

Fare policy Many governments have the practice of subsidising bus travel for disabled people. The issue of concessionary fare policies should be considered with caution to ensure it does not act as a substitute for other improvements to the bus service that could be more cost-effective.

4.1.2 Best practices – Full wheelchair access

Boarding for wheelchair users The best way to allow wheelchair users to board buses is through universal design: the use of low-floor buses, or high-floor buses with raised boarding platforms (such as those used in many bus rapid transit systems). Other options include the use of mechanical lifts (deployed either in the main doorway or from a separate doorway), and level boarding from small roadside platforms, using a removable bridge to cover the gap.

Wheelchair space Doorways should be 850mm wide to allow a wheelchair through, with a clear width of 750mm from the doorway to the wheelchair bay. Wheelchair users can travel facing either forward or backward, but never sideways. The length of the wheelchair space of 1500mm is important – a number of guidelines recommend a length of 1300mm, which is not sufficient. Rearward facing wheelchair spaces should allow the user to back against a back rest. A vertical pole or fold-down armrest on the aisle side of the wheelchair space prevents the wheelchair moving sideways when the bus goes round a corner.

WHERE TO START?

The least expensive way to incorporate best practice features into buses is to include them when new vehicles are ordered. Bus manufacturers should be able to include handrails and stanchions, correctly designed route number and destination display, colour contrasted steps and handrails, bell pushes, and priority seating at marginal cost.

Improving operating practices costs little but will need some training and supervision of drivers and conductors. Calling out of major stops, consistently drawing up close to kerbs, considerate driving habits and general awareness of the needs of passengers with disabilities, will work best in the context of a general improvement in customer service in bus operations.

4.2 Design and operation of mini- and midi-buses

Public transport is increasingly provided by informal operators who use midi-buses, minibuses, and other informal vehicles. The vehicles operate on relatively flexible routes and schedules, and authorities typically have little regulatory control over them. While some vehicles have relatively low floors, others are harder to enter or exit due to high steps, narrow doors and an absence of handrails.

BEST PRACTICES

Vehicle entrance/exit The entrances to all vehicles (regardless of their size) should follow best practice guidelines.

Seating Seating should provide sufficient space for people with walking difficulties to enter and leave easily.

Access for wheelchair users Providing wheelchair access to existing mini-buses is difficult due to the narrow doors, low roof heights and limited internal space. Wheelchair access is likely to be limited to subsidised operations using specially adapted vehicles. Midi-buses with floor heights not exceeding 500mm may be large enough to provide direct access for wheelchair users via a short ramp.

Signage Route numbers or destinations should be prominently displayed. Colour coding to indicate different routes has worked well and helps not only low-vision passengers but also people who are illiterate or unfamiliar with the system.

Communication The small size of the vehicle usually aids easy communication between passenger and driver, which is critical.

Operating practices Authorities can prohibit minibus drivers from charging extra for wheelchairs, walking frames or other personal mobility equipment. It is important for drivers to be courteous and aware of the needs of people with disabilities.

WHERE TO START?

The first step to improving safety and accessibility for all passengers on informal services is to foster greater accountability within the industry. As with larger capacity buses, retrofitting existing vehicles with low-cost features such as handrails, adequate signage and colour contrasting can benefit many. But opportunities for such interventions are limited by operators' financial inability to invest in vehicles they do not own. A more effective way of improving vehicle standards is for government regulators to require higher standards of new vehicles used for public transport services.

4.3 Specialised transport services

Specialised services refer to transport services that are specifically tailored to the needs of passengers with disabilities. Specialised services usually use vehicles that provide full access to wheelchair users through mechanical lifts or ramps, and differ from regular public transport in the way they are operated. They range from door-to-door services that exclusively serve disabled people to 'Service Routes' (which are scheduled bus services routed close to the origins and destinations of journeys by elderly and disabled people). Taxis, although not a specialised service, are also used to provide kerb-to-kerb services for disabled people.

Demand-responsive: individual transport

These services provide transport for an individual (plus companion) door-to-door. They fall into two categories; voluntary car schemes and accessible taxi schemes.

Demand-responsive: shared transport

Often known as Dial-a-ride or dial-a-bus, this service provides door-to-door service, using minibuses which should be equipped to carry passengers in wheelchairs.

Community transport and shared transport services

These services, usually using lift-equipped minibuses, provide collective transport for disabled people. They will provide a shared service from an individual's home to a facility such as a day centre or luncheon club or to an accessible town centre.

Hybrid services

There are services which, while not being exclusively designed for disabled people, nonetheless offer a better level of service than conventional public transport. An example of this is the Swedish Service Route system. This overcomes the problems older and disabled people have in using mainstream bus services, which are walking to and from bus stops, waiting at a stop, moving quickly to board and pay a fare, moving quickly to alight and possibly having to stand during a journey. Service Routes offer fully accessible medium-size buses; time tabling with more time at stops; routing to reduce walking distances to and from stops, at the expense of a more tortuous route and slower journey; flexible pick-up/set down points; and well trained drivers.

4.3.1 Best practices – Door-to-door services

Choice of vehicle Door-to-door services typically use small vehicles (mini- or midi-buses) as they are cheaper to operate.

Choice of operator Many door-to-door services are contracted to private operators, many of whom are taxi companies using regular and wheelchair accessible taxis. This results in lower costs to the subsidising agency. The use of taxis exploits the inherent efficiency of the taxi system in high demand areas.

Trip reservation Reservations for door-to-door services are typically made by telephone, between two days and a few hours in advance of the trip. This gives the operator enough time to assign each trip to a vehicle. If telephone access is a concern, it becomes more important to work with social workers to ensure that reservations can be made through alternative means.

Eligibility Passengers are usually required to pre-register for using door-to-door services, to make sure that only eligible people use it. Best practice uses face-to-face contact with potential users to determine if they are eligible for specialised services.

Vehicle scheduling If stops are 'clustered' in the same neighbourhood or corridor, more passengers will be carried at a lower cost per trip, making the service more cost effective.

4.3.2 Best practices – Service Routes

Choice of vehicle Service Routes are usually operated by medium-size vehicles with higher capacities than door-to-door services. Vehicles are fully accessible, almost always low-floor.

Route planning and schedule Service Routes operate along fixed routes near appropriate destinations. They reduce walking distances to and from bus stops; typically, at the cost of increased travel time on more circuitous routes. Staff are specially trained to take account of the needs of elderly and disabled passengers.

4.3.3 Best practices – General

Fares Specialised services should be priced to ensure that disabled people – many of whom have very low incomes – can afford to use them. This often requires subsidies from government. The eligibility process can be used to ensure that subsidies are targeted at those who really need them.

Operating rules Restricted capacity usually forces Dial-a-ride services to limit eligibility to people with disabilities. However, if extra capacity exists the service can be marketed to other potential passengers to become more cost effective. A premium fare could be charged to non disabled passengers.

Training Drivers and assistants of door-to-door services and service routes should be trained to provide a quality service to disabled passengers. Assistance should be given during boarding and alighting and in ensuring wheelchairs are secure and that their occupants are safe to travel.

WHERE TO START?

Providing subsidised door-to-door services should be considered if funding can be raised. Door-to-door services can often be started more quickly than upgraded bus and rail services. Door-to-door services do not rely as much on accessible footways and other infrastructure as do bus and rail services. Productivity can be increased by choosing areas with high concentrations of persons who are likely to require the service, and by linking multiple residential locations to one or a few non-residential location.

Service Routes are also more expensive than regular bus transport, though not as expensive per passenger as door-to-door services. They may be an approach particularly suited as an interim solution in developing countries where accessibility of the mainstream public transport system is poor. Starting by funding well-designed Service Routes may ensure that funds are spent where they can best be used in terms of transporting passengers who cannot use other modes. In the long run accessible mainstream public transport will serve the most passengers (disabled and other) at minimum cost.

4.4 Design and operation of rail vehicles

BEST PRACTICES

Boarding for wheelchair users Providing level boarding for wheelchair users and others is easiest with the platform and train floor at the same height. A temporary approach is to construct a locally raised platform where carriages that accommodate wheelchair users stop. An alternative to level boarding is the use of portable hand-operated lifts. This is a cost-effective option as only one is required per platform.

Boarding using steps The design of steps to ensure they can be used by the largest number of ambulant people should follow the guidelines given for buses.

Layout of carriage Guidelines for the interior layout of rail carriages are similar to those for buses: adequate passageway widths, space for one or two wheelchair passengers, priority seating near entrances/exits, and colour contrasted handrails and step edges.

Signage If a station serves more than one train line, the name of the line or the destination of the train should be displayed on the front of each train and the side of each carriage.

Communication On-board announcement of the next stop before the train arrives at the station is helpful to all passengers, but especially to visually impaired passengers. A public announcement (PA) system is typically needed for this.

Fare policy As with bus systems, many governments subsidise rail travel for disabled people. Introducing concessionary fares should be considered with caution to ensure it does not act as a substitute for other improvements that could be more cost-effective.

WHERE TO START?

It may be possible to start by upgrading carriages used on one line, and to coordinate that with incremental access improvements to the busiest stations on that line. It is usually hard to improve the accessibility of train carriages without major refurbishing. New train carriages should be built to conform to the access norms. All passengers will benefit from incremental improvements, such as installing extra handrails and colour contrasting step noses at entrances, providing priority seats near the entrance and announcing upcoming stops. Improvements can be phased in by providing at least one accessible carriage per train. Finally, helpful staff at stations and on trains can be extremely useful in assisting passengers to overcome some of the access barriers that remain.

5. Bus stops, bus stations and train stations

5.1 Best practices – Bus stops

Location and spacing of bus stops It is best practice to place bus stops close to amenities. UK guidelines indicate that stops should ideally be positioned so that no passengers need walk more than 400m along a route.

Surface quality A paved and level surface around a bus stop can greatly help all passengers.

Bus stop layout Bus stops should have ample space for passengers to wait and board without obstructing other pedestrians. The clear footway width between the shelter and the kerb should be 1300mm. The clear width behind the shelter or waiting area should be at least 1500mm, with an absolute minimum of 1000mm in severely restricted cases. The length of the bus stop should be sufficient to provide access to all entry and exit doors of the bus.

Bus boarders or bulbs, which extend the footway across the parking lane to the edge of a traffic lane, can be an effective way of providing more space while at the same time making it easier for buses to draw up close to the kerb.

Shelters and benches Shelters at bus stops can significantly increase the ease of using bus transport, especially in areas with extreme weather conditions. An accessible shelter provides space for users of wheelchairs and other aids to enter and manoeuvre; has a paved floor level with the surrounding area, and has a bench or seat for waiting passengers.

Bus stop poles and information The bus stop pole indicates where the entrance of an arriving bus will be. Where timetable information is available, this should be provided in large print inside the bus shelter or on the bus stop pole.

Enforcement of no-parking zones It is important to partner with traffic authorities to paint clearly marked no-parking zones at bus stops, and to enforce the zone.

Wheelchair access using raised boarding structures An alternative to low-floor buses or mechanical lifts is to use roadside structures raising the passenger to the approximate height of the bus floor, in conjunction with bridging plates and appropriately designed bus interiors.

WHERE TO START?

Bus stops that currently have no facilities should at a minimum be levelled and paved, and provided with a kerb delineating the passenger space from the space used by buses.

5.2 Best practices – Bus and train stations

Entrances Although it is preferable to make all entrances fully accessible, at least one accessible entrance on each side of the railway lines should be provided.

Layout of station A simple and compact layout makes stations and terminals easier for visually impaired, cognitively impaired, and occasional users/visitors to navigate. It also reduces walking distances.

Ramps are usually the best way to provide wheelchair access between different floor levels. Most guidelines specify 5% (1 in 20) as the preferred gradient for a ramp, and 8% (1 in 12) as the maximum acceptable. So if a substantial height change is involved, the ramp will be very long. European guidelines recommend that ramps should never be longer than 132m in total, limiting the height change to 6.6m.

Steps and stairs The design of steps and stairs assists ambulant disabled people. Steps should be 150mm high and 300mm deep, with vertical, round nosed risers without overhangs. Handrails should be provided on both sides, and also in the centre if stairways are wider than 1800mm.

Lifts It is desirable that lifts can be used by passengers without involving station staff. Many systems allow this. It has been found helpful to use glass walls for the lift cage and for the lift shaft at levels where it can be seen by the public.

Pedestrian clearways between seats, stalls, waste bins and so forth should have a minimum width of 1800 to 2000mm for two-way pedestrian flows. Where this needs to be restricted, it should never be less than 1000mm and continue for more than 6m in length.

Handrails are important, as many people rely on them to maintain balance and avoid falling. Handrails are needed in queuing and waiting areas. Handrails should be fixed between 800mm and 1000mm above the floor, ramp or step noses. They should be continuous along the ramp/stairs, and continue past the end of the ramp or stairway by at least 300mm and then be turned towards the wall or floor. Handrails should be made from circular tubing 40 to 50mm in diameter.

Signage throughout the building is important for everyone, particularly hearing impaired people.

Platforms at rail stations should be reachable by ramps or lifts, and should also provide sufficient space and tactile cues for safe use.

Information Helpful and knowledgeable station personnel are needed to provide information and improve confidence for travellers with disabilities. Trained station personnel should be clearly identifiable and available to answer questions.

Amenities Ticket-counters, ticket gates, telephones, waiting areas, and toilets can be designed to be accessible to all users. If toilets are available for non-disabled people, they should also be available for disabled people.

Seating should be provided for people who cannot stand for long, in waiting areas and on platforms if there is enough space.

WHERE TO START?

It is much easier and cheaper to achieve full access at the design and construction stage, rather than by trying to modify a building at a later stage. When existing stations have to be retrofitted with access features, a good starting point is to select major stations with high passenger flows and stations serving major destinations in the city, as this will benefit most passengers. When existing stations are upgraded or maintained, the opportunity should be taken to make incremental improvements to serve passengers better.

6. Signage and information

Signage and information is important for all passengers. They need to know when to catch public transport, which route or service to take, how much the fare is, and where to find a specific train, bus or minibus within a station or rank. Information should be clear, concise, accurate and timely. Signs should be well lit.

BEST PRACTICES

Size and format of signage The minimum size of letters and symbols should be 1% of the distance from which the sign is read. The best typefaces to use for signs and information are sans serif, with a width to height ratio of between 3:5 and 1:1. Lower case letters are easier to read.

Wall-mounted signs Signs should be placed at a consistent height of between 1300mm and 1600mm above floor level to be at an optimum viewing angle. They should be higher in areas where they would be obscured by crowds.

Colour contrast Letters and symbols on a sign should contrast with the background of the sign. In general, dark text on a light background is preferable.

Tactile signage Signage can be used to provide information to visually impaired passengers such as route numbers or the direction to ticket counters, bus bays or railway platforms. The letters, numbers or pictograms should be fixed against the wall or bus stop pole at a height of 1m from the ground. Most blind and visually impaired people do not read Braille, so embossed signs will generally be more useful.

Audible announcements Announcements are helpful to most people but particularly to people with visual impairments. Public announcement systems in stations or terminals should be clear and loud enough to be understood by people with hearing impairments.

WHERE TO START?

All new signage in newly constructed transport facilities (stations, ranks, stops) should follow best practice guidelines. The refurbishment or maintenance of existing facilities also presents good opportunities to improve the quality of signage and information.

7. Training and policies

7.1 Training

Wherever public transport services have become more user-friendly towards people with disabilities, the training of staff, managers and officials has been an important element. The needs of people with disabilities can best be served if staff are not only courteous and helpful, but are also equipped with specific knowledge on how to serve people with special needs.

BEST PRACTICES

7.1.1 Training courses

Staff training courses should include the barriers faced by disabled people; how to identify accessibility and inaccessibility; information on all disabilities, including hidden disabilities; suggestions for removing barriers faced by disabled people, and the skills needed to serve disabled travellers; communication and interpersonal skills for communicating with disabled people, particularly those with a hearing impairment or learning disabilities; and the skills to

enable staff to deal with unexpected incidents. Training should be given to all levels of staff, including managers who set the ethos of the organisation.

7.1.2 Training of users

In many cases travel training can assist new passengers who have never travelled by public transport before.

WHERE TO START – TRAINING

Many public transport operators train their staff in safety and operational aspects of the service. Modules on disability awareness can easily be incorporated into these programmes, especially for new recruits.

7.2 Transport operators' policies

Some of the barriers faced by disabled people are an unintentional result of the policies of transport operators. These are often driven by concerns over the safety of disabled people if they are involved in an emergency situation or service disruption. Any policy restricting travel by disabled people should be examined in detail to determine if it is really necessary. Where there is any uncertainly, the decision should be biased to enable disabled passengers to travel independently.

7.3 Government policies

Barriers for disabled people can be created by government policies. These are usually a consequence of concerns over safety, though another group of barriers can be caused by the need to ration access to special services for disabled people

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Abbreviations

ADA	Americans with Disabilities Act
BRT	Bus rapid transit
DETR	UK Department of the Environment, Transport and the Regions
DFID	UK Department for International Development
DfT	UK Department for Transport
DPTAC	UK Disabled Persons Transport Advisory Committee
ECMT	European Conference of Ministers of Transport (now known as the International Transport Forum or ITF)
ICIDH	International Classification of Impairments, Disabilities, and Handicaps
IHT	UK Institution of Highways and Transportation
OECD	Organisation for Economic Co-operation and Development
PA	Public announcement system
SAFCD	South African Federal Council on Disability
TDD	Telecommunications device for the deaf
TRB	US Transport Research Board
TRL Ltd	Transport Research Laboratory Limited
UK	United Kingdom
UNDP	United Nations Development Programme
WHO	World Health Organisation

1. Introduction

Accessible transport is about making transport systems and services easier for people to use.

Everybody has limitations to their capabilities. If using a transport service requires them to perform an action that they are not capable of doing, then that service is not available to them. The barriers that may limit access can be physical (climbing steps, walking distances, lifting weights); sensory (reading a destination on a bus, hearing a public announcement); cognitive (identifying which train to board, or finding the way to the platform or departure gate); and financial (paying the fare). The barriers may also involve having information that a service exists, or knowing how to use it. Other barriers can involve being deterred by operating staff who are unhelpful or unfriendly, or policies that bar certain groups of travellers, usually on grounds of safety (for example, no passengers in wheelchairs on underground trains in deep tubes, or a limit on the number of wheelchair-bound passengers on a single flight).

Accessibility can be improved by removing the feature that creates a barrier for a particular group of people. Removing steps from a system can make the system accessible to people using wheelchairs; easier for people who can walk but have difficulty with stairs; and assist people with luggage, baby buggies or shopping trolleys. Reducing the height of steps can make a system accessible to people who can walk, but with difficulty, but does not make it accessible to a passenger in a wheelchair. Improving accessibility for people with mobility limitations can make the system easier for everyone to use, provided the improvements are based on the principles of universal design.

Thus it is necessary to consider the types of impairment or disability experienced by particular passengers, and the barriers that the system creates for people with those impairments.

The European Conference of Ministers of Transport comments that "Accessibility is increasingly recognised as a key element of a high-quality, efficient and sustainable transport system. Indeed all of us as users of the transport system benefit from easier access to buses, trams, trains, planes and ships. The economic benefits of better accessibility for transport operators and service providers are also becoming progressively clear." (ECMT, 2006). Such thinking underpins the concept of universal or inclusive design, which is to make systems and products easy to use for as many people as possible.

This report reviews the current best practices for accessible public transport. It draws heavily on a number of publications by the European Conference of Ministers of Transport (ECMT) (now the International Transport Forum or ITF), plus Overseas Road Note 21 *Enhancing the mobility of disabled people: Guidelines for practitioners* published by TRL Limited and the UK Department for International Development (DIFD/TRL, 2004). Another useful source of guidance is the World Bank's *Bus Rapid Transit Accessibility Guidelines* (Rickert, 2006).

The report is structured as follows.

Section 2 'Elements of accessibility', provides some information on the population of disabled people and examines the barriers that affect people with different impairments.

Section 3 'The road and pedestrian environment' concentrates on local mobility for pedestrians. This is relevant to public transport, because passengers must be able to get to stations and bus

stops. It has wider relevance to accessibility, because the same pedestrian infrastructure is used for local wholly pedestrian journeys, which usually outnumber journeys by public transport and which are the first priority for enabling people to be independently mobile. The section includes a short summary of the basic principles of access to buildings from the street.

Section 4 'Vehicle design and operation' covers the design of buses, minibuses and metros to make them easier for everybody to use.

Section 5 'Bus stops, bus stations and train stations' covers the design and maintenance of stations and bus stops to improve accessibility, plus access to buildings such as transport information offices, ticket offices, shelters and public toilets.

Section 6 'Signage and information' deals with information in all formats: signage used in terminals, stations and on-board vehicles; printed leaflets and timetables; and audible announcements. It concentrates on best practice regarding format, but includes a short section on the types of information that are most useful to passengers.

Section 7 'Training and policies' covers not only the training of front line staff in sensitivity to people with disabilities and how best to serve them, but more general training to sensitise senior managers and local government staff with respect to to the requirements of people with disabilities who wish to use public transport services. It also identifies the kinds of policies and regulations that unintentionally create barriers for disabled and elderly people.

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2. Elements of accessibility

2.1 The prevalence of disability

The United Nations Convention on the Rights of Persons with Disabilities and its Optional Protocol was adopted on 13 December 2006. Article 1 includes the clause "Persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others." In 1980 the World Health Organisation published *International Classification of Impairments, Disabilities and Handicaps* (ICIDH). This publication described impairment in medical terms as any loss of psychological, physiological or anatomical structure or function. It regarded disability as any limitation or loss of functional ability deriving from an impairment.

When planning access of transport systems, disability described in functional terms is usually a more useful measure than medically based impairment. Thus the inability to climb steps higher than 25cm can be caused by many different medical impairments, but it is the functional limitation that must be considered in the design of a transport system.

In Europe, 12 to 14% of the population are disabled (ECMT, 1986). A survey in Britain in 1988 estimated that 13.5% of the population are disabled. The percentage of people with disabilities increases with age, from 5.6% of those aged 16 - 59, and 28% of those aged 60 - 74, to 53% of those aged 75 and over. Sixty-nine percent of those with disabilities have locomotive disabilities, 41% hearing disabilities, 24% seeing disabilities, and 21% intellectual functioning disabilities. Many people have multiple disabilities. Disabilities vary greatly in severity; 7% have the most severe disability (can only walk a few paces without stopping or severe discomfort/cannot walk up and down one step of a flight of stairs) to 35% with the least disability (can only walk up and down a flight of stairs if the person goes sideways or takes one step at a time) (Martin, Meltzer and Elliot,1988).

ECMT (2006) estimates the percentages of people with disabilities in Europe are as shown in Table 2.1:

Table 2.1: Percentage of people with disabilities in Europe

Disability	%
Any disability	14 - 15
Cannot walk without aid	5.6
Wheelchair user	0.4
Reduced strength	2.8
Reduced co-ordination	1.4
Dyslexia	3.1
Intellectually impaired	3.8
Hard of hearing	10.0
Low vision	1.4

Source: ECMT (2006)

2.2 Factors that influence accessibility

Accessible transport must provide much more than vehicles that can be used by a person in a wheelchair. Accessibility requires knowledge, ability, financial means and confidence. The passengers must know that a service exists and how to use it. The passengers must be able to get to the bus stop, station, curbside or wherever else the vehicle is entered. The passengers must be able to board the vehicle, locate and secure themselves within it, tolerate any stresses during traveling, identify when the destination is reached and leave the vehicle at the end of the journey. The passengers must be able to pay the fare. Finally, the passengers must have the confidence that the service will operate as scheduled and the staff will have the training and willingness to provide the necessary support.

In particular, staff training, attitude and the willingness to help can overcome many deficiencies of vehicle, infrastructure or supply of information. Many disabled travellers in less developed countries have reported few problems, despite inaccessible vehicles and infrastructure, because there have been so many people willing to assist. In contrast, a surprising number of disabled people in Europe stop using public transport because the staff make them feel like a nuisance or inadequate because they take more time to board the vehicle or find their fare.

The term accessibility is used in two senses. First, policies and regulations can create barriers for disabled people. This may be a regulation that bans passengers who travel in wheelchairs from deep underground metros, because of the difficulty of evacuating them in an emergency, or a health regulation that bans dogs, including guide dogs, from shops, hotels and restaurants. Care is needed to avoid creating barriers unintentionally, as a result of measures that are intended to improve some situation.

It should be appreciated that the term 'accessibility' is used in a second and different sense by transport planners. This is to describe the time or cost it takes to reach various destinations from a given origin. This is important for everybody, including people with disabilities, and techniques are being developed for mapping the accessibility provided by public transport and individual car travel.

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3. The road and pedestrian environment

Safe mobility is necessary for pedestrians to access public transport and also for independent local mobility. In most countries, about four times as many journeys are made wholly on foot than are made by public transport. In Britain, typical of a European country, for adults aged 17 and over, 22% of all journeys are as pedestrians compared to 6% by bus or coach (19% and 5% for men and 24% and 7% for women), a survey in 2006 shows.

