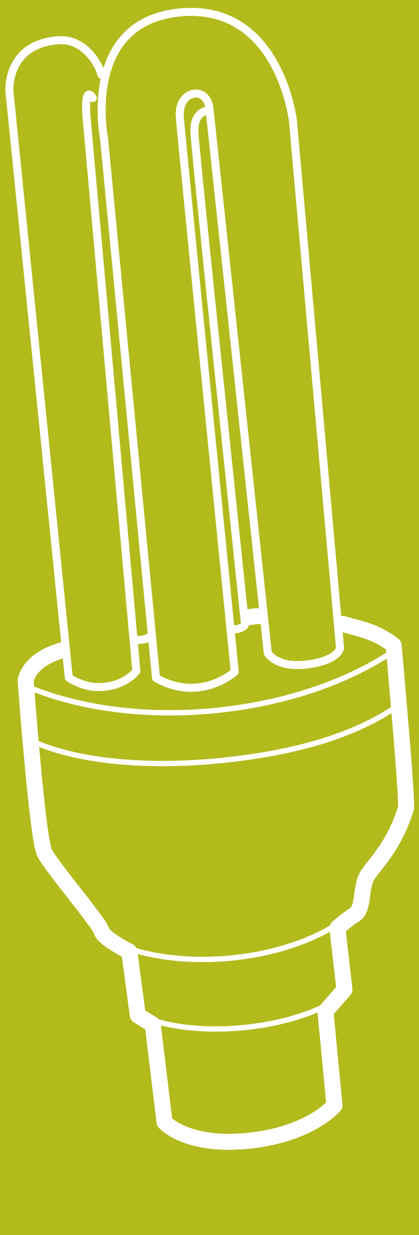
Building for Everyone:

A Universal Design Approach

Internal environment and services

4



Centre for Excellence in Universal Design

Creating an environment that can be used by all people, regardless of their age, size, disability or ability.

The National Disability Authority's Centre for Excellence in Universal Design has a statutory role to promote the achievement of excellence in universal design in:

- the design of the built and external environment
- product/service design
- information and communications technologies (ICT)
- the development and promotion of standards
- education and professional development
- raising awareness of universal design

More information and updates on the website at: **www.universaldesign.ie**

Building for Everyone

Booklet 4 – Internal environment and services

The other booklets from the
Building for Everyone series:

Booklet 1 - External environment and approach

Booklet 2 - Entrances and horizontal circulation

Booklet 3 - Vertical circulation

Booklet 5 - Sanitary facilities

Booklet 6 - Facilities in buildings

Booklet 7 - Building types

Booklet 8 - Building management

Booklet 9 - Planning and policy

Booklet 10 - Index and terminology

Contents

4.0 Objectives

The guidance in this booklet promotes the concept and philosophy of universal design and encourages developers, designers, builders and building managers to be innovative and think creatively about solutions that meet the needs of all building users regardless of their age, size, ability or disability.

The objectives of the series of booklets are to:

- identify and promote best practice with regard to universal design of the built and external environment
- provide best practice guidelines that in no way conflict with the requirements of existing regulations in Ireland
- provide guidelines that are usable by and accessible to the target audience
- promote the achievement of universal design in Ireland

This booklet aims to:

- identify and promote best practice for the design of a building's interior and the provision of services within the building with regard to universal design
- increase awareness of, and to encourage designers to identify, the needs of all those who require good internal environments and layouts within buildings in order to undertake daily activities
- highlight the wider benefits experienced by all when accessible and universally designed features, services, and layouts are provided within buildings
- encourage designers to provide universal design solutions for internal environments that look beyond the recommended requirements of national building regulations

4.1 Introduction

This booklet is part of the series "Building for Everyone – A Universal Design Approach," which aims to provide practical guidance on the universal design of buildings, places and facilities.

Universal design places human diversity at the heart of the design process so that buildings and environments can be designed to meet the needs of all users. It therefore covers all persons regardless of their age or size and those who have any particular physical, sensory, mental health or intellectual ability or disability. It is about achieving good design so that people can access, use and understand the environment to the greatest extent and in the most independent and natural manner possible, without the need for adaptations or specialised solutions (see full definition in **Appendix A1**).