3.1 Problems experienced by pedestrians

Infrastructure for pedestrians needs to provide routes that are direct, continuous, safe, convenient and attractive. Paths and sidewalks should provide comprehensive coverage of an area, to serve the journeys that people want to make, including routes through residential areas. They should be sufficiently wide (1.8m is a minimum, with at least 1.0m at pinch points), well surfaced and drained, lit at night and overlooked for personal security. Pedestrian routes should include frequent seats or resting places, because about 10% of adults cannot walk more than 400m without a rest or experiencing pain, and 5% of adults cannot walk 50m. At least in town centres, pedestrian routes to major destinations should be signed. Ramped kerbs should be provided wherever people may need to move from the sidewalk to the surface of the road. At any point where blind pedestrians could move from the safety of the pedestrian infrastructure to the danger of a roadway surface without crossing a kerb (such as at a ramped kerb), tactile paving should be installed to warn the pedestrians that they are leaving the pedestrian area.

Some features, such as hills, narrow or uneven sidewalks, and crossing roads, affect everyone, though people with disabilities are more affected. Other features, such as crowds, kerbs and steps, affect mainly people with more severe impairments.

There are many guidelines on the physical design of pedestrian infrastructure that is easy for older and disabled people to use – the US Federal Highway Administration's (FHWA) *Designing sidewalks and trails for access* (Kirschbaum et al, 2001), the UK Department for Transport's (DfT), *Inclusive Mobility: A Guide to Best Practice* (Oxley, 2002) and Overseas Road Note 21 *Enhancing the mobility of disabled people: Guidelines for practitioners* (DFID/TRL, 2004) are good examples. Another useful source of guidance is the World Bank's *Bus Rapid Transit Accessibility Guidelines* (Rickert, 2006). The French *Une Voire pour tous* (CERTU, 2000) summarises legislation on accessible infrastructure and many of the technical requirements for accessibility. The DfT's *Guidance on the use of tactile paving surfaces* (DfT, 2005) provides detailed guidance on the topic.

Aspects of the pedestrian environment that cause difficulties for people with disabilities were summarised in Hitchcock and Mitchell (1984). Table 3.1 quotes the percentages of people with different levels of disability (the left column is most disabled, and the right column is least disabled).

Table 3.1: Percentage of people reporting difficulties in the pedestrian environment (%)

Aspect of pedestrian environment	Registered disabled	Elderly, with walking difficulties	Non-elderly, with walking difficulties	Elderly, no difficulty with walking	Non-elderly, no difficulty with walking
Kerbs Steps	12 58	5	4	4	2
Hills/ramps	59	45	30	19	12
Uneven/ narrow pavements	21	19	13	14	8
Crowds	50	4	0	5	2
Traffic/ crossing roads	35	31	22	16	17
No difficulties	2	23	43	54	67

Source: Hitchcock and Mitchell (1984)

Traffic and crossing roads affect all pedestrians. Sources of high risk for older pedestrians, and where they find it difficult to cross roads, are:

- Crossing busy two-way streets;
- Crossing major roads, particularly with fast traffic;
- Intersections with heavy traffic, particularly where there is no centre refuge;
- Complex situations, where vehicles can come from several directions; and
- Where traffic is allowed to turn across pedestrian routes at light-controlled crossings, or where right turn on red is permitted.

The difficulties faced by older pedestrians are described by Dunbar et al (2004).

Drivers' behaviour that threatens older pedestrians includes:

- Exceeding speed limits;
- Infringing red lights;
- Parking on and blocking sidewalks;
- Reversing;
- Turning at intersections.

Measures to improve pedestrian safety include (OECD, 2001):

- Separate the pedestrians from vehicles, for example by providing a sidewalk;
- Pedestrian only areas where possible;
- Reduce traffic volumes, by directing traffic away from areas of high pedestrian activity and from residential areas;
- Reduce traffic speeds;
- Provide pedestrian crossings;
- Provide street lighting;
- Improve infrastructure:
  - Kerb extensions to minimise time on road;
  - Bollards to prevent parked vehicles from blocking sidewalk or to narrow traffic lanes;
  - Traffic calming to reduce vehicle speeds;
  - Speed tables at pedestrian crossings, across side roads, at junctions;
  - Provide median pedestrian refuges;
  - Adequate footpath widths.

Many design features that improve road safety for older people can be found in the US Federal Highways Administration's journal Public Roads (Mitchell, 2007a).

3.2 Guidelines and standards for pedestrian footways

The most recent accessibility guidelines are contained in Overseas Road Note 21 *Enhancing the mobility of disabled people: Guidelines for practitioners* (DFID/TRL, 2004). Chapter 5 from this document will be cited extensively in this section. Two older documents, that cover some topics not included in the above-mentioned report, are *Designing sidewalks and trails for access Part II: Best practices design guide* (Kirschbaum, 2001) and *Inclusive Mobility: A Guide to Best Practice* (Oxley, 2002).

Chapter 5 of *Enhancing the mobility of disabled people: Guidelines for practitioners* defines pedestrian footways as any areas primarily used by pedestrians. They can be adjacent to roadways (also called sidewalks or pavements), or away from the road (also known as footpaths). Providing accessible footways in the right places is a fundamental aspect of promoting mobility for everybody, as almost every trip starts and ends on foot. Furthermore, very poor people with disabilities often have no means of using public transport, and would particularly benefit from having access to a safe and accessible footway on which to travel to undertake livelihood activities. Well designed and maintained footways can benefit people with a variety of disabilities, including users of wheelchairs and tricycles, by providing a safer alternative to having to share the roadway with fast-moving traffic.

In this chapter, sections with the headings 'Basic principles', 'Best practices' and 'Where to start?' are largely taken from *Enhancing the mobility of disabled people: Guidelines for practitioners* (DFID/TRL, 2004), though with amendments by the author drawing on other guidelines and experience of making systems accessible. The basic principles of accessible systems set out in Section 5 of *Enhancing the mobility of disabled people: Guidelines for practitioners* are as follows:

Safety: • Level and smooth surface. • Clearly separated from vehicular traffic. • Adequate clear width and height. • No open utility covers, streetworks. • Good street lighting.	**Accessibility:** • Remove obstacles, including parked vehicles from the footway. • Gradients not too steep. • Adequate resting places. • Simple layout and adequate cues to visually impaired people.
Reliability: • Footway should provide uninterrupted accessible way between designated points.	**Affordability:** To the provider: • Minimise costs by including access improvements in regular maintenance and new construction. • Maximise impact by upgrading highly used pedestrian areas first.

BEST PRACTICES

Surface quality Firm, even surfaces are important to people using sticks, crutches or wheelchairs; or people walking with difficulty. The removal of obstacles like potholes, tree roots and storm water drains crossing the walkway will do much to make it safe and usable. Torrential rain in many developing countries wreaks havoc with unpaved surfaces – it is therefore best to pave pedestrian facilities with asphalt or concrete. If brick paving is used care should be taken to lay it evenly. Lower cost surfacing such as compacted crushed rock or unpaved compacted earth may be an option in footways with very low usage, but these are typically not accessible to persons with wheelchairs unless they are kept smooth, compacted or otherwise stabilised. Where grates over storm water drains cannot be kept out of the footway, the gratings should be aligned across the direction of travel to prevent wheelchairs' wheels from falling through.

Crossfall *Enhancing the mobility of disabled people: Guidelines for practitioners* (DFID/TRL, 2004) recommends that crossfalls should only be provided where absolutely necessary for drainage purposes. For persons using wheelchairs, a uniform crossfall is often more important than a flat surface or a uniform gradient. Where crossfalls need to be provided, they should never be steeper than 2.5% (1 in 40). Anything more than this makes it difficult for a wheelchair to steer in a straight line. US ADA Accessibility Guidelines limit crossfall to 2.0% (1 in 50), and recommends that changes of crossfall be assessed over a distance of 0.61m. If the change in crossfall over this length is so severe that one wheel of a wheelchair or one foot of a walker leaves the ground, it may cause the user of the wheelchair or walker to fall.

Width Footways and paths should ideally be at least 2000mm wide in areas with moderate to high pedestrian traffic. This width will allow two wheelchairs to pass each other comfortably. Where this cannot be achieved, or in areas with light pedestrian traffic, a width of 1500mm is regarded as the minimum acceptable, giving enough space for a wheelchair user and a walker to pass each other. At obstacles and pinch points, the absolute minimum width should be 1000mm. Where possible, the full path width should be maintained consistently, even behind bus shelters and in front of shop fronts. This clear space should be maintained free from traders and hawkers who will inevitably use the space for marketing foods and other goods and services and from squatters and migrants using the footway as 'home'. Where possible, local authorities should seek to find alternative locations for hawkers and squatters while enabling all pedestrians to be mobile.

Height Clearances of at least 2100mm should be provided to prevent visually impaired people from hitting overhanging branches or signs. Where this is not possible (for instance, under the stairs to a pedestrian bridge) a physical barrier should be used to warn blind or partially sighted pedestrians.

Simplicity of layout Footways should be designed as straight and simple as possible, with benches, poles, rubbish bins etc. to one side, out of the way. This aids visually impaired people. Changes in slopes and crossfalls, for instance when the footway crosses a vehicle driveway, should be gradual and kept to a minimum. Frequent changes make it more difficult for people who are walking, as well as those using wheelchairs.

Tactile guideways and tactile surfacing Sometimes visually impaired people need guidance in using a pedestrian area, especially if the footway crosses larger open spaces where the usual guidance given by the edge of the footway or building base is not available, or when pedestrians need guidance around obstacles. A continuous tactile guideway in the direction of pedestrian travel, which has a different texture to the rest of the footway, can provide this guidance. The different texture can be followed by people using a long or guide cane, and can also be detected underfoot by others with low vision. Research has shown that a height of about 5mm for the raised part of the surface is sufficient for almost all visually impaired people to detect, without

causing too much discomfort for other pedestrians. Tactile guideways should however be used sparingly as they can hinder wheelchair users and other pedestrians.

Tactile guideways can take the form of pre-fabricated guide blocks with raised flat-topped bars which can also be in a contrasting colour. In Mexico City and Buenos Aires subway stations, tactile guideways incorporating grooves cut in the floor have been used, but these are less common.

Where the path leads to a dangerous situation (such as a street crossing – see Section 3.3) a tactile surface should be used to warn visually impaired pedestrians. This can take several forms, such as pre-cast concrete blistered paving or 'bubble blocks', which are used to warn a pedestrian at a ramped kerb that they are leaving the safety of the footway without crossing a kerb.

Gradient Guidelines from many countries agree that a gradient of 8% (1 in 12, or 1m rise to every 12m in horizontal distance) is the absolute maximum that may be used in pedestrian areas. Anything greater than this causes difficulties for manual wheelchair users and may cause them to topple over. Steeper slopes than 8% can be managed by some wheelchair users, but only over very short distances (see Table 3.2). In fact, any footway or ramp that is steeper than 5% should provide level areas as resting spots every 10m or so. Changes in slope should be gradual enough that wheelchairs do not become stuck.

To ensure that users of wheelchairs, tricycles, crutches, pushcarts etc. can use the walkway, small ramps should be installed in all places where there are changes in level. Section 3.3 provides more information on kerb ramps and street crossings.

Table 3.2: Gradients for footways and ramps

Gradient of footways or ramps	Recommended use
10% (1 in 10)	Only over very short distances (1000mm or less), such as kerb ramps.
8% (1 in 12)	Maximum slope for general use.
5% (1 in 20)	Preferred slope where possible.

Source: Based on Oxley (2002)

Maintenance To preserve usability and continuity of the walkway, it is critical that it be kept clear of rubbish, dirt, street works, parked cars and other obstacles. Street works (especially when left unattended) should be guarded by a continuous, rigid barrier (not plastic tape) along the entire perimeter. These can be made at very low cost from timber painted in contrasting colours.

Footbridges and subways New footbridges and subways should be built with ramps to allow everybody to use them. The guidelines on ramps and handrails in Section 3.4 should be followed.

Rest areas Elderly and disabled pedestrians need to rest at reasonably frequent intervals. Along frequently used pedestrian ways, seating should be provided at regular intervals, typically every 50m. As with all street furniture, seating should be placed next to the footway without obstructing it, and painted in contrasting colours. Seats can be as simple as wooden benches or perch-type rails to lean against. Seats should be 480mm high and painted to contrast with the surroundings.

Guardrails Where there is a large drop at the edge of a footway, guardrails could be provided. Guardrails should be at least 1100mm high and painted to contrast clearly with the surroundings.

WHERE TO START?

The most common barriers to safety, accessibility and reliability of pedestrian footways and footpaths are bad surface quality and obstructions in the form of poles, kerbs, parked vehicles or traders. First steps in providing adequate pedestrian facilities should therefore include:

- Surfacing footways with an all-weather material (asphalt or concrete);
- Installing kerb ramps where the footway crosses streets, driveways and so forth;
- Ensuring that street signs and street furniture are located to provide an adequate clear width and height that is continuous along the footway; and
- Ongoing enforcement to keep parked cars, vendors, and rubbish out of the clear width.

Of course this standard cannot be achieved everywhere at once. But an Authority can start by taking the following steps:

- When doing regular maintenance, upgrading or construction of roads and footways, ensure that accessibility guidelines are followed. Access improvement can be achieved in this way at minimal cost.
- Start by identifying high priority pedestrian routes used by many people (including many people with disabilities), for upgrading first. Bear in mind what the origins and destinations of people are along this route, in order to ensure that reliable, uninterrupted accessibility is provided between these points. Providing a footway only on one side of the street and later completing the other side may be adequate as a start, although it is generally desirable to provide footways on both sides of streets used by pedestrians.

3.3 Guidelines and standards for street crossings

Street crossings are important elements of the pedestrian environment. Disabled pedestrians are particularly vulnerable because they often move more slowly, or are slower to perceive and react to danger than other pedestrians. Mitchell (2007b) has reviewed the safety of older pedestrians, and the measures that can improve safety. All pedestrians – and disabled pedestrians, children and elderly people in particular – can benefit greatly from well-marked and well-designed crossings. By channelling pedestrians into designated points, crossings make drivers more aware of the presence of pedestrians. Street crossings can be uncontrolled (with no traffic signal) or controlled (with a traffic signal). Signals are usually only warranted if vehicle and pedestrian volumes are high enough, such as on busy roads or near schools and hospitals. In all cases it is crucial to observe best practice to promote safety, accessibility and reliability.

BASIC PRINCIPLES

<table>
<tr>
<td rowspan="3">Safety:
• Crossing clearly marked on the surface of the road.
• Advance warning to vehicles to stop or giving priority to pedestrians.
• Warning to visually impaired pedestrians that they are approaching street crossing.
• Method of informing visually impaired pedestrian when it is safe to cross.
• If signalised, keep traffic stopped long enough to allow slow walkers to cross.
• Good street lighting.
• Traffic calming to reduce vehicle speed.
• Divide two-way roads into two parts using central pedestrian refuges.</td>
<td>Reliability:
• Warnings, information and traffic signals well-maintained and in good working order.</td>
</tr>
<tr>
<td>Accessibility:
• Kerb ramps providing level from footway to road.
• Minimise crossing distance, for instance, by extending kerbs across parking lanes or installing centre islands.</td>
</tr>
<tr>
<td>Affordability:
To the provider:
• Minismie costs by installing at least kerb ramps and warning surfaces at newly constructed or upgraded crossings.
• Maximise impacts by prioritising crossings with high pedestrian volumes.</td>
</tr>
</table>

BEST PRACTICES

Crossing design The design of street crossings should aim for simplicity and consistency. The recommended minimum width of a street crossing is 1200mm. Where the pedestrian has to cross many lanes of traffic, centre islands are extremely helpful because they reduce the distance the pedestrian has to walk on the road at one time without protection. Central islands convert two-way roads into two separate one-way roads, which are much easier to cross. They can also calm traffic and reduce vehicle speeds. Centre islands should be at least 1500mm wide across the direction of the road to cater for wheelchairs, with a cut through at the surface level of the crossing, at least 2000mm wide along the length of the road.

The safety of a crossing can be significantly improved by extending the footway out across any parking lanes (Figure 3.1). This has the triple purpose of reducing the width of roadway to be crossed, slowing vehicular traffic and improving the ability of pedestrians and drivers to see each other. Crossings should be laid out with ample space, especially at the top of the kerbed ramp to allow easy passage for pedestrians who are not crossing the road.

It is important to design crossings following consistent patterns, to enable visually impaired users to orientate themselves easily. For instance, the traffic signal pole should always be on the left (or the right) of the crossing; and the push button at the same height (about 1000mm above the ground).

Figure 3.1: Extending the footway out across parking lanes at a crossing

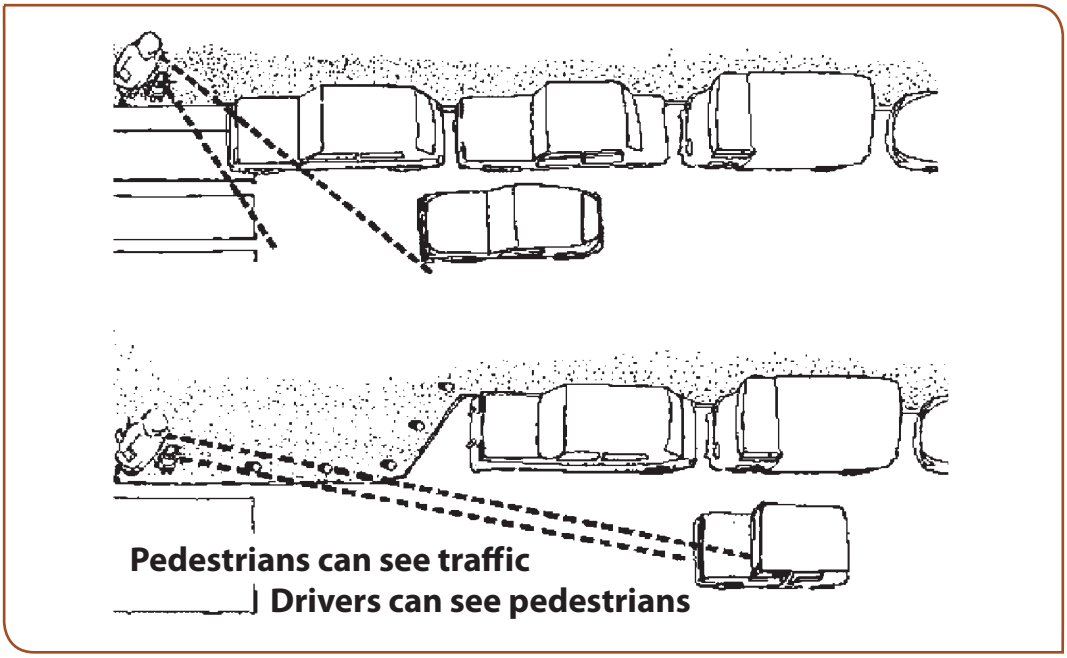
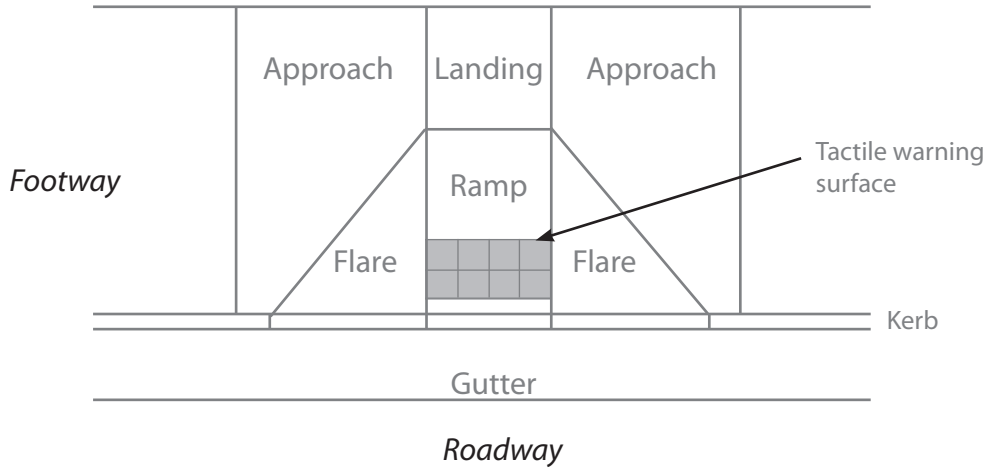


Figure 3.2: Example of extending the footway at a crossing

Kerb ramps Kerb ramps (also known in some countries as dropped kerbs, bevelled kerbs, or kerb cuts) should be used wherever footways cross roads, medians or other raised surfaces. The recommended dimensions for kerb ramps are shown in Figure 3.3. The ramp should have a minimum width of 1200mm. At crossings, the ramp should be as wide as the crossing (minimum 2400mm), especially in new construction where the cost is minimal. Kerb ramps should be free of obstructions such as signposts, bollards and traffic lights. They should also not project into the roadway where they would obstruct traffic.

Where possible, the bottom of the ramp should be installed flush with the roadway, as even a small 'lip' of more than 6mm can cause the front wheels of a wheelchair to swivel sideways and bring the wheelchair to an abrupt and dangerous stop.

Figure 3.3: Recommended design for a kerb ramp



Design specification

Ramp slope	8% maximum, 7% preferred
Gutter slope	5% maximum, 2% preferred
Flare slope	10% maximum, 9% preferred
Lip at roadway	6mm maximum, flush surface preferred
Ramp width	1200mm minimum, width of crossing preferred
Landing width	1200mm minimum, 1500mm preferred
Crossfall on landing and approach	2% maximum
Width of tactile warning surface	610mm

Source: Based on DFID/TRL (2004) and Kirschbaum (2001)

The landing at the top of the kerb ramp is an important component of the ramp. It provides a level area for persons to bypass the kerb ramp, as well as for wheelchair users to change direction after ascending the ramp. Changing direction across the flared sides of the ramp would be much more difficult. The landing should be at least 1200mm but preferably 1500mm wide.

The maximum gradient should preferably be 8% (1 in 12) on the ramp itself and 9% (1 in 11) on the flared sides. A ramp that is too steep is inaccessible and unsafe, as it cannot be used by wheelchairs and is harder to negotiate by pedestrians. As with footways in general, slope changes between kerb ramp and pavement should be gradual to prevent the front wheels of a wheelchair getting caught. Similarly, the change in slope from the ramp to the gutter and roadway should not be more than 12% over a 600mm length, and preferably not more than 10%.

Kerb ramps should as far as possible be oriented perpendicular to the kerb. Skewed ramps can cause problems for wheelchair users and persons pushing trolleys or carts, as a skewed approach can lift one wheel off the ground, compromising balance and control. It follows that providing

two ramps at road junctions is far preferable to only one, if space allows. The single ramp design has the additional drawback of aligning pedestrians in the wrong direction, and could lead visually impaired persons inadvertently into the middle of the junction.

Drainage should be provided near the bottom of kerb ramps, but drainage gratings should not be located in the crossing itself.

Traffic signals Most countries have guidelines on when to install traffic signals at crossings, depending on the prevalent safety and traffic flow conditions. If a traffic signal is used, the red phase should keep traffic stopped for about 12 seconds for a 7.5m crossing to allow most disabled pedestrians to complete their crossing. Signals are available (the 'Puffin' crossing in Britain) that use pedestrian detectors to extend the crossing time for slow walkers. Signals that can be activated by the pedestrian using a push button box are useful, particularly at mid-block crossings. A large diameter (up to 50mm) raised button that can be activated by a closed fist will be usable by most people. Traffic signal poles and push buttons should also be colour contrasted.

At signalised intersections audible signals can be very useful to visually impaired pedestrians. Audible signals may encourage safer crossing behaviour among children. These signals have a bleep which sounds during the first part of the green phase to indicate when it is safe to cross the road. To help visually impaired pedestrians the push button box should be located consistently at crossings.

Tactile warning surfaces Tactile surfaces are important at the edge of street crossings to warn visually impaired pedestrians they are about to step on to the road. Various types of tactile surfaces are used across the world, as described in Section 3.2 above. It is important that, whatever tactile surfaces are used, they are used consistently and sparingly to avoid confusion within a country. Layouts should also be consistent. Research conducted by TRL has indicated that flat topped domes are acceptable both to people with ambulant disabilities and to wheelchair users (Department for Transport and the Regions, 2005).

Traffic calming Various methods can be used to increase crossing safety by reducing the speed of vehicles. Traffic calming measures like speed bumps or pinch points can be very effective in developing countries due to their low cost nature. Raising the surface of a crosswalk can be used both to slow down traffic and to provide a level crossing for pedestrians. In Santiago, Chile, for example, raised crossings are used effectively at side streets and junctions to slow down right-turning cars (in right-turning traffic). Raised crossings should be designed with a minimum width of 2400mm (as other crossings), and built at the same level as the footway.

The UK Institution of Highways and Transportation has published guidelines on best practices for traffic calming (IHT, 2005).

Pedestrian guardrails Guardrails may help to improve pedestrian safety at road intersections in cities in developing countries where poor road user discipline is the cause of many accidents. To be clearly detectable, guardrails should be at least 1100mm high and painted to contrast clearly with the surroundings. Simple galvanised railings are not acceptable unless they have contrasting markings on them.

WHERE TO START?

Whenever new street crossings are constructed, or existing ones are upgraded, the opportunity should be taken to install at least kerb ramps, even if other features are only to be added at some future date. If possible, the opportunity should also be taken to move street signs, bins etc. that

block the pedestrian flow on the footway. If an authority has to prioritise at which crossings to install the access features described here, the decision could be guided by factors like:

- Prioritising street crossings that are part of accessible networks and are thus important for completing an origin-to-destination travel chain for disabled people;
- Prioritising crossings with high pedestrian volumes (like in central business districts) or near major public transport stops, if no accessible networks have been identified in the city;
- Prioritising crossings where vulnerable pedestrians like children, disabled people, or patients would benefit from improved safety and accessibility. Examples include crossings near schools, hospitals/clinics, or sheltered homes/workshops for disabled people.

Minimum requirements for these crossings will be dictated by what is needed to ensure satisfactory levels of safety for pedestrians. Usually this will include at least clear markings, signage and/or traffic calming measures to warn motorists of the crossing and to slow down vehicles; central pedestrian refuges are extremely helpful, especially for streets that are wide, carry traffic in two directions, or carry fast traffic. High pedestrian volumes and high vehicle speeds may require traffic signals to be installed if affordable. It must be remembered that, without signal control, many visually impaired people will be unable to use crossings on busy roads without help.

3.4 Guidelines on getting into buildings from the street

Sources of information on access to buildings include ODPM (2004), Oxley (2002), Access Board (2004, 2006) and ECMT (2006).

The basic principles in designing access are the same whatever the specific physical characteristics of the building. A single step at the entrance or a kerb without a ramp in the road outside can make the most carefully-designed building inaccessible to people with certain disabilities.

The clear width of the open door(s) must be sufficient to allow easy access for anyone, including people in powered wheelchairs, walking with a helper or pushing a double-buggy. Recommendations on minimum width vary, but a clear width of 1200mm should be provided. Where double doors are installed, each door should be a minimum of 800mm (or preferably a little more – 830 - 900mm) wide. Doors should be automatic, linked either to a weight sensor or sensors mounted above the door.

Glass doors must be marked with a brightly coloured banding about 150mm deep at a height of at least 1500mm from the ground. Glass should not be used below a height of 400mm to avoid damage from pushchairs and wheelchairs.

The way into the building must be fully accessible and step free. Where the height change between the pavement or road outside and the floor level of the station is comparatively small, a ramp (in addition to steps) will be adequate. The ramp should have a shallow gradient, ideally about 1 in 20 and certainly no steeper than 1 in 12. The maximum length between level landings, where a wheelchair user could rest to regain his breath, should ideally be no more than 6m and the ramp itself should be at least 2000mm wide, so that two wheelchair users can pass one another. The level landings should be at least 1200mm long, preferably 1800 - 2000mm. Ramps should be built with handrails on both sides, set at about 850mm above the surface of the ramp. The handrail should be circular in cross-section and about 45mm in diameter. If fixed to a wall there should be a clear space between rail and wall of 45mm. A second lower handrail, set at 700mm

above the ramp surface, can be helpful for children and people of reduced stature. Where the ramp is open sided, a tapping rail or kerb for long cane users should be provided along each (open) side to a height of 100mm.

Even where a ramp is provided, there should also be stairs. Some people, often those suffering from arthritis and back pain, find it easier to climb stairs than to use a ramp. In designing any stairs, whether two steps or twenty, the same principles apply:

- All the steps in a flight should be uniform;
- The risers should be between 100 and 150mm high with 130mm preferred; treads should be 300mm deep and treated with a non-slip surface; nosings (step edges) should be slightly rounded (6mm radius) without any overhang, and the step edge should be colour contrasted; risers should be vertical; the minimum width between handrails should be 1200mm;
- The maximum rise of a single flight of stairs should be 1200mm;
- Rest areas between flights of steps should be at least 1200mm preferably 1800mm;
- There should be a minimum of three steps in each flight;
- Handrails should be provided and should extend 300mm beyond the start and finish of the flight of steps;
- Handrail dimensions should be the same as those given above for ramps;
- Approaches to steps should have a tactile 'warning surface' to alert visually impaired people.

Open tread staircases should be avoided: some people feel unsafe on them and they are more difficult for visually impaired people to use.

Where there is a substantial difference in height between the pavement and the interior of the building, or where space is limited, a ramp may not be appropriate and a lift will have to be provided.

It is important that disabled passengers should be able to find accessible entrances easily, so there should be clear signs to indicate where the accessible entrance is and to direct people to it from any other entrances that may not be fully accessible. Entrances should be in contrasting colours to their building.

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4. Vehicle design and operation

Although design solutions may differ between modes of transport, many of the ergonomic and design requirements for vehicles are the same for buses, minibuses, light rail and heavy rail. Section 4 concentrates on the design and operation of buses, but summarises guidance on the other modes of public transport where it differs from that for buses.

The United Nations Convention on the Rights of Persons with Disabilities (UN, 2006) states that, as part of Article 4 General obligations: "To this end, States Parties undertake: (f) To undertake or promote research and development of universally designed goods, services, equipment and facilities, … which should require the minimum possible adaptation and the least cost to meet the specific needs of a person with disabilities, to promote their availability and use, and to promote universal design in the development of standards and guidelines".

The Convention includes, as part of Article 9 on Accessibility: "1. To enable persons with disabilities to live independently and participate fully in all aspects of life, States Parties shall take appropriate measures to ensure to persons with disabilities access, on an equal basis with others, to the physical environment, to transportation, to information and communications, … These measures, shall include the identification and elimination of obstacles and barriers to accessibility."

For all forms of public transport, a distinction should be recognised between two different levels of accessibility. The first concerns the design features and operational procedures that improve access to those people with disabilities who can walk, but with difficulty, and can climb at least a few steps. These features and procedures often cost very little to implement and can assist over 90% of people with disabilities. They also assist many non-disabled people who are temporarily handicapped because they are carrying luggage, shopping or children, or are temporarily impaired by an injury. The second level of accessibility is that which enables a passenger in a wheelchair to board and travel in a public transport vehicle. Depending on how this access is achieved, it may improve ease of use for all passengers, as is the case with low-floor vehicles or level boarding from a platform. But if access depends on the use of special equipment such as a lift, either vehicle-mounted or mobile at a station, the majority of passengers gain no benefit from the improvement.

Provided the design of vehicles is based on universal and inclusive design principles, the features that provide accessibility for people with disabilities will make travelling easier for everybody, and may provide economic benefits through increasing ridership.

4.1 Design and operation of buses

Large capacity buses transport significant numbers of passengers in cities on all continents. In Europe, significant gains were made in the accessibility of buses through the use of lower-floor vehicles with low steps, well-designed handrails and other low cost features. This was followed by the development of low-floor vehicles, which provide step-free boarding to wheelchair users and all other passengers. Lower-floor vehicles are gradually being introduced in cities in South America and Asia. Yet, in most developing countries, buses with high floors (typically 1m above ground level) remain popular due to their affordability and their suitability to rugged operating

conditions. Their entrances (narrow, steep, and with high steps) and internal layout (narrow seat spacing) make them difficult for many passengers, especially for those with less agility. Significant improvements can, however, be made even before addressing the problem of high floor heights, which is ultimately needed.

Another universal design solution is the use of specially designed high-floor buses with boarding platforms. These increasingly popular 'Bus Rapid Transit' systems largely serve concentrated high-volume corridors in cities, but still require conventional boarding solutions along feeder routes off the main corridors. It is therefore likely that the use of conventional buses will continue to predominate in developing countries for at least the foreseeable future.

This section considers both full wheelchair access and incremental improvements to conventional buses to help people with disabilities to board, travel in, and alight from such vehicles more easily, quickly and safely. Improvements are needed in both the design and operation of bus services. Solutions like clear signage, adequate handrails and priority seating can be implemented at low cost and help to retain existing users as well as to attract new ones and boost revenue. To capture the maximum benefits, improvements to vehicles should be coordinated with improvements to infrastructure.

Guidance on bus design and operation is available in Overseas Road Note 21 *Enhancing the mobility of disabled people: Guidelines for practitioners* (DFID/TRL, 2004), *Improving transport accessibility for all* (ECMT, 2006), various British Disabled Persons Transport Advisory Committee (DPTAC) recommended specifications and *Research on the ergonomic capabilities of public transport passengers* (Mitchell, 2007). Another useful source of guidance is the World Bank's *Bus Rapid Transit Accessibility Guidelines* (Rickert, 2006). COST Project 322 *The low floor bus system* gives guidance on low floor buses (COST, 1995).

In this chapter, sections with the headings 'Basic principles', Best practices' and 'Where to start?' are largely taken from *Enhancing the mobility of disabled people: Guidelines for practitioners* (DFID/TRL, 2004), though with amendments by the author drawing on other guidelines and experience of making systems accessible.

BASIC PRINCIPLES

Safety: • Wheelchair users should be able to travel safely. • Dedicated wheelchair space for wheelchair users to remain seated in their wheelchairs. • Smooth driving and braking to avoid injury. • Ways to request a stop without passengers leaving their seats. • Handrails and stanchions for boarding, alighting and standing passengers.	**Accessibility:** • Easy and unhindered boarding via steps (if any). • Level boarding for wheelchair users into bus. • Step noses and hazards highly visible. • Priority seats near entrance available for disabled passengers. • Easy stowage of mobility aids (wheelchairs, walking sticks). • Clear signage indicating bus route/ destination, fare, and other relevant information. • Bell/light activation to inform driver of request to stop.

Reliability: • All advertised accessibility features available and working. • Bus stops in same place every time. • Clear announcement of major stops. • Bus driver and conductor providing helpful service and assistance.	**Affordability:** To the provider: • Retrofit existing buses with low-cost features for ambulant passengers. • Introduce wheelchair access route by route. To the user: • Concessionary fares could be considered.

ECMT (2006) lists various measures to assist ambulant disabled people on buses:

For people with impaired sight:

- Clear marking of the edge of any steps (contrasting band on leading edge of steps);
- Colour contrasted handrails and stanchions;
- Colour contrasted bell pushes;
- Audible announcements (of next stop, terminus, etc.);
- Audible announcements at bus stops of service number/destination of next bus;
- Adequate space in the priority seating for guide dog.

For ambulant disabled people:

- Any interior steps to be between 120 and 200mm and all of the same height (± 10mm);
- Gangway width to be a minimum of 450mm, and preferably 550mm, up to a height of 900mm above the floor, increasing to a width of 550mm at a height of 1400mm above the floor;
- Stanchions/handrails to be at intervals of no more than 1050mm apart down the length of the bus;
- Bell pushes within reach of a seated passenger (1200 to 1400mm above floor);
- Priority seating with a minimum pitch of 650mm; this gives sufficient space for people with stiff legs to get in and out and sit down easily;
- Compulsory kneeling of low-floor vehicles at all stops, as for example, in Munster.

For hearing impaired people:

- Visual display 'bus stopping';
- Visual display of name of next stop.

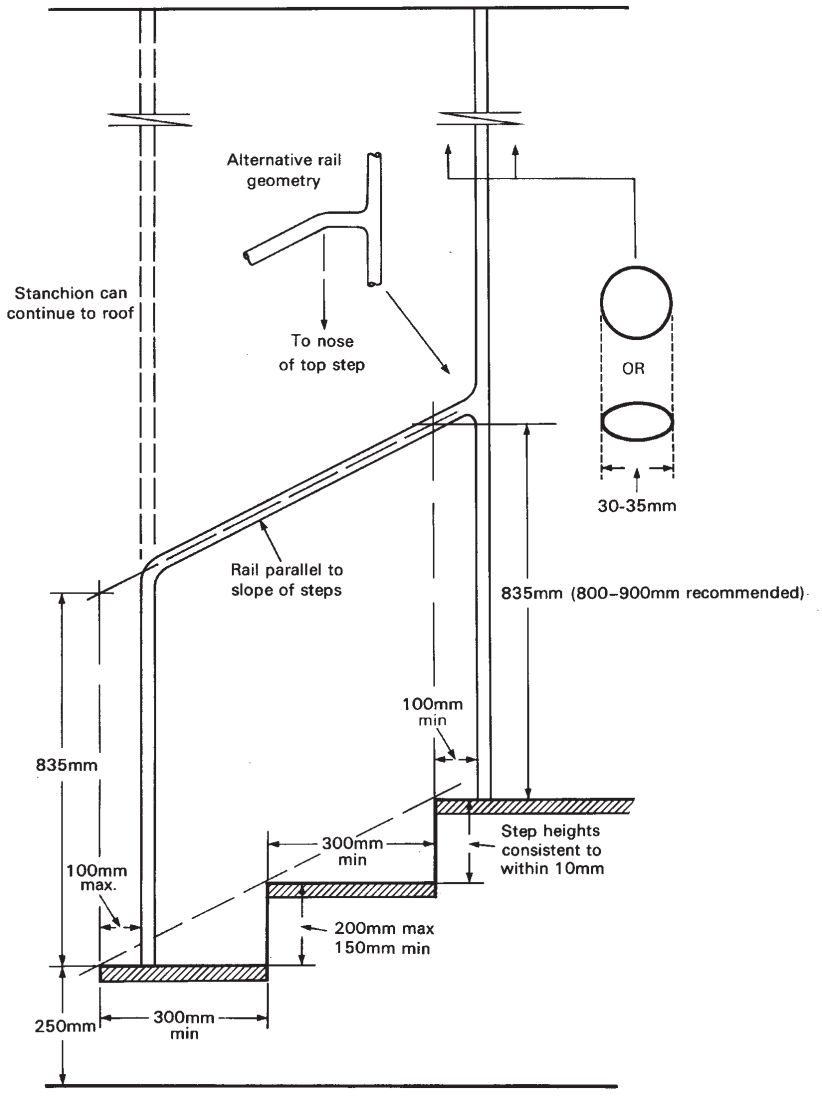
In general, all surfaces should be non-slip and all entrances and exits should be well lit and have appropriately placed handrails.

4.1.1 Best practices – Incremental improvements, but not full wheelchair access

Bus entrance The height and steepness of steps in high-floor buses are often major barriers to users with disabilities. Entrances can be improved through adequate design of steps and the installation of handrails and grab handles.

Specifications for steps vary somewhat between countries, and local circumstances dictate what can be achieved, so a useful starting point is to state what is considered 'ideal' for enabling ambulant disabled people to enter and exit buses easily and safely. Working back from there, one can suggest what is adequate in the short to medium term. The UK's *Disabled Persons Transport Advisory Committee (DPTAC)* has advised on 'ideal' specifications. But the committee acknowledges that many operators cannot meet these standards with existing fleets, so included less-than ideal specifications that may be used during a transition period *(DPTAC, 1996)*. Table 4.1 summarises both the ideal and the transitional specifications for vehicles which are not designed with a low floor. Figure 4.1 illustrates an entrance that complies with the 'ideal' specification.

Figure 4.1: Recommended geometry for bus entrance/exit steps and handrail



Note: *The handrail shown is for the centre of a two-stream entrance. Handrails at the sides of entrances should have the sloping rail and the vertical rail near the outside of the bus. The vertical rail should extend to within 200mm vertically from the first step. Handrail centrelines should be 50mm from bulkheads or doors. On a low-floor bus, there should be a vertical rail near the outside of the bus plus a horizontal rail 800 - 900mm above floor level.*

Source: DPTAC (1988)

Table 4.1: Ideal and transitional specification for bus entrances (no wheelchair access)

Item	Ideal specification	Transitional specification
Maximum first step height	250mm	325mm
Maximum height for subsequent steps	200mm	225mm
Maximum number of steps (total)	3	3
Maximum ground to floor height	650mm	775mm
Minimum depth of steps	300mm (280mm on vehicles less than 2.5m wide).	
Step risers	Vertical, smooth, flat, colour contrast on nose.	
Minimum ceiling height at door	1.8m above first step.	
Entrance width between handrails	min 700mm, max 850mm (single stream) min 530mm, max 850mm (for wider doorways with central handrail). Handrails to start within 100mm from outside edge of first step.	

Source: DPTAC (1996)

Note: The transitional specifications have been superseded in the UK by the Public Service Vehicle Accessibility Regulations 2000.

In the UK, the Public Service Vehicle (PSV) accessibility regulations 2000 require all buses carrying more than 22 passengers to be low-floor. Bus operators, regulators and other stakeholders in developing countries must use their own judgment to select from this range of specifications to suit local conditions.

A low-cost way to lower the distance to the first step without interfering with the need for high clearance of the bus chassis, is to use a foldable step attached to the stairwell. The step is either deployed automatically when the door opens, or manually by the driver.

The aisle should be at least 450mm wide, and preferably 550mm wide, up to a height of 900mm. The width should be 550mm at a height of 1400mm above the floor.

Handrails and stanchions Falling is a major cause of injuries to bus passengers, and fear of falling is a deterrent to bus use among elderly and disabled people, so provision of adequate handrails can be of major assistance. Handrails at the entrance are very important. Handrails are even more necessary when step heights and depths depart from the 'ideal' dimensions of Table 4.1. In fact, handrails can to some extent compensate for the adverse effects of inadequate step design. Entrance handrails should extend as far towards the entering passenger as possible, starting from a point within 100mm from the outside edge of the first step. Handrails are needed

on both sides of the entrance. Folding doors may need to be strongly-built or stiffened to support handrails.

Sloping handrails (parallel to the slope of the steps) are needed in addition to the vertical rail close to the outside of the entrance. Handrails can be fixed to the inside of the door as long as they do not move excessively when the door is open. If possible, handrails should be provided in a continuous path from the entrance at a height of 800 - 900mm, past the driver, to at least one of the priority seats, to help visually impaired and other disabled passengers reach their seats.

Handrails should be round, 30 to 35mm in diameter, and fixed with a minimum clearance of 45mm to the adjacent surface to allow for good grip. Good grip is also promoted by using a non-slip rather than a polished finish.

Inside the bus, vertical handrails or stanchions at every second row of seats are very helpful to passengers moving around or standing. If there are many standing passengers, stanchions could even be provided at virtually every row. The maximum recommended distance between handrails is 1050mm so people can reach from one stanchion to another. Inward facing seats should have one vertical stanchion to every two seats. Many passengers are not able to use hanging straps and ceiling mounted rails.

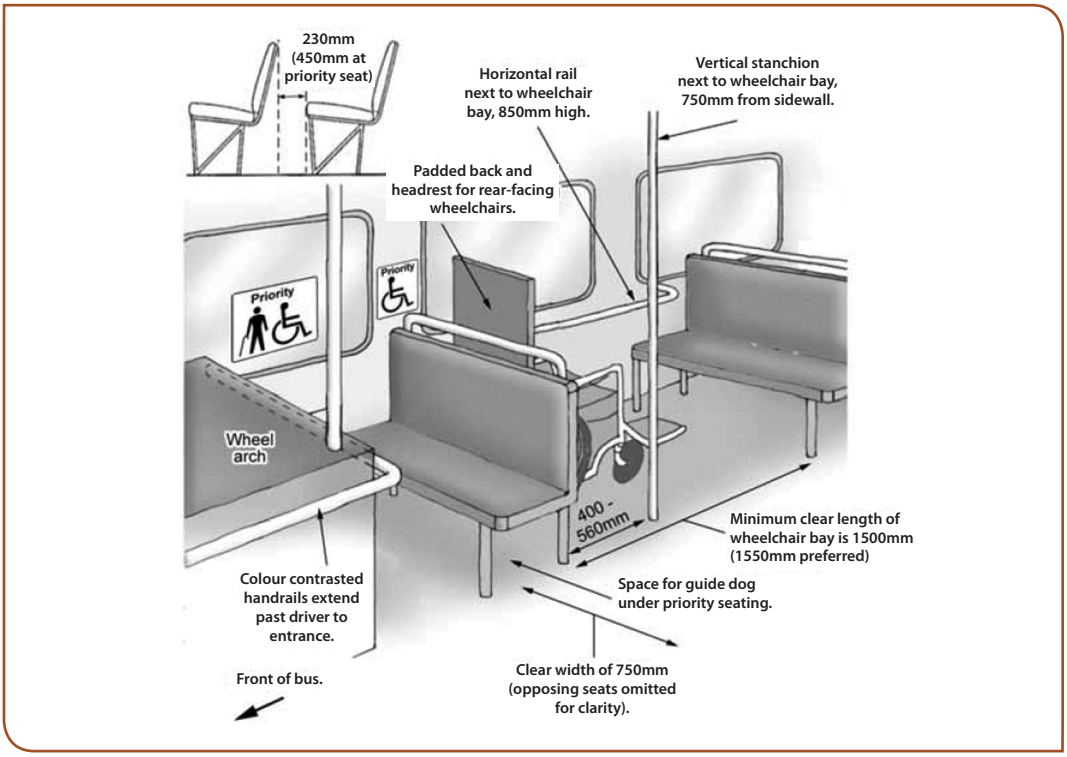
For good visibility, handrails and stanchions should be painted in a colour contrasting with the surroundings, such as bright yellow, orange, or bright green, with bright yellow preferred. The same colour should also be applied to the edges of any steps, the outlines of information sources, fare boxes and bell pushes.

Seats and floor The floor of the bus should preferably be flat and level from the entrance at least to the middle of the bus to make it accessible for wheelchair users. Many passengers feel insecure on sloping surfaces, and would also want to avoid internal steps. If no alternative exists, steps of 150mm to 200mm high or slopes of up to 1:30 (over short distances) are recommended.

To allow the highest number of passengers to travel whilst seated, seats should be at least 450mm wide (per passenger), between 430mm and 460mm high above the floor, and allow at least 230mm standing space (Figure 4.2). Well-spaced seats will help speed up boarding and alighting as passengers can move to and from their seats quickly. If these dimensions cannot be provided throughout the bus, they should at least apply to the first few rows of seats. Handholds on the top of seats are also very useful to help passengers to get up from the seat. It is best practice to reserve two or more seats for elderly and disabled passengers, as many find it impossible or dangerous to stand in a moving vehicle. These seats should have 450mm leg room if possible.

Priority seats Priority seats are especially important in overcrowded buses. These seats should be as close as possible to both the driver and to the entrance/exit, to improve communication with the driver and to minimise the distance walked in the bus. It is best practice in two-entrance buses to allow disabled passengers to board and alight through the front door, even if all other passengers must board through a rear door. Clear signage should identify priority seats. Seats installed on top of the wheel arches are not suitable for most disabled people as they are usually raised further from the floor and subject to higher acceleration forces (discomfort). Priority seats should be either forward or rearward facing, with leg room extended to 450mm, and adequate space should be available under them for a guide dog to lie down if needed.

Figure 4.2: Recommended layout and interior dimensions for buses



Source: Based on DPTAC (1996), DETR (2000) and COST 322

Note: *DPTAC, and some other guidelines, give 1300mm as the lenght of the wheelchair bay. This is sufficient. COST 322 gives 1500mm from backrest.*

Aisles The aisle should be wide enough for all passengers to move freely: a minimum unobstructed width of 450mm is recommended. Directly behind the driver (at least up to the priority seating and wheelchair bay, if there is one) this should be increased to 800mm to assist with passenger circulation.

Bell pushes In buses that stop on request only, bell pushes are needed to signal a request for the next stop, positioned so that they can be reached by seated passengers (1200mm - 1400mm above the floor). This makes it not only much easier for speech and hearing impaired people to use the bus, but also safer for all passengers – and disabled passengers in particular – by not having to leave their seat while the bus is moving. Bell pushes that can be pressed with the palm of the hand are preferable as they assist people with arthritis and rheumatism. However, mechanical systems that are activated by pulling on a cord can also be used if other options are not available. Bell pushes should be available throughout the bus, not more than 1500mm above the floor for standing passengers, but should at least be installed next to priority seats. To reduce anxiety and aid hearing impaired passengers, many bell systems light up a 'STOPPING' sign in the front of the bus when the bus has been requested to stop.

Signage and information Clearly legible destination and route number displays on the outside of the bus are essential for passengers to identify their bus, and helpful for all passengers especially at night. Both the route number (if used) and the destination are most important on the front of the bus (to help identify an approaching vehicle), but displaying the route number on the side (to confirm the information) and the back (to identify it to passengers approaching from that direction, and to confirm whether a bus was missed) is helpful.

Signage should be printed using lower case letters at least 200mm high (for route numbers) or 125mm high (for destinations). White or bright yellow letters against a black background are most clearly visible, especially for visually impaired passengers. Signs should be illuminated at night. Signage is best mounted above the windscreen where it is not hidden by other traffic, but cheaper options such as printed signs fastened to the inside of the windscreen are also possible provided they remain clearly legible.

Driver operation Drivers and conductors can greatly increase the usability of bus services to older and disabled passengers by observing some simple operational guidelines. Accessible design features will not help much if passengers are first required to jump on board a moving vehicle or to cross lanes of moving traffic before boarding. Reliability and predictability of the service is very important to many disabled people including visually and intellectually impaired people. Predictability can be enhanced by consistently stopping the vehicle close to the kerb and next to the bus pole at stops. Drivers should call out major stops, transfer points, or the end of the line, some time before arriving at the stop. This greatly assists visually impaired passengers, for whom the need to identify the correct stop at which to alight is a major barrier. The practice also benefits occasional users and tourists. If no amplification system is available, the announcement should at least be audible in the front of the bus (where prioritised seating should be provided).

Driving behaviour is also very important: a well-driven bus with smooth acceleration and deceleration (i.e. without sudden jerks and hard braking) improves safety and comfort for all passengers. The driver should also wait until all passengers (and specifically frail, older and disabled passengers) are seated before starting to move from a bus stop.

Fare policy Many governments have the practice of subsidising bus travel for disabled people by charging them at reduced fares or no fare at all. While this is undoubtedly helpful to overcome affordability barriers among the poorest of disabled users, the issue of concessionary fare policies should be considered with caution to ensure it does not substitute for other physical or operational improvements to the bus service that could be more cost-effective.

4.1.2 Best practices – Full wheelchair access

ECMT (2006) lists measures to assist wheelchair users on buses as:

- Minimum gangway width from entrance to wheelchair space of 750mm, preferably 800mm or more;
- A wheelchair space, clearly marked as such, with a flat surface without obstacles and with minimum dimensions of 1500mm x 750mm as well as space to manoeuvre*;
- It is safer for the wheelchair passenger to sit with his or her back to the direction of travel; there should be a back rest (300mm wide and from 480 to 1400mm in height) against which the wheelchair can rest, a clear space of 300mm behind the backrest for the large wheels of a manual wheelchair, a horizontal rail at a height of 850 - 1000mm to one side of the space and a bell push within easy reach. On the gangway side there should be a device (for example a stanchion or a movable armrest) to prevent the wheelchair swinging into the guideway **;
- The general consensus is that on low-floor buses in urban areas, there is no need for the wheelchair and occupant to be secured against fore and aft accelerations. (This comment relates to ECMT countries. Poor driver training or bad geography can create problems, and some wheelchair users always need securement due to lack of body strength.)

* *ECMT gives a length for the space of 1300mm, which is insufficient. COST 322 suggests 1500mm. A length of 1550mm is preferred, because wheelchairs are getting longer (Mitchell, 2007)*

** *ECMT recommendation extended to include recommendations from COST 322.*

Boarding for wheelchair users The best way to allow wheelchair users to board buses is through universal design: the use of low-floor buses with boarding ramps, or high-floor buses with raised boarding platforms (such as those used in many bus rapid transit systems). These options also benefit the operator by speeding up boarding and alighting. Achieving universal access requires a systems approach that pays attention to multiple vehicle, infrastructure and operations related aspects. On low-floor buses, the most reliable and lowest cost boarding ramps are those hinged along the outer edge of the floor at the doorway, that lie flat on the floor when not in use (Figure 4.3). These are deployed manually, which requires the driver or conductor to go to the doorway to deploy the ramp.

Other options for overcoming the height difference between the ground and the bus floor include the use of mechanical lifts (deployed either in the main doorway or from a separate doorway), and level boarding from small roadside platforms, using a removable bridge piece to cover the gap. Both of these options are only deployed when needed by a disabled person. Wheelchair lifts are the more expensive option, both to acquire and to maintain, and thus may be less affordable for widespread use in bus fleets. But lift-equipped high-floor vehicles, especially if these vehicles are used on routes that are specially designed to serve persons with disabilities, have been shown to be an effective means of creating accessible transport for some disabled users. They are also appropriate for high-floor long-distance coaches (over the road buses).

Figure 4.3: Low-floor bus entrance, ramp deployed to pavement

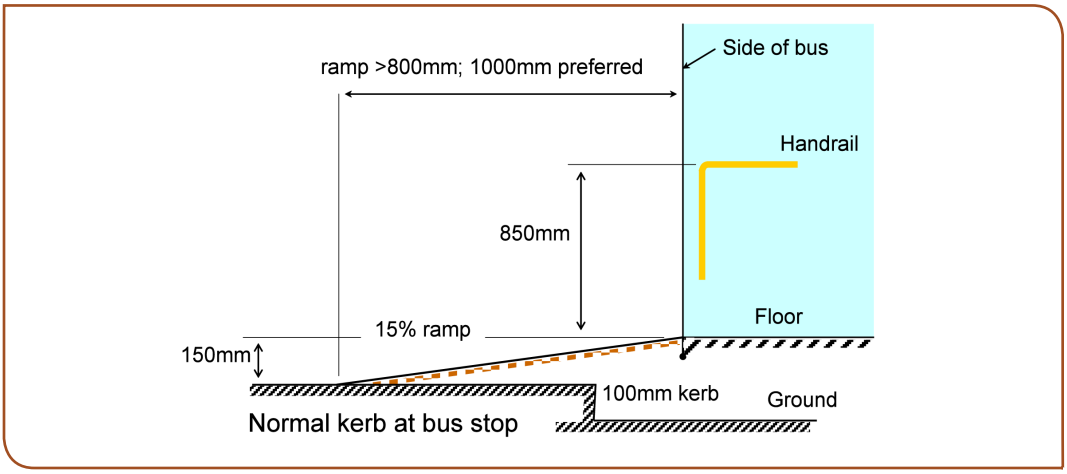
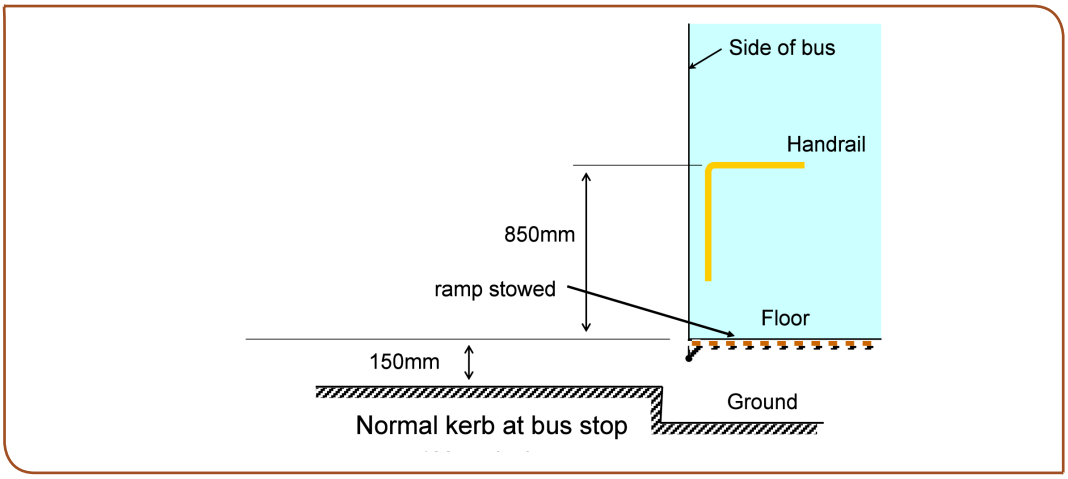


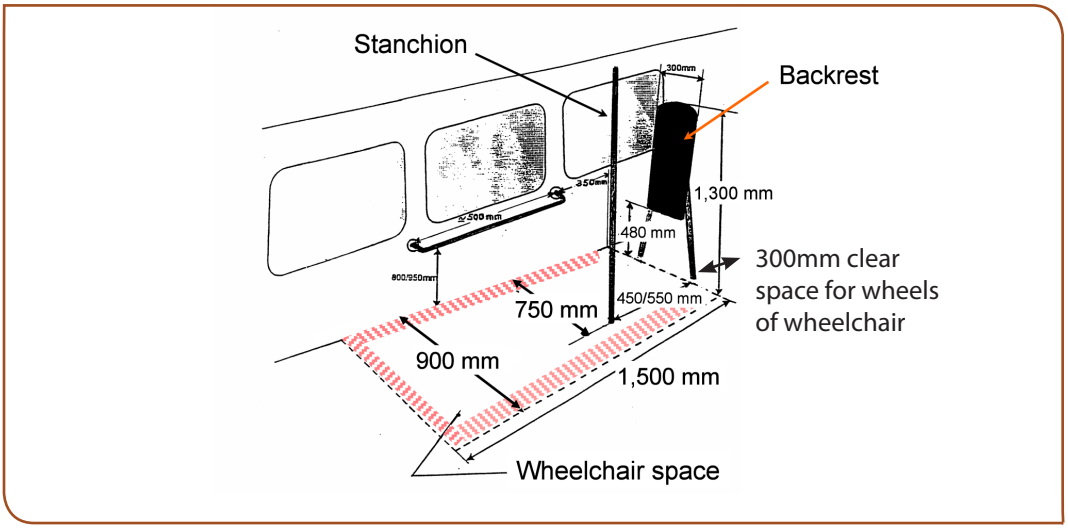
Figure 4.4: Low-floor bus entrance, ramp stowed for ambulant passengers



Where wheelchair lifts are used they must have a safe working load of 300kg and be at least 750mm wide and 1250mm long when deployed. Guardrails are needed along the sides and roll stops at least 100mm high are needed to provide security for a passenger using a wheelchair.

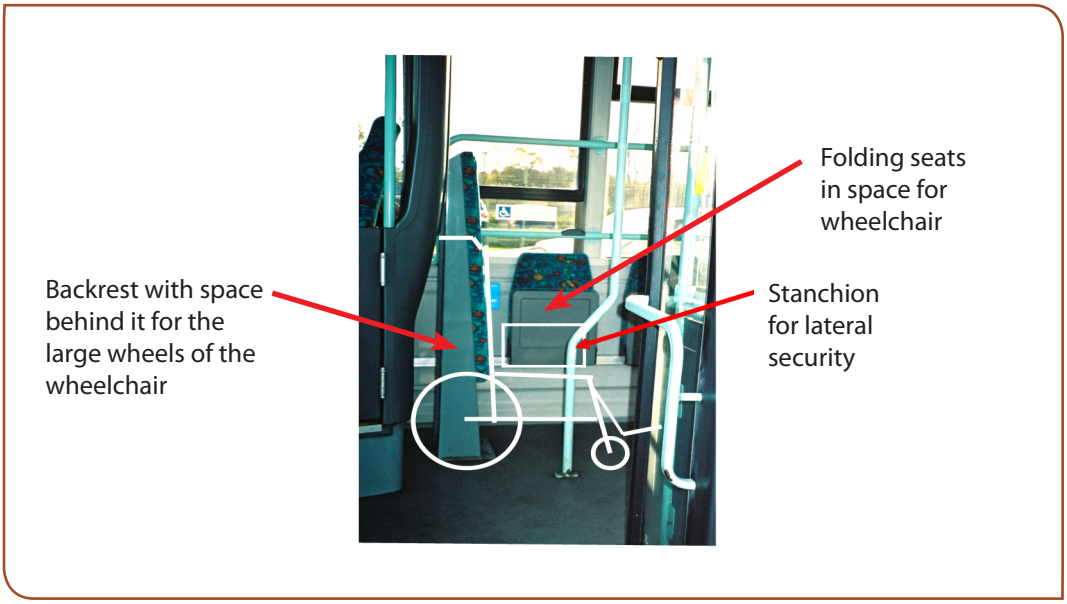
Wheelchair space If wheelchair users can enter the bus without leaving their chair, there should also be a space inside the bus for them to travel in their wheelchair. The number of wheelchair bays required will depend on the demand for them; in Europe and North America up to two spaces are provided in city buses. Doorways should be 850mm wide to allow a wheelchair through. A clear width of 750mm from the doorway to the wheelchair bay should be provided, passing between the wheel arches if necessary. Wheelchair users can travel either facing forward or backwards, but not sideways, as a side-facing wheelchair can tip over more easily in case of sudden braking. The recommended dimensions for a wheelchair space are shown in Figure 4.5. The length of the space of 1500mm is important; a number of guidelines recommend a length of 1300mm, which is not sufficient.

Figure 4.5: COST 322 recommendation for a wheelchair space



Rearward facing wheelchair spaces should be located such that a user can back against a head and back restraint that can support the passenger in the event of an accident. A vertical pole or folding armrest on the aisle side of the wheelchair space prevents the chair moving sideways on corners, and a horizontal handrail on the side of the vehicle helps wheelchair users to steady themselves. A lap seatbelt can be used instead of the vertical pole or folding armrest. The backrest should be no wider than 300mm, and should have a clear distance of 300mm behind it at floor level, to allow the large wheels of a manual wheelchair to fit either side of the backrest and not encounter any obstruction when the passenger in a wheelchair is positioned firmly against the backrest (see Figure 4.6).

Figure 4.6: Backrest for passenger in a wheelchair – Airport bus, Belfast, Northern Ireland



Rearward facing wheelchairs are not usually secured to the floor with extra tie-downs. This practice is limited to larger buses in fixed route service in urban areas and depends also on an assurance that they are driven safely by well-trained drivers. In buses that travel at higher speeds, forward facing wheelchair spaces should be used, and should be anchored to the vehicle using tie-downs for safety. Wheelchair tie-downs should also be used for all wheelchairs in minibuses.

Experience has shown that providing a wheelchair space does not decrease the capacity of the bus, as the space can be used by standing passengers if no wheelchair user is present. Alternatively, side-facing hinged seats can be installed that can be folded away when the space is needed by a wheelchair user. The wheelchair space should be clearly marked as such and give wheelchair users priority.

WHERE TO START?

The most inexpensive way to incorporate best practice features into buses is to include them as specifications when new vehicles are ordered. Bus manufacturers should be able to include at least adequate handrails and stanchions, correctly designed route number and/or destination display, colour contrasted step noses and handrails, bell pushes, and a well-designed priority seating area at marginal cost. Every effort should also be made to improve the design of entrances and steps to better serve all ambulant passengers, especially with regard to steepness and the height of steps.

But operators can install very useful features even on existing vehicles, at low incremental cost. The features mentioned above can improve the ability of many ambulant disabled people to travel by bus, even if the bus still has a very high floor. As a starting point, the features above could be concentrated around the front entrance/exit door, extending only as far as the priority seating area behind the driver – this will not serve all passengers, but at least target those who

could benefit most. As a measure to overcome overcrowding that is endemic on many bus systems, the reserving of priority seats and the use of a priority entrance by disabled and older passengers can be considered.

Improving operating practices is another low-cost intervention – but it will need some retraining and supervision of drivers and conductors. Practices such as the calling out of major stops, consistently drawing up close to kerbs (where possible), considerate driving habits, and generally cultivating awareness of the needs of passengers with disabilities, will work best in the context of a general improvement in customer orientation in bus services.

Full access, including for wheelchair users, can incrementally be achieved through a combination of better bus design, on-board equipment, and infrastructure upgrading. Whichever options are appropriate for wheelchair access, these could first be deployed along major corridors (or accessible networks) with the highest potential for serving people with disabilities, and later extended as funds allow. This would allow time to ensure that bus stops and the infrastructure surrounding them also do not present barriers to wheelchair users. Making one route fully accessible is preferable to having every second or third bus being accessible on a variety of routes. Disabled persons may take a few months to become accustomed to accessible public transport and, as with all passengers, reliability is needed in order for passengers to gain confidence in the service and for usage to grow.

4.2 Design and operation of mini- and midi-buses

Public transport services are increasingly provided by informal public transport operators who operate midibuses, minibuses, and other informal vehicles. A defining characteristic of these services is that they are typically provided by a large number of individual owners or operators who hire/rent the vehicles on a daily basis and hence have to guarantee the daily income to the owners before generating income for themselves. The vehicles operate on relatively flexible routes and schedules, and authorities often have very little regulatory control over them.

While some vehicles have relatively low floors and are easy to enter and exit, others are harder to board or alight due to an absence of steps, handrails and narrow doors. Major problems exist around the way they are operated – fiercely competitive operating conditions often leads to overloading and to a refusal to stop for disabled people due to a perception that they will prolong boarding time, and to speeding and unsafe driving habits. However, the informal nature of this mode also means that some drivers are willing to go out of their way to serve passengers with particular needs, especially if they have built up a relationship with them.

It is precisely the informal nature of mini/midibus operations that makes them difficult to improve–vehicles are often second-hand and governments in practice have little control over their specifications. If government is involved as a provider of infrastructure to the industry (such as stopping points and ranks), some access improvements along the lines of those described in Section 4.1 can be helpful to passengers. But the only way improvements can be made to the accessibility of vehicles – either through government-sponsored renewal of fleets, or incrementally as vehicles are slowly replaced – is government establishing stronger regulation and formalisation of the industry, both in terms of vehicle standards and of operating practices. Only then will it be possible to address accessibility issues in small vehicles. The guidelines in this section are likely to be useful in situations where progress is being made with formalising the industry so that providing a better service becomes a priority for operators.

BASIC PRINCIPLES

Safety: • Unobstructed space for wheelchair users to travel in their chairs (if possible). • Wheelchairs should be restrained where possible. • Smooth driving and braking to avoid injury. • No hazards or sharp edges that could injure passengers. • Single width ramp preferred to help wheelchair users board.	**Accessibility:** • Easy and unhindered boarding via steps. • Boarding devices should be available if wheelchair spaces are available. • Handrails and steps highly visible. • Priority seats near entrance available for disabled passengers. • Easy stowage of mobility aids (wheelchairs, walking sticks). • Clear signage indicating route/ destination and fare.
Reliability: • Drivers consistently stop to pick up disabled passengers. • Drivers and helpers providing helpful service and assistance. • Clear announcement of stops requested by passengers.	**Affordability:** To the provider: • Include low-cost access features as requirements in concession agreements (where relevant). To the user: • Prohibit extra charges for carrying wheelchairs and other aids.

BEST PRACTICES

Vehicle entrance/exit To provide easy entrance for ambulant passengers, the entrance to all vehicles (regardless of their size) should follow best practice guidelines. These include:

- Door width at least 800mm between handrails;
- Steps at least 400mm wide, 280mm deep; the first step no more than 250mm above ground level, other steps 200mm high;
- Handrails provided on both sides of the entrance, reachable from ground level all the way to the inside of the vehicle;
- Step edges (noses), handrails and top of door opening painted in a bright contrasting colour.

If wheelchairs are being accommodated these dimensions should be increased in accordance with the guidelines given for buses (as set out in Section 4.1).

Seating Seating should provide sufficient space for people with walking difficulties to manoeuvre easily. Standing space of at least 230mm (300mm for priority seats), and seats about 450mm wide are required to achieve this (see Figure 4.2). If these dimensions can be achieved in only one place (such as the seats directly behind the driver), a sign should indicate that these are priority seats for older and disabled passengers. Mini- and midi-buses are not usually fitted with seatbelts (besides the driver), but where these can be installed (for instance at priority seats) it will improve the safety and comfort for disabled passengers.

Access for wheelchair users Wheelchair access into existing minibuses is problematic due to the

narrow doors, low roof heights and the limited internal manoeuvring space typical of these small vehicles. The high costs of converting vehicles are therefore likely to limit wheelchair access to special programmes using specially designed and subsidised vehicles.

Midi-buses with floor heights not exceeding 500mm may however be large enough to provide direct access for wheelchair users via a short ramp. The South African Federal Council on Disability has, for instance, recommended that new midi-buses to be used in taxi services provide portable ramps at a gradient of 1:4, but this steepness requires an assistant to push the wheelchair user into the vehicle (SAFCD, 2001). The 2m-long ramp has to be stowed safely inside the vehicle. Since these vehicles are custom-designed for public transport services, sufficient interior space can be provided for a wheelchair user, in combination with a foldable seat. The wheelchair space dimensions given for buses (see Figure 4.5) can be modified in consultation with local users to ensure the majority can use it.

A passenger lift can also be fitted to a separate entrance to facilitate boarding. The lift should have a load bearing capacity of 300kg and a platform size of at least 750mm wide and 1250mm long. Colour contrasted handrails on both sides and a 100mm sill should be available.

Even if floor space or height constraints preclude the provision of wheelchair access, it may still be possible for a passenger to transfer to a regular seat with help. Vehicles should at least have space for a folded wheelchair to be stowed safely. Ideally, appropriate wheelchair and passenger restraints (where seatbelts are provided) should be used as described in Section 4.1.2.

Signage Clear and legible signage is important for all passengers to identify the correct vehicle to board or hail. Route numbers or destinations should be prominently displayed on vehicles. The use of colour coding to indicate different routes or different origin and destination points has worked well in South Africa and helps not only some low-vision passengers but also people who are illiterate or unfamiliar with the system.

Communication Communication inside the vehicle between passengers and drivers/assistants is critical, as the vehicle typically only stops when requested or hailed by a waiting passenger. The small size of the vehicle usually aids easy communication between passenger and driver. But for visually impaired people it is difficult to identify when they are approaching their desired location, while hearing and speech impaired people find it hard to communicate their desire to stop. These problems may be partly addressed by installing a bell push centrally in the vehicle, and by training drivers to proactively ask visually impaired people for their destination when they enter the vehicle, and to announce when they are nearing the destination.

Operating practices Authorities can combat unfair discrimination and reduce cost for disabled people by prohibiting minibus drivers from charging extra for the carriage of wheelchairs, walking frames or other equipment needed for personal mobility. It is important for drivers to be courteous and aware of the needs of people with disabilities – more so perhaps than with formal systems, because operating practices are less formalised and therefore depend more on the judgment and attitude of the driver. This can be achieved by instilling greater awareness through training (see Section 7), monitoring, incentives and contracting arrangements. An effective enforcement mechanism may be to advertise a telephone number for passengers to lodge complaints or compliments, with effective feedback to drivers through incentives or criticisms.

WHERE TO START?

The first step towards improving safety and accessibility for all passengers on informal services, including those with disabilities, is to start fostering greater accountability within the industry. This requires coordinated approaches to creating partnerships with government, formalising

routes and services, stabilising operating conditions, stepping up enforcement, and empowering customers. As with larger capacity buses, the retrofitting of existing vehicles with low-cost features such as handrails, adequate signage and colour contrasting can benefit many passengers and should be pursued if circumstances allow. But in practice opportunities for such interventions are severely limited by operators' financial inability to invest in vehicles they do not own.

More effective ways of improving vehicle standards are for government regulators to require higher standards of new vehicles used for public transport services. This can also be undertaken in an incremental manner, starting with some of the low-cost features described above to assist ambulant passengers, and incorporating wheelchair access in some portion of the fleet. In some cases governments have become involved in subsidising the replacement of vehicles, and using this opportunity to specify significantly higher standards for access. Whether vehicle design is improved incrementally or through large-scale government-sponsored replacement programmes, it is important that the operating practices of drivers be addressed through adequate training and monitoring.

4.3 Specialised transport services

Specialised services refer to transport services that are specifically tailored to the needs of passengers with disabilities. Specialised services usually use vehicles that provide full access to wheelchair users through mechanical lifts or ramps, and differ from regular public transport in the way they are operated. Services range from door-to-door services that exclusively serve disabled people, to 'Service Routes' (which serve the general public but are specifically routed to travel close to the origins and destinations of elderly and disabled people). Accessible (metered) taxis, although not a specialised service, are also used to provide kerb-to-kerb services for disabled people. The use of specialised transport services acknowledges that regular public transport cannot serve the needs of all disabled people: for example, many are unable to walk to, board, or travel independently in public transport vehicles due to the severity of their impairments. On a per passenger basis, specialised transport services are usually more expensive to provide than accessible regular public transport, and such services are often funded publicly to complement conventional public transport.

ECMT (2006) comments that "it is possible that the role of specialised services will diminish as more of the mainstream services become fully accessible, but it is probable that in some areas and some circumstances they will remain as a useful means of providing a better level of service to disabled passengers than can be achieved by conventional means. Certainly there is evidence that these services improve the mobility of many disabled people."

This is to be encouraged, both on grounds of equality of opportunity and of cost, since special services are almost always much more expensive to operate per passenger carried than mainstream transport. However, for some disabled people on some occasions – and for more severely disabled people – most of the time, the extra care that can be provided by special services will remain essential.

The variety of special services is almost infinite, but they can be categorised to some extent.

Demand-responsive: individual transport

This is the group of services that provide transport for an individual (plus companion) door-to-door. They fall into two categories; voluntary car schemes and accessible taxi schemes.

Voluntary car schemes, in which the passenger is carried in a volunteer's own car, are quite

widely used for taking people to out-patient treatment at hospitals. The volunteer will usually be paid a mileage allowance to cover running costs of the vehicle, while the service is free to the user. Such services can be very useful in rural areas where conventional modes of transport, accessible or otherwise, may be thin on the ground. These services, since they rely on the cars owned by volunteers are not appropriate for wheelchair users who cannot transfer from their chair to a car seat, though quite a lot of wheelchair users can transfer and so use ordinary cars. Some community transport services also provide a car service with a vehicle adapted to carry a passenger in his wheelchair.

Accessible taxis can, of course, be used by any disabled person provided they can afford the fare. For many disabled people, the fares are more than they can afford. To help overcome this problem various schemes have been introduced to make taxis available to disabled people at a heavily subsidised rate.

This type of service is frequently found in Scandinavian countries, especially Sweden, and in the UK. To be fully effective, the service should be provided by fully accessible taxis. In the UK this is normally done with accessible purpose built ("London") cabs, elsewhere multi-purpose vehicles or minibus taxis are used. It is important that the taxi driver has had disability awareness training.

Providing a service of this kind can be expensive for the funding authority (local and/or central government) so it is important to try and ensure that the people using it really do need it. Some form of eligibility criteria should be used and even then it is very likely that it will be necessary to impose an upper limit on the number of trips any one individual can make in a given time.

There is evidence to suggest that an accessible taxi-based service for disabled people can be more cost-effective than a shared-ride demand-responsive minibus service. In planning and developing these types of service, it would be prudent to consider all the forms and systems; the most effective, in terms of use of resources and delivery of a good level of service to the individual, may be found by a combination of services rather than just one.

Demand-responsive: shared transport

Often known as Dial-a-ride or Dial-a-bus, this service also provides door-to-door service, using minibuses which should be equipped to carry passengers in wheelchairs. They are booked in the same way as taxis – by telephone or possibly by regular ("standing") order – and the theory is that the control office for the service will be able to organise the requests for trips in such a way that more than one individual is carried at the same time. This shared ride concept, if it could be achieved, would reduce the cost per passenger carried, in theory to less than the cost of an equivalent taxi journey.

In practice this often does not happen, with the result that the cost per passenger trip is higher than the equivalent taxi trip. However, taxi drivers cannot be expected to exercise the level of special care and assistance needed by some disabled people. Dial-a-ride drivers will not only assist passengers from their door to the vehicle, but may also help them to finish dressing. They may, for example in Copenhagen, carry special equipment to enable a wheelchair passenger to negotiate a flight of stairs. It is this level of necessary extra care which, as accessible taxis become more commonplace, should be used to determine whether Dial-a-ride is appropriate, and if so who should be eligible to use it.

Community transport and shared transport services

This is the category of services, again usually using lift-equipped minibuses, which provide collective transport for disabled people. They will provide a service from an individual's home to a facility such as a day centre or luncheon club or to an accessible town centre for shopping. The

essential difference between these services and the ones described above is that they do not cater for individual requests for a journey, but take individuals to a collective or joint activity.

Community transport services are usually funded, at least in part, by local government and are available for use by a wide range of people, not just disabled or elderly. It is their general availability which distinguishes them from the host of transport services provided by disability associations for the use of their own members.

Although these services are specific in the sense that they are provided by and for the members of a specific association, they nevertheless represent a transport resource which may not always be used in the most effective way. When considering the planning and provision of special services, it is always sensible to include these "disability association" services in the planning process.

Hybrid services

Between the special services, of the types described above, and mainstream public transport services, there is scope for services which, while not being exclusively designed for disabled people, nonetheless offer a level of service beyond that normally associated with conventional public transport.

Probably the most widely-known example of this is the Swedish 'Service Route' system, but there are other examples such as London Transport's Mobility Bus. These services are designed to overcome the problems older and disabled people have in using accessible mainstream bus services, which are walking to and from bus stops, waiting at a stop, moving quickly to board and pay a fare, moving quickly to alight and possibly having to stand during a journey. The attributes of the Service Route class of service can be summarised as:

- Use a fully accessible buses, usually medium-size;
- Time tabling of the service which allows more time at stops than on a conventional service;
- Routing of the service to serve places where there will be numbers of disabled passengers – residential homes, clinics, day centres, etc. This reduces walking distances to and from stops, at the expense of a more tortuous route and a slower journey;
- Flexible pick-up/set down points – hail stop where appropriate and possibly a degree of route diversion;
- Well trained drivers (and other staff).

It is possible that the role of this kind of service will diminish as more of the mainstream services become fully accessible, but it is probable that in some areas and circumstances they will remain as a useful means of providing a better level of service to disabled passengers than can be achieved by conventional means. Certainly there is evidence that these services improve the mobility of many disabled people.

Another aspect of special services is their integration into mainstream transport. The Mobinet system in the Dutch town of Voorst is an example, using wheelchair accessible minivans as shuttles to regular public transport services. Door-to-door service is available to anyone who wants it, but people who are not disabled pay a premium fare for it.

This section does not deal primarily with the design of vehicles used in specialised services, as the same best practice discussed in Sections 4.1 and 4.2 applies. The emphasis in this section is more on the operation and planning of specialised services.

Safety: • Vehicle design and features are safe to avoid injury. • Lifting equipment and ramps designed and operated safely to avoid injury. • Vehicles driven smoothly and considerately.	**Accessibility:** • Easy and unhindered boarding via steps (if any). • Level boarding for wheelchair users into vehicles. • Hand grips and steps highly visible. • Easy stowage of mobility aids (wheelchairs, guide dogs, walkers). • Signage identifying vehicles and specialised service. • Call-in telephone service for reservations or queries (if any) with text telephone/ TDD • Alternatives to telephonic booking for non-telephone owners.
Reliability: • All advertised accessibility features available and working. • Driver/staff provide helpful service and special assistance where needed.	**Affordability:** • Affordable fare for targeted passengers with disabilities.

4.3.1 Best practices – Door-to-door services

Choice of vehicle Current door-to-door services typically use small vehicles (mini- or midi-buses) as they are cheaper to operate (especially if a ramp can be used for wheelchair access rather than mechanical lift). Small buses may also be better able to negotiate narrow lanes and poorly maintained roads in residential areas where regular public transport vehicles do not operate. In some parts of the world volunteer drivers carry disabled passengers in their own car. Such services can be very useful in low density areas where conventional public transport is scarce, but since regular private vehicles are used they can only serve ambulant passengers and wheelchair users who are able to transfer to a car seat.

Choice of operator Many door-to-door services in the United States are contracted out to private operators, many of whom are taxi companies using regular taxis and wheelchair accessible taxis or vans to provide the service in urban areas. Contracting out of the service typically results in lower costs to the subsidising agency, as taxi operators frequently achieve very low profit margins but nonetheless provide an efficient service (TRB, 1998a). The use of taxis especially in urban areas takes advantage of the inherent efficiency of the taxi system in high demand areas using vehicles with lower capital costs and operating costs than other vehicle types that could provide such a service.

Trip reservation Reservations for door-to-door services are typically made by telephone, between two days and a few hours in advance of the trip. This gives the operator enough time to assign each trip to a vehicle. Telephone reservation does, however, require passengers to have access to a telephone. If access is a concern it becomes more important to work with social service organisations and social workers in the area to ensure reservations can be made through alternative means.

Eligibility Passengers are usually required to pre-register for using door-to-door services in order to make sure that only eligible people use it. Best practice in eligibility certification uses face-to-face contact with potential users to determine if they are eligible for specialised services (for instance if they are functionally unable to use regular public transport) (TRB, 1998b). This is considered a better approach than simply screening people on the basis of the type of their disability.

Vehicle scheduling Thought needs to be given to good scheduling of vehicles, to ensure vehicles carry as many passengers as possible on each trip, without making passengers wait too long. If stops are 'clustered' in the same neighbourhood or corridor rather than scattered over a large area, more passengers will be carried at a lower cost per trip, making the service more cost effective. Although software is available for automating the scheduling exercise, simple manual scheduling techniques undertaken by a person well familiar with the area, have been shown to be adequate for systems with less than about 25 vehicles.

4.3.2 Best practices – Service Routes

Service Routes are designed to overcome the problems older and disabled people have in using accessible mainstream bus services, which are walking to and from bus stops, waiting at a stop, moving quickly to board and pay a fare, moving quickly to alight and possibly having to stand during a journey.

Choice of vehicle Service Routes are usually operated by medium- or full-size vehicles with higher capacities than door-to-door services. Vehicles are fully accessible, almost always low-floor.

Route planning and schedule Service Routes operate along fixed routes which are specifically chosen to connect origins and destinations frequently used by older and disabled passengers. Thus routes may run past retirement homes, home-care facilities, medical facilities, social service facilities, and shopping areas. They maximise access to various destinations by minimising walking distances to and from bus stops. Typically, this comes at the cost of increased travel time as routes are more circuitous.

Service Routes also often have more flexible pick-up/alighting points, including stop-on-demand (instead of only at designated bus stops) and possible route deviation. With route deviation services it is possible to deviate slightly from the core route on request. The timetable usually allows more time at stops than on conventional services. Staff are specially trained to take account of the needs of elderly and disabled passengers. Both service routes and door-to-door services can be used to provide a feeder service to accessible bus routes or railroad stations.

4.3.3 Best practices – General

Fares Door-to-door services typically charge between one and two times the fare for an equivalent trip by public transport. As with other accessible services, specialised services should be priced to ensure that disabled people, many of whom have very low incomes, can afford to use them. This often requires subsidies from government, as the services are more expensive to provide than general use-services. The eligibility process can be used to ensure that subsidies are targeted at those who really need them because they cannot access any other transport services.

Operating rules Restricted capacity usually forces Dial-a-ride services to limit eligibility for the service to people with disabilities. However, if extra capacity exists the service can be marketed to other potential passengers to become more cost effective whilst providing a service in an

increasingly integrated setting. A premium fare could be charged to non disabled passengers to increase revenues and ensure the sustainability of the service. Service Routes are usually not limited by capacity in this way, and are available to any passenger on a 'turn up and go' basis.

Training Drivers and assistants on door-to-door services and Service Routes should be trained to provide a high quality service to disabled passengers. Assistance should be given during boarding and alighting and in ensuring that wheelchairs are secure and that their occupants are safe to travel.

WHERE TO START?

Providing subsidised door-to-door services should be considered if funding can be raised. Specialised services for disabled people is the most common first step to serve people who are excluded from using other forms of transport, especially wheelchair users who do not have access to private vehicles. Door-to-door services can often be initiated more quickly than upgrading bus and rail services. Door-to-door services do not rely as much on accessible footways and other infrastructure as do bus and rail services. One approach that has been used successfully is to initially restrict the areas served by door-to-door services to a limited part of the city. Productivity can also be enhanced by choosing areas with higher concentrations of persons who are likely to require the service, and by designing the service as a 'many-to-one' (serving many individual locations at the residential end of trips, but only one or a few at the town centre end of the trip).

Service Routes are also more expensive than regular bus and rail transport, though not as expensive on a per passenger basis as door-to-door services. This may be an approach particularly suited as an interim solution in developing countries where accessibility of the mainstream public transport system is poor. Starting by funding well-designed Service Routes may ensure that funds are spent where they can best be used in terms of transporting passengers who cannot use other modes. But Service Routes alone are usually not sufficient, and as a second stage the rest of the transport system should be upgraded and made accessible. In the long run this will serve the most passengers (disabled and other) at minimum cost.

4.4 Design and operation of rail vehicles

This section deals with the design and operation of heavy rail vehicles operated in some cities of the developing world, including those used in providing urban, suburban, and metro/underground services. Many of the guidelines provided here – as well as those on rail infrastructure in Section 5, can also be applied to other variations of rail transport, such as light rail and trams.

ECMT (2006) comments that many of the design requirements for heavy rail are similar to those for light rail, but because some journeys made on heavy rail will be long, there are some additional requirements. Perhaps the most important of these, aside from providing adequate space in carriages for wheelchair passengers, are accessible toilets. These should be located close to the wheelchair position (and to any priority seating) and should be designed for ease of use by all disabled passengers.

As with buses, provided the design of access features on trains are based on the principles of universal and inclusive design, they should make travel easier for all passengers.

Thought should be given to the approach to the toilet as well as the interior layout and facilities,

to make sure that there is sufficient space for a wheelchair to manoeuvre to and into the toilet. The Helios report noted that the accessible toilets on Austrian inter-city trains were a little difficult for a wheelchair user to negotiate because of a narrow corridor (1080mm) and poorly positioned seating in the approach area to the toilet.

There are various ways of designing the layout of an accessible toilet, but the following items and standards should be followed:

- The doorway into the toilet cubicle should be at least 900mm wide;
- There should be sufficient space inside for a wheelchair to be positioned in front of the lavatory or to one side of it so that it is possible for a disabled person to move from wheelchair to the lavatory seat from the front or the side;
- The surface of the lavatory seat when lowered should be not less than 475mm and not more than 485mm above floor level;
- The toilet cubicle should have facilities to enable a person in a wheelchair to wash and dry his or her hands without moving from the seat of the lavatory;
- There should be two control devices to enable a disabled person to communicate in an emergency with train staff, one placed no more than 450mm above the floor, the other placed between 800 and 1200mm above the floor;
- There must be adequate hand holds and handrails, including a hinged handrail at the side of the lavatory where the wheelchair space is.

Further information on access to rail services is contained in the proceedings of COST 335 which include a section on rail rolling stock design. Many countries have set national standards for access to their heavy rail services and related infrastructure.

Light rail or light rapid transit represents a spectrum of systems from trams to a half-way house between tram and traditional heavy rail. It is often built to the same gauge as heavy rail but with lighter vehicles and relatively more frequent stops. The majority of these systems are comparatively recent and generally provide good levels of access for all disabled people including wheelchair users. As they are usually built with dedicated infrastructure (boarding platforms) there is no reason why they should not permit direct access for wheelchair passengers without the need to use a ramp.

Aside from the question of access, other requirements for the design of trams and light rail are really similar to those for buses: adequate gangway widths, space allocated for wheelchair passengers, colour contrasted handrails and step edges, audible and visual information and so on.

Some tram and light rail vehicles (and some buses) have press-buttons on the outside of vehicles which, when pressed, open the doors. These should be placed no more than 1300mm above the platform, raised from the surrounding area and should be illuminated. They should be big enough to be pressed by the palm (i.e. about 20mm in diameter).

As trams have a longer operational life than buses, it may be worth considering modifying existing high-floor vehicles with a central low-floor section. This has been done in several places in Germany, giving vehicles a low floor over 15 to 30% of their length, so that disabled passengers can board and alight at least through one door. Another way of achieving access more quickly is to construct low-floor trailer trams which can be coupled to high-floor existing power cars, as is being done in Berlin.

BASIC PRINCIPLES

Safety: • Unobstructed space for wheelchair users to travel safely. • Smooth acceleration and braking deceleration to avoid injury. • Personal security enhanced through good lighting and surveillance. • Ramps should preferably be single width.	**Accessibility:** • Level boarding for wheelchair users into train or boarding devices should be provided (e.g. lift or ramp). • Easy and unhindered boarding via steps (if any). • Handrails/handholds, steps and hazards highly visible. • Priority seats near entrance available for disabled passengers. • Easy stowage of mobility aids (wheelchairs, walking sticks). • Clear signage indicating train or tram route and destination.
Reliability: • All advertising accessibility features available and working. • Train (or at least accessible carriage) stops in same place every time. • Clear announcement of stations or stops being approached. • On board staff providing helpful service and assistance.	**Affordability:** To the provider: • Start by implementing low-cost features on designated carriages. To the user: • Concessionary fares could be considered.

BEST PRACTICES

Boarding for wheelchair users Providing direct and level boarding for wheelchair users and others is best practice if the platform and train floor are at the same height. A temporary approach is to construct a local raised platform where carriages that accommodate wheelchair users stop, or provide a portable ramp.

Figure 4.7: A locally raised platform – Toronto, Canada

An unobstructed door width of at least 800mm is needed to allow entry to wheelchair users – in some systems a vertical pole in the doorway prevents this clear entry width. A maximum horizontal gap of 50mm between the platform and the car floor is recommended. This is almost certainly not achievable in older systems, or when the train station is built on a curve in the line, but it should be considered an ideal.

An alternative to level boarding is the use of portable hand-operated lifts. This is a cost-effective option as only one is required per platform, and it can be wheeled to the desired boarding point when required. Train-mounted lifts, a more expensive option, are also increasingly used, but these require careful design to fit within the specific train car dimensions. For small height differences, a ramp (preferably single width) can also be used, ideally with a maximum gradient of 8% (1 in 12).

Figure 4.8: A portable ramp ready for use – Great Britain

Train doors should open automatically or when the passenger presses a button on the outside or inside. On the outside the button should be mounted less than 1300mm above the floor, raised from the surrounding area by at least 3mm and it should be big enough to be pressed by the palm (about 20mm in diameter).

Boarding using steps The design of steps and stairs, to ensure they can be used by the largest number of ambulant people, should follow the guidelines given for buses (section 4.1.1 and Figure 4.1). This includes the use of handrails and colour contrasting, both of which are very important.

Layout of carriage Guidelines for the interior layout of rail carriages are similar to those for buses: adequate passageway widths, space allocated for one or two wheelchair passengers, priority seating near entrances/exits, and colour contrasted handrails and step edges. Wheelchair spaces should be located close to the entrance, require a clear length of 1500mm (some guidelines including COST 335 recommend 1300mm, which is not sufficient) and could be facing forward or backward. Typically no restraint is provided other than the wheelchair brakes. Wheelchair spaces may be usable by other passengers when no wheelchair is present, such as those with luggage, wheeled walkers and trolleys, bicycles, or seated passengers (if hinged seats are installed).

Entry and exit from overcrowded trains can be difficult for disabled passengers. It is the practice in some systems to reserve one carriage or one section of a carriage for disabled people. This practice does raise security concerns due to the isolation of some passengers from the watchful eye of others; therefore, it is best to locate the reserved carriage next to the driver or conductor's cabin. Where possible, facilities for disabled people, in particular people with ambulant disabilities, should be available in all carriages.

Signage If a station serves more than one train line, the name of the line or the destination of the train should be displayed on the front of each train. Best practice guidelines regarding signage discussed in Section 6 should be followed. Line or destination information should be repeated on the side of the carriages next to doors, in case passengers missed the sign on the front. Inside the carriage, diagrams indicating major stops served on a line can be very helpful to hearing impaired passengers and tourists.

Communication On-board announcement of the next stop before the train arrives at the station is very helpful to all passengers, but especially to visually impaired passengers. A public announcement (PA) system is typically needed for this. PA systems are also valued by all passengers for providing details of delays and emergencies. If no PA system is available, it becomes even more important to ensure the platforms display the station name clearly and legibly at every station, and that this display is illuminated at night. Visual signs especially benefit people with hearing impairments. They should be located so that a sign can be seen by passengers inside each carriage.

Fare policy As with bus systems, many governments have the practice of subsidising rail travel for disabled people by charging them reduced fares or no fare at all. While this is undoubtedly helpful to overcome affordability barriers among some disabled users, the issue of introducing concessionary fare policies should be considered with caution to ensure it does not act as a substitute for other physical or operational improvements to the rail service that could be more cost-effective.

WHERE TO START?

As with all modes of transport, improving access to train carriages needs to be coordinated with access features on related infrastructure. It may be possible to start with upgrading carriages used on one line, and to coordinate that with incremental access improvements to major stations

on that line. This is especially important if wheelchair access is to be provided, as it helps little if carriages are wheelchair accessible but wheelchair users are barred from getting to the platform by flights of stairs.

It is usually hard to significantly improve the accessibility of train carriages without major refurbishing or rebuilding the carriages, especially carriages with doors and passages too narrow to admit a passenger using a wheelchair. New train carriages should be built to conform with the access norms. Meanwhile, small incremental steps should be taken that will assist all passengers, such as installing extra handrails and colour contrasting step noses at entrances, assigning priority seats near the entrance for disabled passengers and announcing upcoming stops. Improvements can be phased in by providing at least one accessible carriage per train. Provided passengers with disabilities know about this, it is not necessary to upgrade a whole train before some benefit can be gained. It is important that these carriages be clearly identified, and that they are consistently placed in the same location in the train, to enable users to wait in the correct spot on the platform. Locating them close to the driver or conductor will also improve security and the possibility of providing assistance where it is needed.

Finally, helpful staff at stations and on-board trains can be extremely useful in assisting passengers to overcome some of the access barriers that remain.

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5. Bus stops, bus stations and train stations

5.1 Best practices – Bus stops

Improving access to buses can provide significant benefits to the general travelling public as well as to people with disabilities. Bus services cover large areas at relatively low fares in most cities of the developing world. Together with improved vehicle design and operation (discussed in Section 4), improvements in bus stop design are needed to maximise the benefits achieved for all users. This may require coordination and partnerships between bus operators and local authorities. The improvements described here are in the context of formal (fixed-route) bus systems, but many elements may also be applicable to services provided by operators of informal modes.

It is important to realise that bus stops typically consist of several components: a connection to the footway, waiting area, boarding area and street crossings. Attention should be paid to each component in turn, to ensure the whole functions in an accessible way.

BASIC PRINCIPLES

Safety: • Waiting area separated from traffic. • Adequate clear space without obstacles and hazards. • Personal security enhanced through good lighting and open design.	**Accessibility:** • Shelter and seat, especially if area prone to rain or extreme heat/cold. • Clear displays with information on bus routes served from the stop. • Kerb or platform at correct height to minimise height of first step into the bus. • Layout and kerb height correct for wheelchair access to buses (if wheelchair accessible buses are provided).
Reliability: • Marking and enforcement to prevent cars from obstructing bus bay. • Accessible walkway between bus stop and surrounding footway/building entrances.	**Affordability:** To the provider: • Start by providing at least paved area, kerb and signage at bus stops. • Install seats and shelters where most needed. • Fund upkeep of bus stops by selling advertising space on shelters.

GUIDELINES

Guidance on bus stops, bus stations and train stations is available in Overseas Road Note 21 *Enhancing the mobility of disabled people: Guidelines for practitioners* (DFID/TRL, 2004), *Improving transport accessibility for all* (ECMT, 2006), *Inclusive Mobility: A Guide to Best Practice* (Oxley, 2002), *ADA Standards for Transportation Facilities* (Access Board, 2006), and for Bus Rapid Transit, the World Bank's *Bus Rapid Transit Accessibility Guidelines* (Rickert, 2006). COST Project 322 *The low floor bus system* gives guidance on low floor buses (COST, 1995), and COST Project 335 *Passengers' accessibility of heavy rail systems* focuses on heavy rail (COST, 1999).

In this chapter, sections with the headings 'Basic principles', Best practices' and 'Where to start?' are largely taken from Overseas Road Note 21 *Enhancing the mobility of disabled people: Guidelines for practitioners* (DFID/TRL, 2004), though with amendments by the author drawing on other guidelines and experience of making systems accessible.

ECMT (2006) comments that bus and tram stops may be no more than a pole with a timetable board attached. But bearing in mind that people do have to wait at the stops, the following should be taken into account:

- Shelters to keep the worst of the weather off waiting passengers are helpful, but they should be designed so that people inside them can see the approaching bus or tram;
- They should be lit, or if that is not possible, situated in a well-lit area;
- Modern shelters make a lot of use of glazed areas which is good from the point of view of increasing ambient light in them but can make them a hazard for people with impaired vision. Where glazing is used, a bold brightly coloured band 140 to 160mm wide should be placed on the glazing about 1500mm from the ground;
- Seating should be provided, ideally some at the conventional height (450mm) and some perch seating (700 to 800mm high);
- Timetable information should be provided at a height of between 1000 and 1700mm from the ground – illuminated if at all possible;
- To assist people with intellectual disabilities, timetables should make use of symbols and illustrations.

Whether or not a shelter is provided, timetable information should be given perhaps on the pole which also has the bus or tram stop flag. The flag itself should contain the route numbers of the services using the stop in clear bold numbers on a contrasting background (black on white or dark blue on yellow). The numbers should be at least 50mm high, and preferably 60mm, and the flag itself should be a minimum of 450mm wide by 400mm high. The bottom of the flag should be no lower (but not much higher) than 2500mm from ground level. If services using the stop are fully accessible, the international wheelchair symbol can be used on the timetable information.

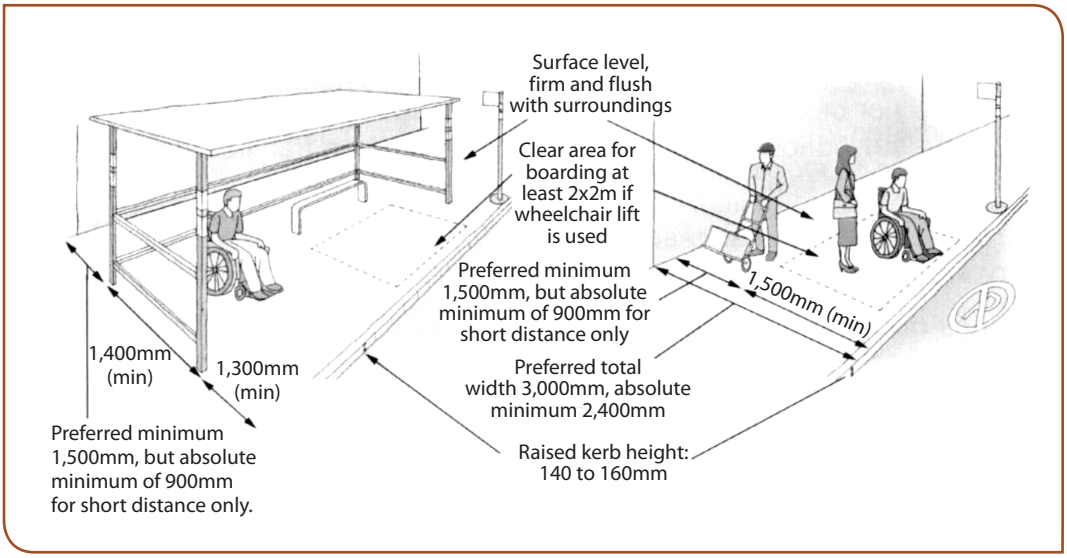
BEST PRACTICES

Location and spacing of bus stops As observed in Section 3, many disabled people cannot walk long distances. While it is best practice to place bus stops close to amenities, this becomes even more important when people with disabilities are being served. Guidelines from the UK indicate that stops should ideally be provided so that nobody need walk more than 400m along a route.

Surface quality A paved and level surface around a bus stop can greatly help all passengers to safely board and exit the vehicle. Potholes, gaps between paving slabs, and drains should be removed or covered.

Bus stop layout Bus stops should have ample space for passengers to enter, wait and board, without obstructing other pedestrians passing by. Ideal clear dimensions for bus stops with and without shelters are shown in Figure 5.1 (note that the clear area for a wheelchair should extend 2400mm from the kerb, to allow for a 1000mm ramp and a 1250mm wheelchair).

Figure 5.1: Dimensions and layout of bus stops



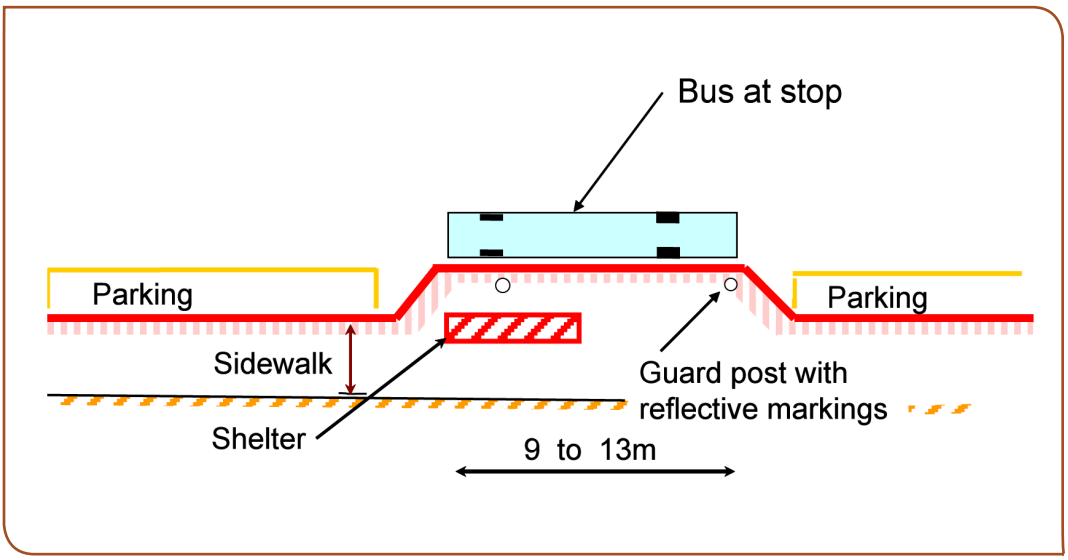
Source: Adapted from Oxley (2002)

Note: *Clear space for wheelchair needs to be 2400mm from kerb, to allow 1000mm for ramp and 1400mm for wheelchair.*

Where bus stops are provided in areas with more restricted space (which is often the case), the shelter can be sited against the rear of the footway. The clear footway width between the shelter and the kerb should be 1300mm. The clear width behind the shelter or waiting area should be at least 1500mm, with an absolute minimum of 1000mm in severely restricted cases. These dimensions are adequate to accommodate wheelchair users waiting for or boarding a bus. If boarding is achieved through the use of mechanical lifts or ramps, then extra space will be required for the lift to deploy and the wheelchair user to manoeuvre (typically 2m along the kerb by 2.4m deep from the kerb). Even if buses are not designed for a passenger to board in a wheelchair, the space is useful to accommodate those who can transfer out of their chairs and other passengers. The length of the bus stop should be sufficient to provide access to all entry and exit doors of the bus.

The use of bus boarders (also called bus bulbs) can be an effective way of providing more space while at the same time making it easier for buses to draw up close to the kerb. Bus boarders extend the footway across the parking lane to the edge of a traffic lane (see Figure 5.2), so that the bus can be aligned with the kerb without large steering movements. Research has shown that the use of bus boarders actually decreases the delay caused by stopped buses to other vehicles in the street (Fitzpatrick et al., 2001). This is because buses attempting to get close to the kerb across a parking lane often stop blocking the traffic lane, and also often affect two traffic lanes when weaving back into traffic. Bus boarders smooth the flow of traffic. In addition, because the bus does not overhang the footway while manoeuvring to stop close to the kerb at a bus boarder, the footway can be raised at the bus stop to reduce the height to the first step of the bus entrance.

Figure 5.2: Bus stop with sidewalk built out 2m (bus boarders or bulbs)



Source: IHT (1999)

Shelters and benches Shelters and seats at bus stops can significantly increase the ease of using bus transport, especially in areas with extreme weather conditions. Very often the costs of providing and maintaining shelters can be fully recovered through selling advertising on the shelters. Advertising should be restricted to defined areas so it does not impinge on service information.

An accessible shelter provides ample space for users of wheelchairs and other aids to enter and manoeuvre; has a paved floor which is level with the surrounding area; and has a bench or seat for waiting passengers. The seat can be as simple as a rail to rest against or a wooden bench, but can be invaluable to infirm passengers unable to stand for long periods of time. Many older people find standing at a stop more difficult than walking to the stop. Seating should be fixed at a height of about 480mm and painted in a contrasting colour. Shelter glazing should be marked with contrasting colour bands about 1500mm from the ground, to make it more visible to partially sighted people and at night.

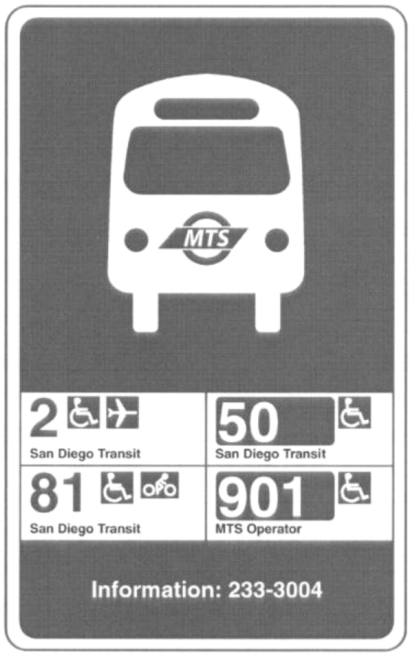
Security, especially at night, is a major concern for many travellers with disabilities. Security in and around a bus shelter can be enhanced by providing good lighting (such as street lights or lighting within the shelter itself) and removing unnecessary structures, fencing and vegetation that can serve as hiding places for criminals.

Bus stop poles and information Bus stop poles indicate the spot where the entrance of an arriving bus will be. Stop poles will benefit visually impaired users and speed boarding by all passengers. Poles should be painted with coloured bands to enhance visibility. If existing poles are used (such as lamp poles), very clear markings to distinguish them as bus stop locations are important for low vision passengers, as well as users unfamiliar with the system.

'Flags' (decals) could be used for this purpose, the lower edge about 2500mm from the ground (to provide adequate clearance), with at least the following information on them (see Figure 5.3 for details):

- Pictograph of a bus to identify it as a bus stop;
- Route number/name;
- Wheelchair symbol if services using the stop are fully (wheelchair) accessible; and
- Telephone number for more information.

Figure 5.3: Typical bus stop sign, USA



A limited amount of information tends to be better than a large amount as it avoids confusion. If a different telephone number is used for each stop, the caller can be given an automatic message of the times of the next few buses from that stop (timetabled or real time information, if available), with the option to speak to a staff member if other information is required.

Where timetable information is available, this should be provided in large print inside the bus shelter (see Section 6). Information on routes, destinations and departure times reduces uncertainty for passengers, benefiting all users. Reliability and confidence are important access principles. It particularly assists deaf or hearing impaired people, who often find verbal communication with the driver a barrier to public transport use.

Timetable information is only useful if the bus service generally keeps to the posted timetable; if not, it may be better to limit information at the bus stop to route details, a general statement of frequency and a telephone number for further information. Ideally there should also be a number for a text phone to assist hearing impaired passengers.

Another factor sometimes limiting the display of information on the shelter is recurring vandalism. In such cases, access to information by telephone can be a partial alternative.

To assist visually impaired passengers, it is often a good idea to provide important information in a tactile form. This can be in the form of numbers (about 20mm high) indicating the route number, attached directly to the pole. Letters, numbers or symbols that are slightly raised (1 or 2mm) may be more appropriate than Braille in developing countries where relatively few blind people use Braille.

Boarding area It is practice in some countries to mark on the ground the exact spot where boarding takes place, to guide visually impaired people towards the bus entrance. This is done with a row of coloured tiles, about 2m long, and perpendicular to the kerb. By raising the height of the boarding area, the height to the first step of the bus may be reduced sufficiently to make it much more usable by people with walking difficulties, children, or people carrying loads. The

entire boarding area could be constructed at a height of 140 to 160mm above the street level. Care has to be taken to provide kerb ramps at the edges of the raised area (maximum slope 1:12) to provide access to wheelchair users.

Enforcement of no-parking zones To reduce the height of the first step into a bus, drivers need to pull up close to the kerb which requires driver training and enforcement of no-parking zones at the stop kerbs. It is therefore important to partner with traffic authorities to paint clearly marked no-parking zones at bus stops, and to enforce the zone.

Wheelchair access using raised boarding structures The use of low-floor bus designs and buses with mechanical lifts to allow wheelchair users to enter buses is likely to be limited in most developing countries due to cost and the need for high-floor vehicles to operate on poor roads. An alternative is to use roadside structures raising the passenger to the approximate height of the bus floor, in conjunction with bridging plates and appropriately designed bus entrances. Such approaches have been used very successfully in bus rapid transit systems in Latin America, where buses operate on their own exclusive rights-of-way and specially designed bus stops. Guidelines for this type of system are provided by Rickert (2006). Some experiments have been undertaken with roadside access structures in mixed traffic, indicating that such solutions may be affordable and appropriate to the rugged conditions of developing countries. Best practice is still developing.

WHERE TO START?

Bus stops that currently have no facilities should at a minimum be levelled and paved, and provided with a kerb delineating the passenger space from the space used by buses. This sets the stage for more orderly operations and improved safety. If combined with driver training, it can be used directly to reduce the effort of boarding and alighting by reducing the height of the first step. At a minimum, a colour contrasted pole should be provided to identify the bus stop. Secondary features that should be considered are provision of more information on the pole, a shelter and seating.

Bus stops that currently have shelters should, likewise, firstly be examined for surface quality, kerb, and a clearly marked identifying pole. This would ensure that ambulant passengers can at least identify and enter the bus stop area. It is then important to remove obstacles such as street furniture so that passengers with disabilities can use at least some part of the shelter, and preferably all of it. Since there already is a shelter, seating can be added at relatively low cost. A further consideration would be the provision of information on the pole using a flag and tactile lettering.

New bus stops should at least be paved, kerbed and provided with a pole. Even if a shelter is not immediately erected, the stop should be laid out with adequate space for an accessible shelter to be installed in the future. New stops should aim to provide more space than the minimum indicated in this guide, and should be linked to the existing network of footways. Where bus stops have to be ranked for treatment, a good starting point would be with stops most frequently used by people with disabilities, such as in front of medical facilities, workshops, etc. As part of accessible networks, these stops should be connected by accessible footways, street crossings and kerb ramps to the origins and destinations of journeys by disabled bus users.

5.2 Best practices – Bus and train stations

This section deals with transport buildings such as train stations, bus stations and bus terminals. Although primarily aimed at buildings serving urban bus and rail services, these guidelines could

be equally applicable to intercity services. Train stations are often difficult to make fully accessible because trains, road traffic and pedestrians move on different levels. Judicious use of ramps can provide affordable solutions, though they are not suitable for height changes of over about 5 - 6m. Improving existing stations and terminals can be high on the priority list: despite the higher cost (as compared to bus stops), there are fewer of them, and high passenger volumes can often guarantee high impacts.

Guidance on accessible building is provided in Overseas Road Note 21 *Enhancing the mobility of disabled people: Guidelines for practitioners* (DFID/TRL, 2004), *Inclusive Mobility: A Guide to Best Practice* (Oxley 2002), *Improving transport accessibility for all* (ECMT, 2006), *the Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines* (Access Board, 2004) and *US ADA Standards for Transportation Facilities* (Access Board, 2006), the British Building Regulations Part M (ODPM, 2004) and the World Bank's *Bus Rapid Transit Accessibility Guidelines* (Rickert, 2006).

The following section is based mainly on DFID/TRL (2004) and ECMT (2006). Guidance from these two documents does not significantly conflict with that in the other sources listed above. Sections with the headings 'Basic principles', 'Best practices' and 'Where to start?' are largely taken from *Enhancing the mobility of disabled people: Guidelines for practitioners* (DFID/TRL, 2004), though with amendments by the author, drawing on other guidelines and experience of making systems accessible.

BASIC PRINCIPLES

Safety: • Walking area (platforms, kerbs) separated from vehicles. • Tactile warnings near to, and white line on, rail platform edge. • Personal security enhanced through good lighting and design. • Steps should not have open risers as these are a trip a hazard.	**Accessibility:** • Shelter and seats, especially if area prone to rain or extreme heat/cold. • At least one barrier-free access route into building and onto platform – no stairs, obstacles, vendors. • Simple layout and clear information to help navigate to correct platform/bay. • Kerb or platform at correct height to ease entry into vehicle (in combination with correct vehicle design and user-friendly operation). • Access to ticket counters, toilets, kiosks and other facilities.
Reliability: • Lifts, stairlifts etc. In good working order and operator available (if applicable). • Real time information on service changes or delays available in visual and audible formats. • Trained staff available to provide assistance. • Accessible walkway between station and surrounding footways.	**Affordability:** To the provider: • Minimise costs by including access features on new/upgraded stations. • Maximise impact by installing access features in high use stations first.

ECMT (2006) comments that the size and complexity of transport buildings varies enormously from small bus and rail stations to huge interchanges and international airports. Designs for the interiors of those buildings will reflect their size, complexity and the numbers of passengers using them, but there are some design guidelines that should apply whatever the size and type of terminal.

Pedestrian clearways

As a general principle, station furniture should be designed to minimise obstruction to the main pedestrian flows. Facilities such as telephones, vending machines, seating, litter bins, etc. should all be placed in such a way that, although easy to see and reach, do not obtrude into the pedestrian flow corridors.

At a minimum there should be a 2000mm pedestrian footway clear of all obstacles. It should include a directional tactile surface to help blind people (and appropriate warnings of any changes in level) and any adjacent station furniture or structural features such as columns supporting the roof must contrast in colour and tone with their surroundings. If there are columns in the main pedestrian flow corridor, they should be marked with two horizontal bands 140 to 160mm wide, preferably of alternative yellow and black stripes, with the lower band 800mm from the ground and the upper one 1600mm. For secondary circulation spaces such as short passages to toilets, offices or service areas a reduced width (minimum 1200mm) may be acceptable. Footways should have a clear overhead height of 2300mm.

Facilities and services

Buying a ticket Where there is a ticket office it should:

- Have one position suitable for wheelchair users (and people of reduced stature) with a desk height of between 75 and 85mm;
- All positions where there is a security screen between the ticket salesman and passenger should have an induction loop;
- Handrails along the queuing positions which passengers who find it difficult to stand can lean against; and
- Counter tops should have a lighting level of 250 lux.

These guidelines also apply to information offices and desks.

Many terminals, whether or not they have a ticket office, will have ticket machines. These are often awkward to use. As with ticket offices, designers should remember that wheelchair passengers will want to use the machines so none of the operating elements of the machine – push buttons, coin/note slots, ticket dispenser should be more than 1200mm from the ground. Operating buttons should be at least 19 - 20mm in diameter, protrude sufficiently to enable use by people who use palm pressure and contrast in colour from the face of the machine. Tickets and change should be easy to retrieve for people who have limited manual dexterity.

Instructions on how to use the machine, and the process of actually using it, must be kept simple and clear. Ideally, this should be just a three stage process: choose ticket – tender fare – collect ticket (and change if any). The face of the ticket machine should be well lit.

Many transport systems require tickets to be validated before the journey is started. Much of the same principles apply to validation machines: they must be clearly identified and within reach of passengers in wheelchairs.

Where there are ticket barriers, at least one gate should be available at all times for use by wheelchair passengers, people with guide dogs and others with heavy luggage or pushchairs. Ticket slots in barriers must be clearly visible.

Waiting for buses and trains

A lot of disabled and elderly people find standing for any length of time uncomfortable or even impossible, so providing seating at appropriate points throughout the terminal is very important. It is worth remembering that some of the distances people have to negotiate within a terminal are considerable.

Only 40% of wheelchair users and 20% of ambulant disabled people using walking sticks can manage to walk 180m without a rest. Quite large proportions of the ambulant disabled cannot manage more than 60 to 70m without a rest. So, as a general guide seating should be located so that people do not have to walk more than about 50 to 60m without the opportunity to sit and rest for a moment.

There are a lot of different types of seating, some more suitable than others for people with different kinds of disability. There are five broad types of seat:

- Perch-type seats against which passengers can lean or 'half sit' for a short period of time. They require minimal maintenance, take up very little space and are attractive to some passengers with arthritis, stiff joints or back problems who find it difficult to get up from a low seat;
- 'Flip-up' seats, which also have the advantage of saving space and do not become wet when it rains;
- The traditional wooden bench, with end (and possible intermediate) armrests, is more comfortable for sitting on for extended periods than either the perch-type or the 'flip-up' seat. Wood is a relatively 'warm' and non-slip surface which dries quickly and does not encourage vandalism;
- Wire-mesh or perforated metal seats installed in rows fulfill largely the same role as the traditional bench. A brightly-coloured coating (possibly the provider's corporate colour scheme) helps visually-impaired passengers and makes the seats less cold and slippery. Arms help passengers to get up from the seat and also deter vagrants from sleeping on them;
- For indoor waiting rooms where there is not a serious problem with vandals, a more expensive form of upholstered seating can be provided.

Seat heights should be about 450mm (and not less than 420mm) for conventional seating, about 550 to 600mm for flip-up seats and about 700-800mm for perch-type seats. If possible and space permits, the three basic types of seating should all be provided. Whatever type of seating is provided, sharp edges and corners should be avoided and for conventional seating, arm rests should be provided at a height of 200mm above the seat.

At terminals where passengers are likely to wait for quite a long time, enclosed waiting rooms should be provided. They should be heated/air conditioned, free of draughts but well ventilated and have easy access doors. Most importantly, both visual and audible information should be relayed to all waiting rooms.

Refreshment facilities

Many terminals have restaurants, cafes and bars but not always designed with the needs of disabled people in mind. Key design criteria include:

- Gangways and spaces between tables sufficient to allow wheelchair access: 1300mm width if possible;
- Tables designed for wheelchair users with space under the table for adequate leg room – 700mm high, 500mm deep and 600mm wide. This means a table-top height of about 730mm; and
- Furniture, trays and crockery that contrast with their surroundings.

There seems to be an increase in refreshment rooms designed with fixed furniture – seats and tables. If this is used, some spaces must be left for wheelchair users to sit at a table.

Toilets

It is most important that terminals and stations and other transport-related buildings used by the public should have toilets for disabled people. These should be designed to accommodate people in wheelchairs. There are usually national building regulations which specify the design standards for toilets for disabled people, but there are common requirements:

- A wide, easily opened door (minimum clear width 925mm; preferably 1000mm);
- Sufficient space for a wheelchair user to manoeuvre inside the cubicle;
- Space around the lavatory to enable the wheelchair user to transfer forward or sideways from wheelchair to lavatory;
- Hand washing and drying facilities within reach from the lavatory;
- Sufficient space for a helper to assist in the transfer.

As a general rule, toilets for disabled people should be no less available than ordinary toilets for able-bodied people.

BEST PRACTICES

Entrances A single step outside the doors of a transport facility can make the whole building inaccessible to some disabled people. Although it is preferable to make all entrances fully accessible, this is not always practical and in such cases entrances to be made accessible should be carefully chosen (for instance at least one accessible entrance on each side of the rail line). An accessible entrance has the following features:

- Step-free access between street level and doorway (see the subsection on 'Ramps' below). Thresholds should be no more than 10mm high so as not to preclude wheelchair users from entering.
- A level landing at least 1500mm long is needed in front of the entrance to avoid wheelchair users (and other users) having to balance themselves on a slope while opening the door.
- Entrance wide enough (at least 1000mm) and unobstructed by turnstiles.
- If doors do not open automatically, it should be possible to open them with minimum effort. Lever or loop-type door handles are much easier to use than knob handles, and should be colour contrasted to the door.
- Door or door frame in contrasting colour to building. If a fully glazed door is used it should include white or yellow bands at eye and waist height.
- Entrance should be marked as accessible using the international symbol.
- Non-accessible entrances should bear a sign directing passengers to the nearest accessible entrance.

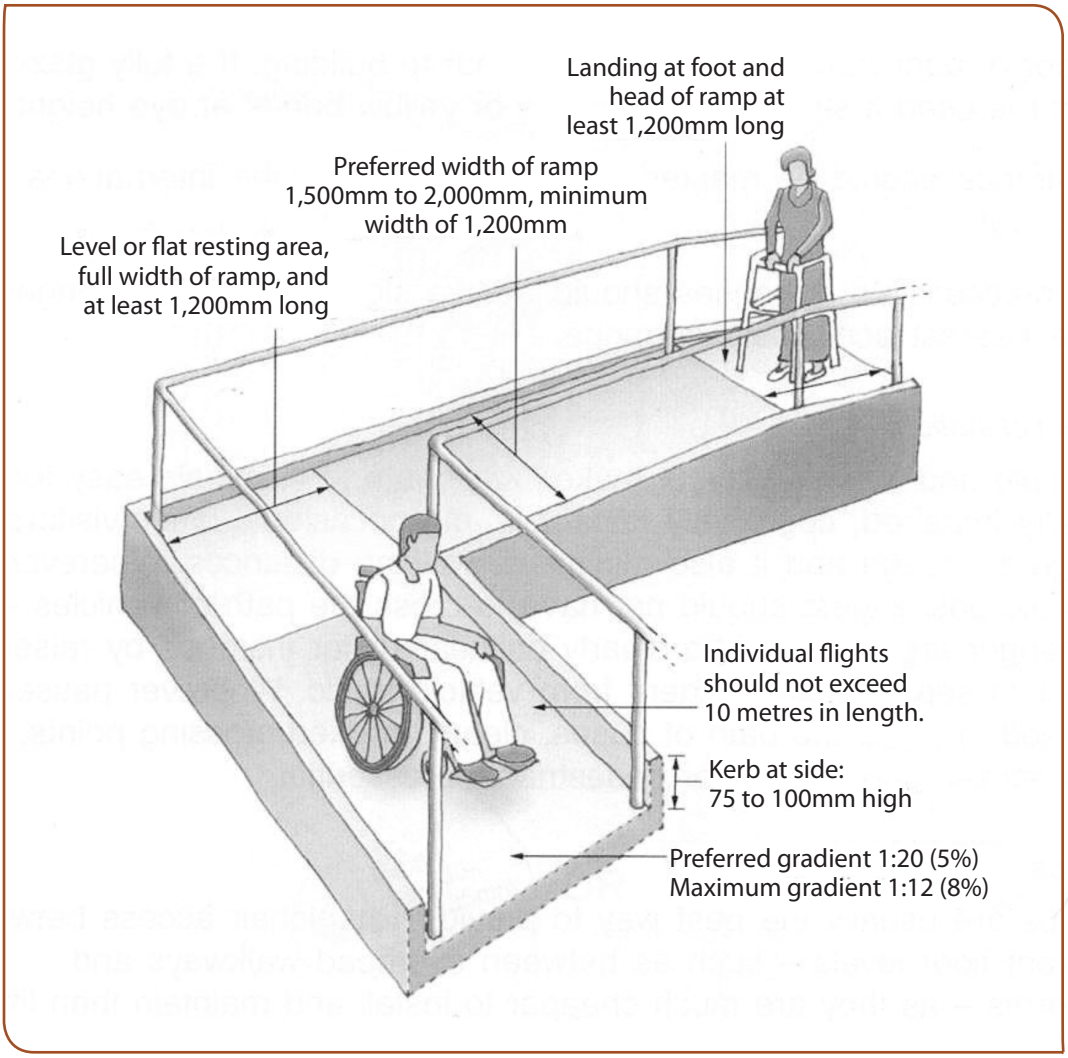
Layout of station A simple and compact layout makes stations and terminals easy to navigate for the visually impaired, cognitively impaired, and occasional users/visitors, and also reduces walking distances. Wherever possible, passengers should not have to cross the path of vehicles – passenger areas should be clearly delineated (for instance by raised kerbs) to separate passengers from vehicle traffic. Where passengers do need to cross the path of buses, clearly marked crossing points, with level access and priority for pedestrians is essential.

Ramps Ramps are usually the best way to provide wheelchair access between different floor levels – such as between overhead walkways and platforms – as they are much cheaper to

install and maintain than lifts, and can serve almost everybody. Having the correct gradient is very important: an overly steep gradient can render a ramp too dangerous and inaccessible for wheelchair users and many others. Figure 5.4 shows the major recommended dimensions for ramps.

As stated in Section 3, most guidelines specify 5% (1 in 20) as the preferred gradient, and 8% (1 in 12) as the maximum acceptable. However although not recommended, it may be necessary to provide short ramps (1000mm or less) with slopes of up to 10% to meet local constraints.

Figure 5.4: Layout and dimensions for ramps



Source: Based on Oxley (2002)

The steeper the gradient, the shorter the distance that most wheelchair users can cover without resting. Table 5.1 shows the maximum preferred horizontal distances for different slopes. In all cases, individual ramps should not be longer than 10m. Resting places in between should be level, at least 1200mm (preferably 1500mm) long, and the full width of the ramp. Level and unobstructed landings at the foot and head of a ramp should be at least 1200mm long.

Handrails should be provided on both sides, to cater for people with different body strengths on their left and right sides (see the subsection on 'Handrails' on page 68). The sides of the ramp (if not against a wall) should be protected by a solid raised kerb at least 75 to 100mm high.

Table 5.1: Recommended maximum lengths and gradients for ramps

Length of a ramp	Maximum gradient	Maximum rise
Not exceeding 2m	1 : 12	167mm
Not exceeding 5m	1 : 15	333mm
Not exceeding 10m	1 : 20	500mm

Source: Oxley (2002)

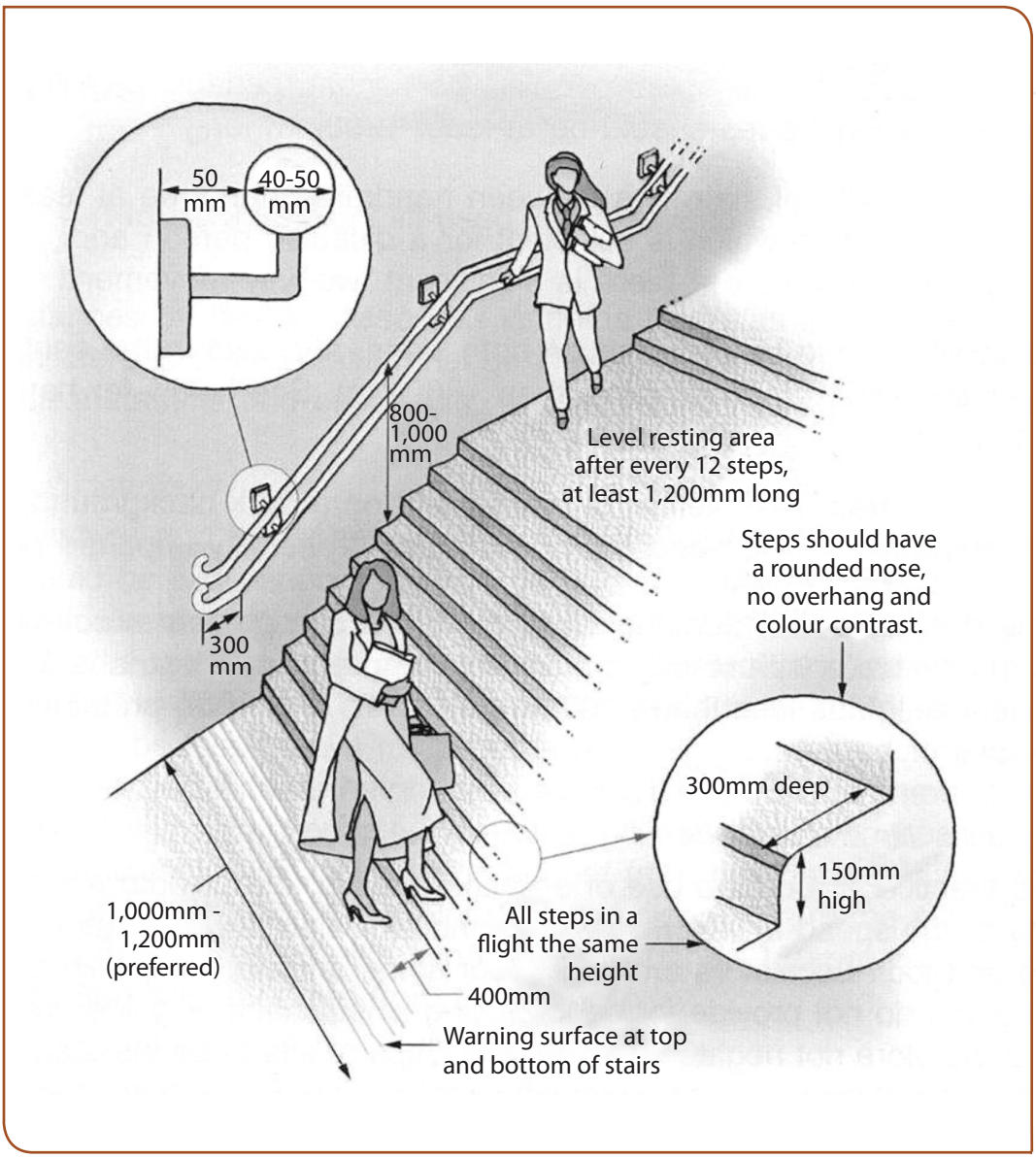
Some level changes are so great that ramps of very long lengths would be required to bridge them. Ramps should never be longer than 132m in total, as the extra distance they add becomes too burdensome for many people. However, the alternative – installing lifts or stairlifts on each platform – may be too costly and long ramps may be unavoidable in many developing countries. Adequate resting places are then very important. As well as breaking long ramps into shorter sections with level resting places, if possible long ramps should change direction by at least 90 degrees at resting places, so that there is not a long length over which a wheelchair or pram could gather speed if released at the top.

Steps and stairs Even though ramps or lifts are needed to provide access to wheelchair users (and benefit many other passengers), the design of steps and stairs is also important to assist ambulant disabled people. It is usually desirable to have both a ramp and steps, especially if ramps are longer than 9m, as many people prefer to climb a shorter staircase than a much longer ramp. But if there is insufficient space for both, a ramp should be provided rather than stairs. Recommended practice for steps and stairs is illustrated in Figure 5.5, and listed in the bullet points below.

- All the steps in a flight should be uniform;
- The risers should be between 100mm and 150mm high; 130mm is preferred;
- Risers should be vertical;
- Nosings (step edges) should be slightly rounded (6mm radius) without any overhang and colour contrasted across the full width of the stair;
- Open riser staircases should not be used as these are more difficult for elderly and visually impaired people to use;
- Treads should not be less than 300mm deep and treated with a non-slip surface;
- The maximum rise of a single flight of stairs should be 1200mm;
- Rest areas between flights of steps should be at least 1300mm long, preferably 1500 - 1800mm;
- There should be a minimum of three steps in each flight;
- The clear width of stairways between handrails should be at least 1000 to 1200mm and more if there is significant two-way movement; this is sufficient for a disabled person and companion;
- Handrails should be provided on both sides, and also in the centre if stairways are very wide (more than 1800mm). See Figure 5.5 for handrail dimensions.
- Approaches to steps should have tactile warning surfaces at the foot and head of the stairs to alert blind and partially sighted people.

The underside of freestanding stairs or ramps are a hazard to people with visual impairments and other pedestrians. Where the clear height is less than 2100mm, the area should be protected by barriers.

Figure 5.5: Layout and dimensions of steps and stairs



Source: Based on Oxley (2002)

Escalators, lifts and stair lifts Best practice for escalators relate to the width and height of stairs, the speed at which it moves, and provision of clear space at the head and foot. Escalators are difficult for some ambulant disabled people to use and do not provide for people using wheelchairs or guide dogs, and would therefore not negate the need for ramps or lifts to be installed. Stair lifts are sometimes used to move wheelchair users up or down stairways. They cost less than lifts, but can have significant operating costs as they usually require trained personnel to operate and maintain them.

Much research has been done to identify best practice in the design of lifts – many guidelines address the internal dimensions, location and type of control buttons, use of audible signals, and door opening times (Access Board, 2004 and 2006; Oxley, 2002). While lifts are an expensive

option, their cost can be justified in certain circumstances by heavy passenger volumes or when there is a substantial change in levels. It must be remembered that, unlike stairlifts and escalators, well designed lifts serve everybody.

It is desirable that lifts can be used by passengers without involving station staff. Many systems allow this. It has been found to be helpful to use glass walls for the lift cage and for the lift shaft at levels where it can be seen by the public. This avoids many of the problems that can occur with uncontrolled use by the public.

Pedestrian clearways Passageways, and the spaces between seats, stalls, waste bins and so forth, should be wide enough to provide adequate clear space for wheelchair users and others needing sufficient space. As indicated in Section 3, the minimum recommended width for two-way pedestrian flows is 1800 - 2000mm. Where this width needs to be restricted, it should never be less than a minimum 1000mm and continue for more than 6m in length. A clear height of at least 2100mm is recommended. To assist visually impaired people hazards such as advertising boards, vendors and rubbish bins should be absent from the clear way. Objects that protrude more than 100mm into the clear space from the side should be protected and marked with two horizontal bands 150mm wide and placed at 800 and 1600mm from the ground.

Handrails Handrails are extremely important, as many people rely on them to maintain balance and avoid falling. Handrails are needed in queuing and waiting areas. Handrails should be fixed between 800 and 1000mm above the floor, ramp or step noses. They should be continuous along ramps and stairs, and continue past the end of the ramp or stairway by at least 300mm, and preferably 600mm, and then be turned towards the wall or floor. Handrails should be made from circular tubing 40 to 50mm in diameter. Other alternative designs of handrail should not be more than 50mm wide and have rounded edges (with no more than 15mm radius) to be most comfortable to people with arthritic hands and be smooth and without any sharp edges. The handrails should be fixed at least 50mm from the adjacent wall to prevent hands being caught between rail and wall. Rails should contrast with the surroundings (e.g. painted bright yellow) to assist partially sighted users.

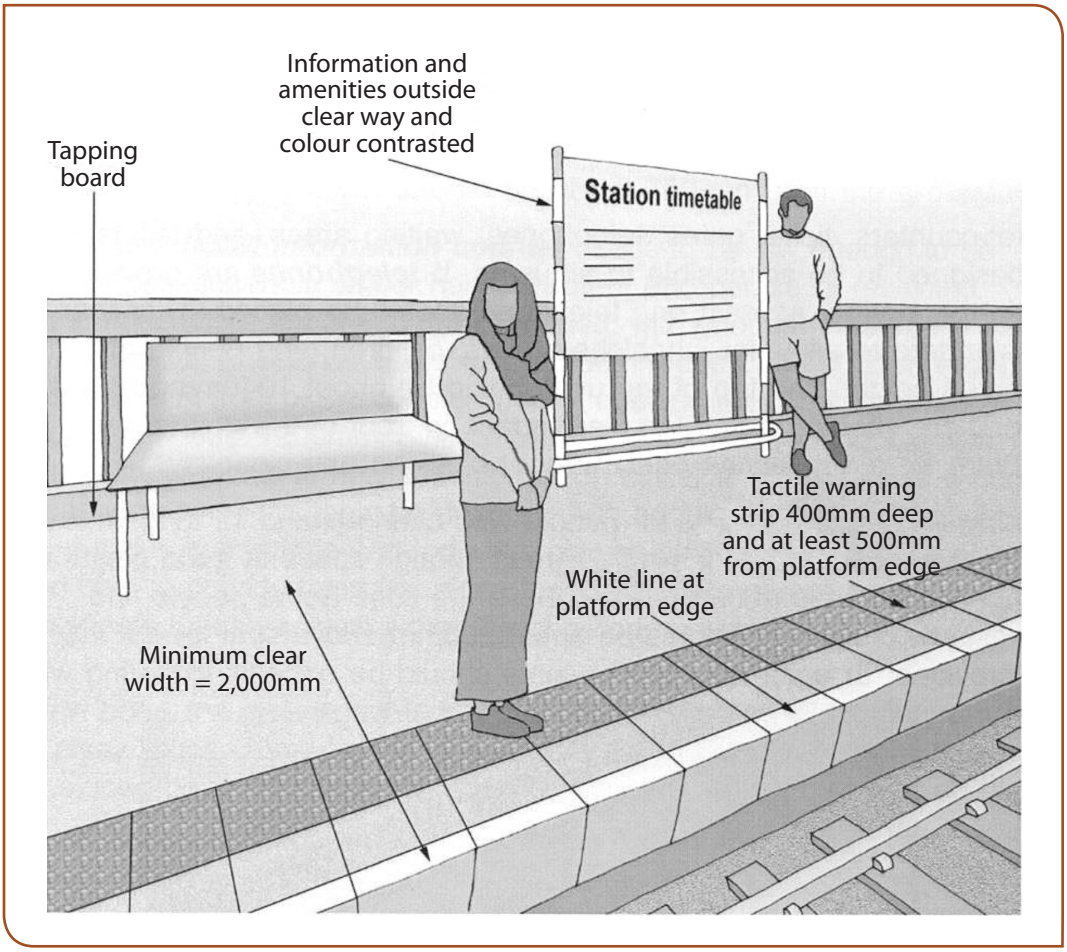
Signage Clear signage throughout the building is important for everyone, particularly hearing impaired people. See Section 6 for more information on formats and requirements for signage.

Tactile and visual guidance In the absence of other cues, visually impaired people may be able to navigate through a station by following a tactile path. People with some vision generally focus on the floor up to 1500mm ahead. Directions to platforms, or warnings of stairs ahead should take this into account. As with footways, it is suggested that tactile and visual clues be used sparingly and consistently. The input of local users with disabilities may be valuable in identifying appropriate approaches.

The Department for Transport and the Regions (2005) provides advice on the use of tactile paving.

Platforms at rail stations Apart from being reachable by ramps or lifts, accessible platforms should also provide sufficient space and tactile cues for safe use (see Figure 5.6). UK guidelines recommend a minimum clear width of 2000mm but this should be increased for busy platforms. A level and well-maintained surface is essential for safety. To warn visually impaired passengers that they are approaching the platform edge, it is best practice to install a tactile warning strip at least 800mm deep, set back about 500mm from the edge, and contrasting with the surrounding floor (see Section 3 for further information). Provided the tactile warning strip is uncomfortable to stand on, and there is not space for passengers to stand between it and the platform edge, it will encourage passengers to stand back from the edge and reduce the number of passengers who fall onto the track.

Figure 5.6: Platforms at railway stations



Source: Based on Oxley (2002)

A white line or equivalent warning along the edge of the platform should always be used to alert passengers to the platform edge. Equipment such as rubbish bins or information boards should be placed outside the clear space along the platform, and colour contrasted for high visibility.

If the practice is to designate one carriage in every train as an accessible carriage (see Section 4.4), and the carriage stops approximately in the same place every time, it would be best practice to indicate the corresponding space on the platform for disabled passengers to wait in.

Information Helpful and knowledgeable station personnel are needed to provide information and improve confidence for travellers with disabilities. Trained station personnel should be clearly identifiable (such as through distinctive clothing or badge), and available to answer questions. If the staff are behind a counter, the counter should be designed to be as user-friendly as possible (see above).

Information on train schedules should be displayed visually using best practice to improve legibility (see Section 6). In addition, it is important that information on any changes to the posted schedule, such as platform changes or delays, be communicated both visually and audibly. At its simplest, this can take the form of notices stuck on a signboard; more expensive options include computerised message signs. Audible announcements should preferably be made with a public-announcement (PA) system. Even if no amplification is available, station personnel should make every effort to inform passengers audibly of real-time changes, as this benefits all travellers, not just those with visual impairments.

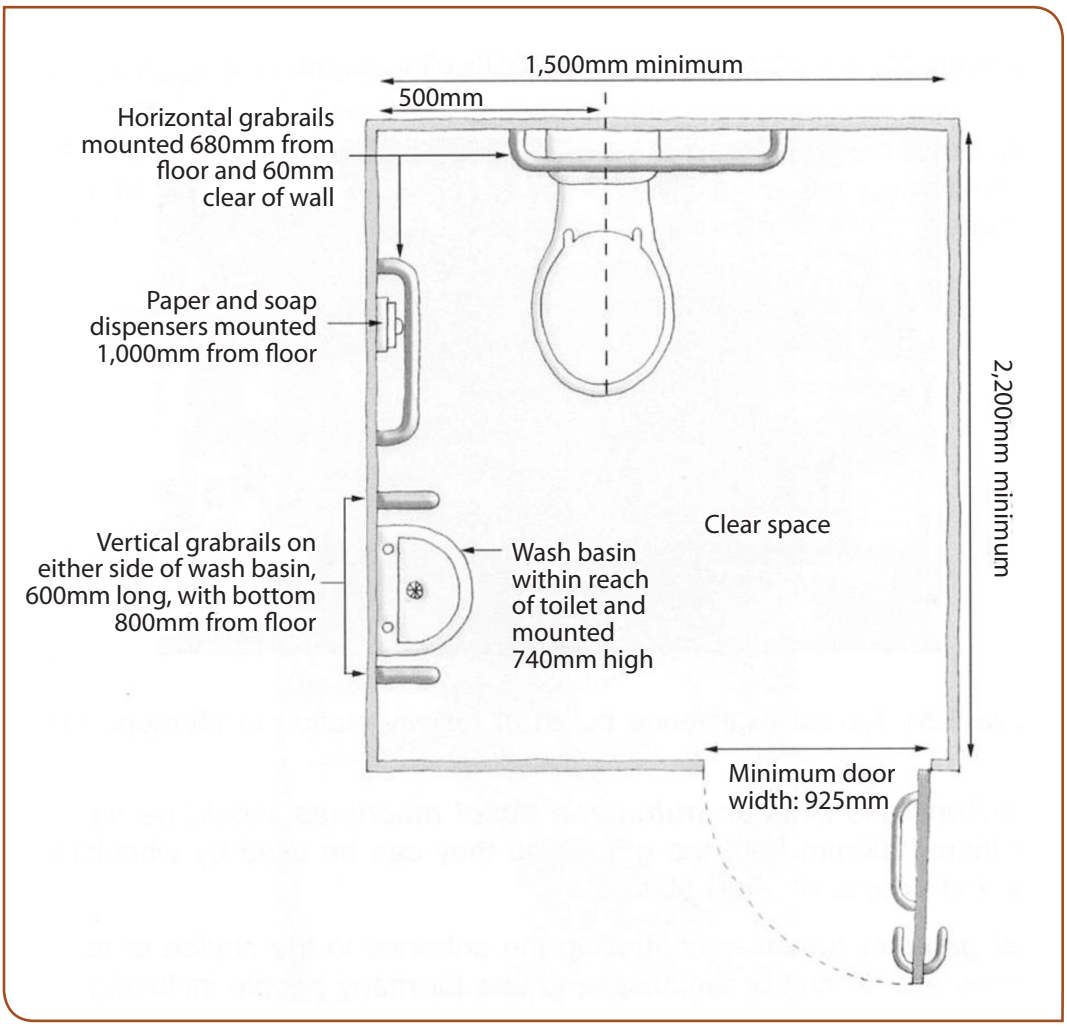
Amenities Ticket-counters, ticket gates, telephones, waiting areas, and toilets can be designed to be accessible to all users. If telephones are provided inside the station, at least one telephone should be placed lower than the standard to allow for wheelchair users, children, and people of restricted height. The top of the unit should be about 1040mm above the floor. There should be enough clear space in front of the unit (about 1200mm for a wheelchair user) without blocking any clearways.

Seating should be provided for people who cannot stand for long, in waiting areas and on platforms if there is enough space. A good height for seats or benches is about 480mm above the floor. Some people find armrests helpful; these should be about 200mm above seat level if they are provided. To enhance visibility, seats should be colour contrasting with the surroundings. For outdoor seats, the use of wire-mesh is a good way to prevent rainwater collecting on the seat. In waiting areas some seats should be reserved (and marked) for use by older and disabled people.

Some (but not all) seating can consist of perch-type seating against which passengers can lean or half-sit for a while. They are simple and inexpensive to construct and maintain, unobtrusive, and attractive to people with arthritis or back problems who find it difficult to get up from a low seat. Perch-type seats should be about 700mm from the ground.

At least one ticket information counter needs to be low enough to be used by passengers in wheelchairs, children, and people of restricted height. A height of about 800mm is needed, with enough knee space below the counter for wheelchair users (about 500mm deep and 900mm wide). Clear space in front of the counter (free of queuing rails and other barriers) should be at least 1200mm. Since it can be very difficult for people with hearing impairments to hear the information officer through a glass window, at least one counter should be provided with an induction loop in situations where this is appropriate and include a sign to indicate as such. It is also a good idea to provide handrails along the area where people queue up, for passengers to lean against if they find it difficult to stand.

Figure 5.7: Dimensions and amenities for a typical wheelchair accessible toilet



Source: Based on Oxley (2002)

The buttons and slots on automatic ticket machines should be no more than 1200mm from the ground so they can be used by wheelchair users and people of short stature.

Ticket gates or turnstiles controlling the entrance to the station or to platforms are difficult or impossible to use for many people including disabled people. There should be a 1000mm wide accessible route, clearly marked, through the ticket gates and collection area. Slots into which tickets are fed, and from which they are retrieved, should be marked with a bright colour.

If toilets are available for non-disabled people, they should also be available for disabled people. Accessible toilets that are marked as 'unisex' are better than separate male and female toilets, as it can be used by the many disabled people who are accompanied by an attendant or companion of the opposite sex. When designing the layout of toilets, it is most important to provide enough clear space for people using wheelchairs and other equipment to enter and manoeuvre; to put amenities at a reachable height; to provide sufficient handrails to assist people transferring from a wheelchair or people with reduced strength; and to provide easy-to-operate amenities such as taps and door handles for people with reduced hand dexterity. Door handles should be large and easy to grasp. Many countries have their own standards for accessible toilets. Figure 5.7 summarises some best practice recommendations.

WHERE TO START?

It is easier and cheaper to achieve full access at the design and construction stage, rather than by trying to modify a building at a later stage.

When existing stations have to be retrofitted with access features, a good starting point is to select major stations with high passenger flows, stations in accessible networks, and stations serving major destinations in the city, as this may benefit most passengers. When existing stations are upgraded or maintained the opportunity should also be taken to start making incremental improvements to serve passengers better.

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6. Signage and information

Signage and information is important for all passengers. They need to know when to catch public transport, which route or service to take, how much the fare is, and where to find a specific train, bus or minibus within a station or rank. Adequate information – and especially real-time information that reflects changes as they happen – helps not only regular passengers when circumstances change, but can also help attract occasional users and tourists – which is a growing market in developing countries. For people with disabilities, having access to information in usable formats is particularly important, to help avoid unnecessary effort and to help plan their journey with confidence. For people with visual, hearing or mental impairments, having access to information may be the defining need that allows them to travel independently.

Signage and information that is well designed for people with disabilities will help everybody. Clear signage and information will help strangers to an area, and the use of pictograms and simple wording is particularly important for people who do not speak the language of the local area.

This section deals with information in all formats: signage used in terminals, stations and on-board vehicles; printed leaflets and timetables; and audible announcements. It concentrates on best practice regarding format, but also provides some guidance on the general content of signs, messages and classes of information.

Guidance on best practice is available in Overseas Road Note 21 *Enhancing the mobility of disabled people: Guidelines for practitioners* (DFID/TRL, 2004), *Inclusive Mobility: A Guide to Best Practice* (Oxley 2002), *Improving transport for people with mobility handicaps* (ECMT, 2006), *Better information for bus passengers* (DoT, 1996), *Improving transportation information* (Transvision Consultants, 1996) and *Sign design guide* (Barker and Fraser, 2000).

In this chapter, sections with the headings 'Basic principles', Best practices' and 'Where to start?' are largely taken from Overseas Road Note 21 *Enhancing the mobility of disabled people: Guidelines for practitioners* (DFID/TRL 2004), though with amendments by the author, drawing on other guidelines and experience of making systems accessible.

The British Department of Transport's *Better information for bus passengers* (DoT, 1996) distinguishes between 'Network information' (which provides an all-operator public transport guide containing a route map and a list of basic service details such as days/periods of operation and a broad indication of frequency) and 'Service information' (which is the detailed route and timetable or headway information for each service using a particular stop). It provides much detailed guidance on the display of information at stops, bus stations, within vehicles and in timetable leaflets.

There is also a need for more general information. Transport services change over time and so do the facilities that they offer. Knowledge about public transport services – where and when they operate, the fares and so on – is important for everyone, but disabled people need more information, especially if they use a wheelchair.

A good example is the guide produced by the French railway company SNCF, which gives information on facilities and equipment (toilets for disabled people, ramps, lifts, accessible telephones, etc.) at stations, on trains and at ticket offices, and also gives information on accessible public transport to and from rail stations.

At a more general level, guides such as that published by DPTAC/British Department of Transport (Door to door) or the French Comité de liaison pour le transport de personnes handicapées' *Guide des transports a l'usage des personnes a mobilite reduite* provide a summary of the services available to disabled people. They do not offer detailed local information but provide a broad overview of what is available and give contact telephone numbers for more specific enquiries.

With a different purpose in mind, guides on good design for accessibility can be used to raise awareness of transport operators and local authorities to the needs of disabled people. In the Netherlands, for example, brochures are being prepared with guidance on accessibility in urban public transport, for information systems and for parking and facilities on motorways. The idea is that such brochures will provide advice to operators and authorities in a way that is easier for them to assimilate than if the same information is conveyed in a scientific report.

ECMT (2006) comments that in whatever form information is made available it should meet the four criteria:

- Clear;
- Concise;
- Accurate;
- Timely.

It makes no difference whether the information is presented in a leaflet, on a sign, in response to a telephone call or in any other way; these criteria must be satisfied if it is to meet the needs of travellers.

These criteria, of course, apply to information for everyone who has to travel, but for disabled people there are aspects of these criteria that are particularly important.

Clear

Clear means two things: easily legible in the case of textual information whether printed, on a screen or on a sign, and in all cases, including spoken information, easily understood.

There are quite a lot of good guidelines developed for the presentation of text.

Generally people find it easier to comprehend text when it is written in lower case, with appropriate capitals RATHER THAN ALL IN CAPITALS. This applies to timetables and leaflets as well as signs and television displays.

Size is important. Failing eyesight is a common accompaniment to increasing age and very small print is difficult to read. Conventional timetables and brochures should be printed in a clear type face for the benefit of everyone, but should also be produced in large print, minimum 14pt, preferably 19pt:

19pt is this size 14pt is this size

Even large print can be rendered difficult to read if the contrast between the colours used for the text and for the background paper is not good. Brown print on a beige background may be aesthetically pleasing but it is not easy to read, especially if the light is not too good. Black or dark blue on a white background is fine.

These guidelines generally also apply to signs. Lower case lettering should be used and the type face should be a clear one such as Helvetica, Airport, Futura or Folio.

Part of the process of ensuring that signs are legible is the placing of them. The ideal position for seeing a sign is on a level with the eyeline of the individual, but this is often not possible. Put at that level in, for example, a railway terminus would mean that unless you were right by the sign you would not be able to see it because of other people in the way. So the sign often has to be raised. The extent to which it is raised will depend on the specific location, but to avoid other people getting in the way it should be placed not less than 2.3m above ground level. In large areas like a station concourse signs will be a lot higher because people need to see them from a long way away.

There are several guidelines on the size of lettering in relation to distance varying according to the degree of visual impairment of the observer. The figure below shows the size of lettering required at a range of distances. To meet the needs of elderly people and others with rather poor sight, a letter height of 25mm is required for a viewing distance of 7.5m. At 20m distance, letters should be about 75mm. Some transport authorities have more exacting standards. For example, London Transport's standard is based on 10mm letter height for every metre of viewing distance, with no lettering less than 22mm.

There is an increasing use of variable message signs, particularly in air and rail services, but also on bus services as well. These take a variety of forms from television screen displays, LED and fibre optics to the more old-fashioned but still much used flip disks. Following the advice given for printed texts and static signs will improve the legibility of these displays – clarity, appropriate size of letters and contrast are just as important.

By their nature, variable message signs change by scrolling or flipping. It is most important that speed of change should not be too fast, otherwise people who can read, but not well, will find it difficult to understand the message. It is recommended that a line of text should be displayed for at least ten seconds, preferably a little longer. Dynamic signs should have non-reflective glass and should be shielded from direct sunlight.

There are increasing numbers of public access information terminals and kiosks at transport terminals and on-street. It seems likely that this source of information will increase in the future and it obviously has great value *if properly designed*. A recent ergonomic evaluation of terminals produced the following guidelines:

- The operational face of the machine, which is a touch-sensitive screen, should be no more than 1200mm from ground level;
- The screen should be flush with the front surface of the terminal casing, not recessed into it;
- Parallax can make it difficult for people to place their finger on the desired icon or symbol on the screen; this effect can be reduced by careful positioning of the screen in relation to the viewing angle;
- The cabinet in which the screen is placed should have a foot and knee recess, so that wheelchair users can get close to it;
- Displays of text should follow the guidelines mentioned earlier concerning clarity, contrast and legibility.

Help Points, where people can get travel information or call for emergency assistance, are becoming more common, particularly on stations which are not staffed all the time. These help points should be placed so that the maximum height of any button which the caller has to use is 1200mm, they should be clearly distinguishable by visually impaired people and should be fitted with an induction loop.

Lighting of static signs

Signs should be well lit. As a rule of thumb it should be possible for a person with good (20/20) vision to read a newspaper in the vicinity of the sign. Where ambient light levels are not as good as this, illuminated (back-lit) signs may be preferable. In conditions where the light is good, glossy finishes to signs should be avoided as they can cause glare and disadvantage people with low or impaired vision; a matt finish is better.

Concise

Quite a lot of information is seen while en route when the observer himself is moving – perhaps walking or maybe on a bus or a train. The time available to see, read and understand the information may therefore be quite short. This then emphasises the importance of keeping information as concise as possible and emphasises the value of using symbols.

The French organisation COLITRAH has produced comprehensive recommendations on signage – *chaine signaletique* – which makes the point that for passengers in transit signs should be designed to give an instantaneous 'snap-shot' of information. Symbols can be very helpful in this process, not least because they can be understood by people with low levels of literacy, but they must be used consistently, be unambiguous and if or when new ones are introduced, they should be accompanied by a verbal explanation until the public is fully familiar with the symbol and its meaning.

Hearing information

The emphasis of the preceding paragraphs has been on visual display of information, but audible information is also important, especially in emergencies and for advising of unexpected changes to services. Audible information is not restricted to announcements at stations and on-board public transport vehicles. Other applications include telephone information, ticket offices and information centres.

Many personal hearing aids incorporate a 'T-coil' which provides direct inductive coupling with a second coil, for example in a telephone receiver or at a ticket office window. As not all hearing aid users have a T-switch, telephones should also have user-controlled amplification of received sound. Amplification is implemented via a button on the telephone, which automatically reverts to the ordinary sound level once the telephone handset has been replaced.

Some telephone information services now include a Telecommunications Device for the Deaf (TDD). Text phones are available and are essential for those people who are profoundly or severely deaf.

Accurate and timely

Any information in whatever form should be accurate. This means more than just making sure that it is correct at the time it is first presented; it also implies a process of up-dating and checking to make sure that it continues to be accurate. A mistake in a timetable may be the cause of irritation to anyone, but to a disabled person the consequences can be much more serious.

Timing of information is also important. Thought should be given not just to the content but to the point in the journey when it is needed. To take one simple example, an audible announcement of the next stop on a metro is very helpful particularly to visually impaired people but it needs to be made in sufficient time for the passenger to get ready to leave the train; an announcement as the train draws to a halt (or the bus) is too late for people who are less than fully agile.

BASIC PRINCIPLES

Safety: • Information signs and boards posted close to but not obstructing passenger circulation areas.	**Accessibility:** • Visual information provided in correct size, colour, format to be easily legible to all passengers. • Adequate lighting to ensure legibility at night. • Key information provided in tactile format where possible. • Visual information should be simple and concise, using symbols where possible, to be easily understood by all passengers, including visitors, illiterate and learning impaired people. • Clear audible information provided to assist visually impaired and hard of hearing people.
Reliability: • Information on times, services and fares should be accurate and updated timely to reflect changes. • Emergency information provided in audible and visual formats.	**Affordability:** • Information (printed and telephone) available at no or low cost.

BEST PRACTICES

Size and format of signage The minimum size of letters and symbols depends on the distance from which it is read and the degree of visual impairment of the reader. Various studies have produced a range of preferred sizes. In the Netherlands, for instance, it is recommended that the letter size should be 1% of the distance from which the sign is read (Ministerie van Verkeer en Waterstaat, 2000). Typical minimum letter sizes for different applications are shown in Table 6.1. Best typefaces to use for signs and information are sans serif (such as *Helvetica, Arial or Standard*), with a width to height ratio of between 3:5 and 1:1. Lower case letters are much easier to read than UPPERCASE (capital) letters.

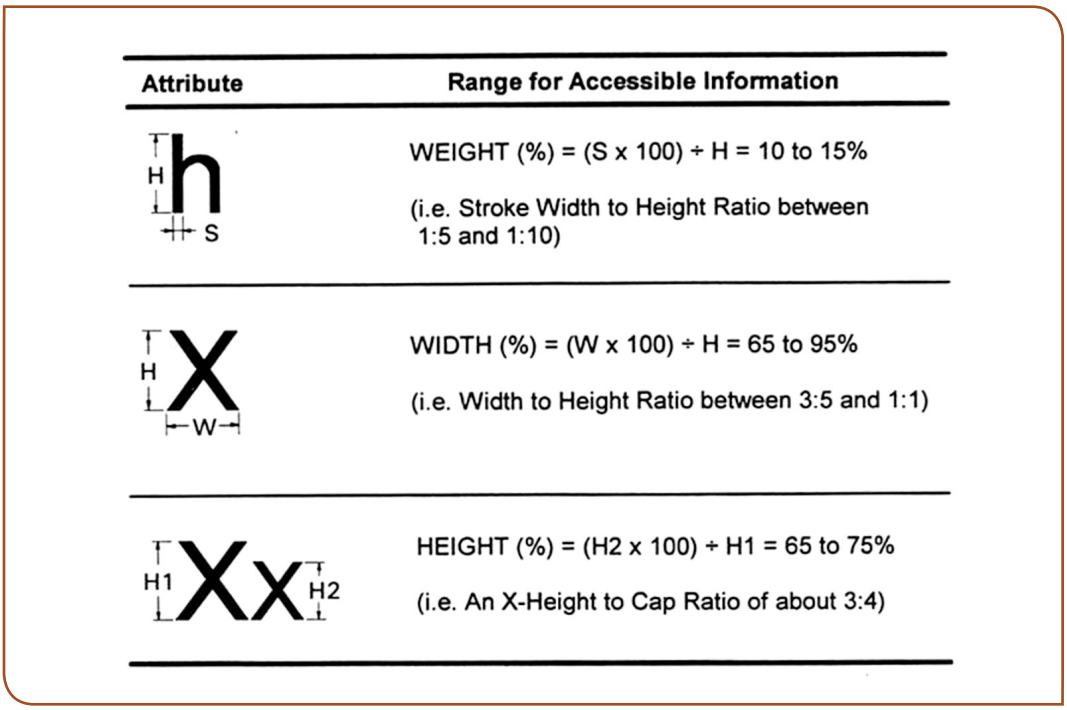
Symbols can help convey information, especially to passengers seeing a sign from a moving vehicle. Signage should be unambiguous and be used consistently, to avoid confusion. The international symbol for access should be used to identify entrances, routes or facilities within a building, or transport services, that are fully (wheelchair) accessible. For symbols, the letter heights of Table 6.1 should be approximately doubled to ensure adequate visibility of symbols.

Table 6.1: Recommended letter sizes and applications for signage

Minimum letter height	Application
200mm	Route number shown on buses and trains.
150mm	Long distance reading e.g. signs on building entrances.
125mm	Route name/destination on buses and trains.
50 - 100mm	Indoor use e.g. signs in corridors and stations.
50mm	Information on bus stop flags and shelters.
15 - 25mm	Close reading e.g. wall-mounted timetables.

Source: Various guidelines

Figure 6.1: Font type proportions



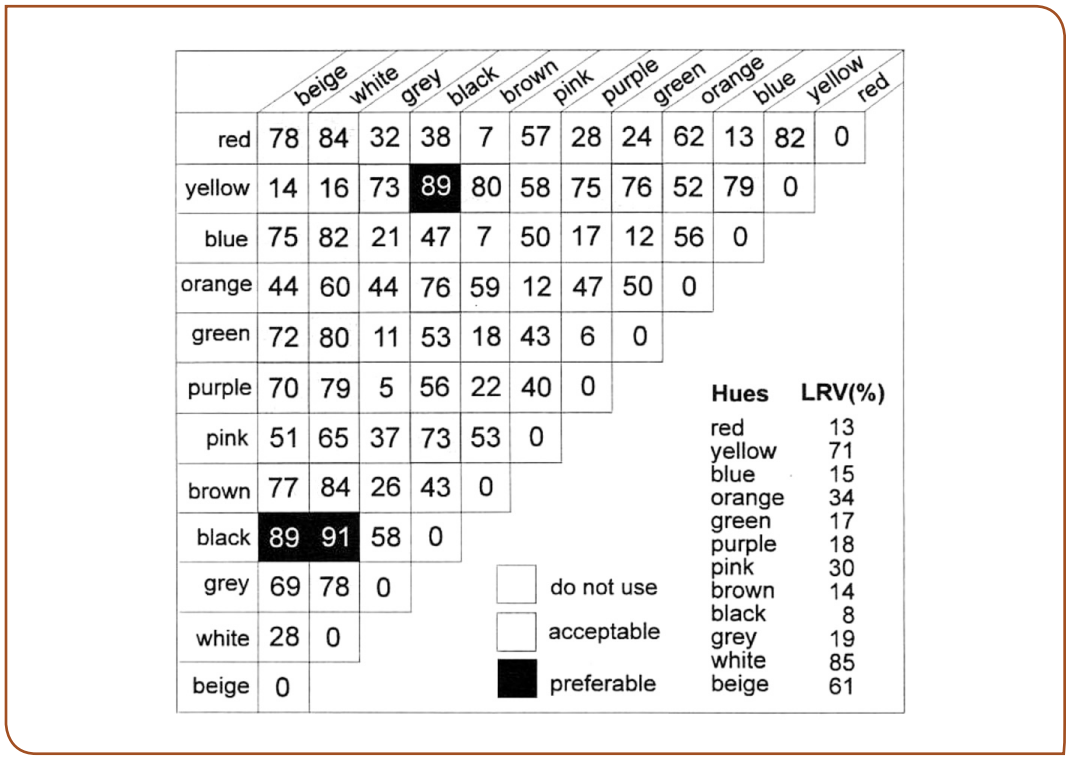
Source: TransVision Consultants (1996)

Placement of signs For an optimum viewing angle, wall-mounted signs should be placed at a height of 1300mm to 1600mm above floor level. Signs that should not be obscured by other people (such as directional or emergency signs) should be higher than 2000mm, or 2100mm if they are suspended overhead. In large areas like station halls they should be higher than this to be visible from a longer distance.

Colour contrast Letters and symbols on a sign should contrast with the background of the sign. In general, dark text on a light background is preferable, except for signs that are lit from inside where light letters show up more clearly. The signboard itself should contrast with its surroundings.

Geehan (1996) provides a guide to acceptable contrast from Arthur and Passini (1994). See Figure 6.2.

Figure 6.2: Colour brightness differentials



Source: TransVision Consultants 1996

Table 6.2 shows colours that contrast well. Good lighting and a matt finish (instead of a glossy, shiny finish) will also enhance readability.

Table 6.2: Colour contrast for signs

Background colour	Sign board colour	Letter/symbol colour
Red brick or dark stone,	White	Black, dark green or dark blue
Light brick or light stone	Black/dark	White or yellow or whitewashed walls
Green vegetation,	White	Black, dark green or dark blue
Back-lit sign	Black	White or yellow

Source: Merseyside code of practice, in Oxley (2002)

Tactile signage Tactile signage can be used effectively to provide information to visually impaired passengers such as route numbers or the direction to ticket counters, bus bays or railway platforms. The letters, numbers or pictograms should be fixed against the wall or bus stop pole at a height of 1m from the ground. Characters should be raised about 1mm to 1.5mm from the surface, at least 15mm high, and painted to contrast with the surface. Most blind and visually impaired people do not read Braille, so embossed signs will generally be more useful.

Printed material Printed material may contain information on bus, train or taxi services; specific services and features for disabled people; or timetables and fares. It should be legible to people with low vision, and larger typefaces imply a trade-off with the amount of information provided. Usually this is a good thing, as simple and clear material with less information is often more user-friendly to everybody than comprehensive but incomprehensible data.

In general the above guidelines on typeface, colour and format also apply to printed matter. UK and European guidelines recommend a minimum letter size of 14pt for timetables and for large-print material. European best practice states that timetables and brochures should be printed in large print.

Grey shading and red or green ink should be avoided; black ink on white paper is the most legible combination. Printed material should always include a telephone number where more information can be obtained.

Audible information Audible announcements are helpful to most people but particularly to people with visual impairments. Public announcement (PA) systems in stations or terminals should be clear and loud enough to be understood by people with hearing impairments, who typically require announcements to be at least 5 dB above the ambient noise levels. Inside public transport vehicles, the use of a PA system is recommended in large vehicles for announcements about major stops to be heard. However this may not be affordable, or indeed necessary in smaller vehicles with up to about 30 seats. In such cases, the driver or conductor should announce information at least loud enough to be heard by passengers in the priority seating area. Some telephone information services include a Telecommunications Device for the Deaf (TDD), while text phones are useful for people who are profoundly or severely deaf.

Emergency information Emergency exit routes from buildings or vehicles should be clearly signed. To serve both visually and hearing impaired people, emergency alarms should have both audible and visual features, such as an alarm sound coupled with a flashing warning light.

WHERE TO START?

All new signage in newly constructed transport facilities (stations, ranks, stops) should follow best practice guidelines. The refurbishment or maintenance of existing facilities also presents good opportunities to improve the quality of signage and information. Printed leaflets and timetables are very useful for people with disabilities to plan their trip beforehand, but only if the information is accurate and up-to-date. Initially it may be reasonable to concentrate on printing timetables in larger print and audio information (on tape or telephone) for major routes and routes that are being made more accessible to people with disabilities.

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7. Training and policies

7.1 Training

Wherever public transport services have become more user-friendly towards people with disabilities, the training of staff, managers and officials has been an important element. In many developing and transition countries, this is particularly important as managers, drivers and conductors often do not have a service ethos towards their passengers, let alone sensitivity towards passengers with special needs. Disabled passengers consistently identify staff attitudes and ignorance as a major barrier deterring them from using public transport. The accessibility of public transport will only be improved in practice if governments, users, and operators work in partnership to create a more customer-oriented culture in public transport. Experience has also shown that the needs of people with disabilities can better be served if staff are not only courteous and helpful, but are also trained in how to serve people with specific needs. Well trained staff are also important to retaining existing passengers and attracting new passengers to public transport by improving the quality of the service.

Another aspect of training relates to the training of deaf/blind people and those with learning disabilities on how to use the public transport system. This so-called 'travel training' can help some disabled people, particularly those with visual or cognitive impairments, to be able to travel without assistants, enhancing their independence.

BASIC PRINCIPLES

Safety: • Driver training should emphasise safe driving. • Staff trained in safe handling of wheelchairs, walkers, etc.	**Accessibility:** • Training could enhance service delivery to people with disabilities without discrimination or prejudice. • Knowledge of how to mitigate effects of inaccessible places, vehicles, services, etc.
Reliability: • Staff able to think on their feet in emergency or unexpected situation.	**Affordability:** • Drivers/conductors trained not to charge extra for passage of necessary mobility aids (wheelchairs, guide dogs, etc.)

Guidance on training is available in Overseas Road Note 21 *Enhancing the mobility of disabled people: Guidelines for practitioners* (DFID/TRL, 2004), *Improving transport accessibility for all* (ECMT, 2006), *Take care of your customers* (DPTAC, 2000a) and *Advice to taxi drivers* (DPTAC, 2000b).

In this chapter, sections with the headings 'Basic principles', Best practices' and 'Where to start?' are largely taken from *Enhancing the mobility of disabled people: Guidelines for practitioners*, though with amendments by the author, drawing on other guidelines and experience of making systems accessible.

ECMT (2006) comments that training all staff who come into contact with members of the public in disability awareness is essential. Without this, the best of technical aids to accessibility may fail to fulfill its potential value. Unfortunately, "the adequacy of training rarely meets the needs of passengers in most Member States, and whilst this situation is improving, it urgently needs to be addressed". That said, there are some good examples of training. In the Netherlands a project has been started to improve the knowledge and perception of staff in public transport companies. A training programme of 3.5 hours has been developed to show the staff what it means to travel as a disabled person, in which staff members experience for themselves how disabled people can best be helped. This is done actively, including a video, discussions and a route with obstacles which the trainees have to negotiate in a wheelchair or as a blind person. The training is given by disabled people with travelling experience.

BEST PRACTICES

7.1.1 Training courses

Training courses in disability awareness have been developed in many countries across the world, including some developing countries. The UK's DPTAC suggest the following elements should be included in courses (DPTAC, 2000a and 2000b):

- Barriers faced by disabled people, covering attitude, environment and organisation;
- Principles of access audits: how to identify accessibility and inaccessibility;
- Information on all disabilities, including hidden disabilities;
- Suggestions for removing barriers faced by disabled people (including changed driving behaviour to improve safety for disabled passengers), and the skills needed for serving disabled travellers (for instance, how to 'push' and 'brake' a manual wheelchair);
- Communication and interpersonal skills for communicating with disabled people, particularly those with a hearing impairment or with learning disabilities (including etiquette and language);
- Enabling staff to deal with unexpected occurrences; to 'think on their feet' when a problem arises (this could include basic first aid training if needed).

Disability awareness training should be based on the concept of the Social Model of Disability, which views disability as a consequence of barriers, some created by society, which are encountered by people with impairments. This approach will help transport staff to view their jobs in terms of promoting equality, rather than undertaking welfare work. It is useful to involve disabled people's organisations directly in the training, for instance by inviting representatives to present some or all of the topics. It is very important to expose not just front-line staff (such as drivers and ticket collectors) to disability awareness training, but also those who design, plan and manage transport systems, as it is managers who help set the ethos of the organisation and who drive decisions regarding access improvements.

One way of exposing non-disabled staff to the issues faced by disabled people when travelling is to use simulation exercises. Disability simulation exercises could consist of putting participants in wheelchairs or blindfolding them. Care is needed to choose a situation and time that is acceptable to all participants.

7.1.2 Training of users

In many cases orientation, also called 'travel training', can be offered to assist new passengers who have never travelled by public transport before. Training is especially important to people with learning disabilities such as Down's Syndrome, many of whom can independently use public transport if it is reliable and predictable. Public transport operators can work effectively with disabled persons' organisations and social workers to promote travel training. It is beneficial to include road safety education in travel training to teach people safe places to cross.

Where to start – training

Many public transport operators routinely train their staff in safety and operational aspects of the service. Modules on disability awareness can easily be incorporated into these programmes, especially for new recruits. The costs of developing and delivering the training can be kept low by involving disabled persons' organisations in the process; this will also enhance the value of the training to both parties.

A training video can be made relatively easily and used to train staff. Helpful videos and other training materials can be shared between transport stakeholders in different countries.

7.2 Transport operators' policies

Some of the barriers faced by disabled people are an unintentional result of the policies of transport operators. These are often driven by concerns over the safety of disabled people if they are involved in an emergency situation or service disruption.

One example occurred in London, UK, where until a few years ago, a passenger who travelled in a wheelchair was not permitted to use the rail services that ran in small-bore deep underground tubes, even if the origin and destination stations were accessible. The reason for this ruling was the difficulty of evacuating a passenger in a wheelchair from a train in a deep tube in the event of a breakdown or accident. Evacuations were through narrow doors between coaches to the end of the train, and then along the track to the nearest station. This regulation or policy has been rescinded, and a passenger in a wheelchair is permitted to travel on any underground line, provided it is physically accessible.

Another example occurs on many rail systems, where passengers who need to use an elevator to reach a platform must be accompanied by a member of staff. This is at best inconvenient, and on the frequent occasions when no staff are available and the elevators are locked, prevents the disabled passenger from travelling. In contrast, the Washington Metro in the United States allows any passenger to use any elevator on the system without a staff member present. There is a simple notice on elevators asking able-bodied passengers to yield priority to passengers with disabilities.

A third example occurs with airlines, where some limit the number of disabled passengers on any one flight. The reason is the extra time required to evacuate them in an emergency.

Any policy restricting travel by disabled people should be examined in detail to determine if it is really necessary. Where there is any uncertainly, the decision should be biased to enabling disabled passengers to travel independently. If this involves passengers with disabilities accepting a greater level of risk than other passengers, they should be informed so that they may take an informed decision on whether to travel.

7.3 Government policies

Just as policies of transport operators can unintentionally create barriers for disabled people, similar barriers can be created by government policies. Again, these are usually a consequence of concerns over safety, though another group of barriers can be created by the need to ration access to special services for disabled people.

An example of barriers created in many countries by concern over safety is provided by the process involved in older car drivers renewing their licences. Because of concerns over the safety of older drivers (for which there is little empirical evidence), some countries require older drivers to undergo medical examinations or driving tests before renewing their licence. The consequence of this is that some older drivers surrender their driving licence rather than undergo the required examinations. Empirical evidence shows that the demanding renewal procedures have no beneficial effect on road safety.

Another example is setting access regulations for public transport vehicles that prevent some classes of mobility aid, such as pavement vehicles or scooters, being carried. A variation of this is setting the maximum size of wheelchair that may be carried too small can prevent a significant number of disabled people travelling.

Another example, this time of rationing provision, is only allowing particular classes of disabled people to use specialised door-to-door services. This usually leaves groups of frail elderly people and people with impaired walking, who are unable to use conventional public transport, with no transport, because they do not satisfy the restrictive definition of disability to qualify for the specialised services.

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