Why universal design?

People are diverse - some are left-handed and some right-handed - and vary in their age, size and functional capacities. Illness or disability (whether temporary or permanent) can also affect characteristics such as a person's mobility, dexterity, reach, balance, strength, stamina, sight, hearing, speech, touch, knowledge, understanding, memory, or sense of direction. A reference list with these booklets indicates some of the key differences in human abilities that should guide design of buildings and of outdoor places. (See full description of Human Abilities in **Appendix A2**).

People of diverse abilities should be able to use buildings and places comfortably and safely, as far as possible without special assistance. People should be able to find their way easily, understand how to use building facilities such as intercoms or lifts, know what is a pedestrian facility, and know where they may encounter traffic.

Given the wide diversity of the population, a universal design approach, which caters for the broadest range of users from the outset, can result in buildings and places that can be used and enjoyed by everyone. That approach eliminates or reduces the need for expensive changes or retro fits to meet the needs of particular groups at a later stage.

It is good practice to ascertain the needs of the range of expected users as early as possible, and to check the practicality and usability of emerging designs with a diverse user panel.

Designing for one group can result in solutions that address the needs of many others. For example:

- level entry (Step-free) entrances facilitate not just wheelchair users but also people with buggies; people with suitcases or shopping trolleys; people using walking or mobility aids; and people with visual difficulties
- larger toilet compartments provide easier access to wheelchair users; those with luggage or parcels; parents with pushchairs or accompanying small children; those using walking or mobility aids; and larger-sized people
- clear, well-placed signage that uses recognised symbols or pictograms helps people with reading or cognitive difficulties, and those whose first language is neither English nor Irish

Sometimes one solution will not suit all and a range of options will need to be provided, for example:

- providing both steps and a ramp where there is a change in level
- providing parking ticket machines that offer slots at different heights to facilitate use at standing height, at sitting height, and by people of small stature.

This series of booklets is for architects, engineers, planners, developers, designers, building contractors, building workers, building managers, and others involved in designing, commissioning and managing buildings and their surroundings. It provides guidance on a universal design approach to all new buildings, and the use and adaptation of existing environments.

Those who commission, design, construct or manage any part of the built and made environment also have a duty of care to adhere to relevant legislation and regulations including equality legislation, building regulations and health and safety regulations.

The guidance is based on a best practice approach, drawing on up-to-date international best practice, guidelines and standards; previous guidance by the National Disability Authority; and extends beyond disability access matters to incorporate a universal design approach. The series is fully compatible with Part M (2010) of the Building Regulations and associated Technical Guidance Documents related to Part M.

A disability access certificate is required for new buildings other than dwellings (including apartment buildings) and certain other works (as set out in Article 20 D (1) of SI 351 of 2009) to which the Requirements of Part M of the Building Regulations apply, which commence or take place on or after 1 January 2012. Further details on these and other relevant standards, codes of practice, and professional codes of practice are listed in **Appendix A3** Further Reading.

The detailed guidance provided here does not represent the only possible solution. Designers may come up with other ways to meet a diversity of users. New materials and technologies that emerge may open up further possibilities of accommodating the diversity of the population.

Checklists are provided throughout the series and while they provide a summary of main considerations and technical criteria, they should not be regarded as a substitute for the main text or an exhaustive list.

A comprehensive **index** is also available with the suite of booklets.

The Building for Everyone series is available online at **www.nda.ie** and **www.universaldesign.ie**. Electronic links are provided to relevant sections in the different booklets. As standards and requirements develop, the electronic versions of these booklets will be updated.

The electronic version is produced in accessible PDF format in accordance with the Web Content Access Guidelines 2.0. If you have any difficulties in this regard or require the document, or particular sections, in alternative formats, please contact the Centre for Excellence in Universal Design at the National Disability Authority, **info@ceud.ie** or (01) 6080400.

4.2 Terminology

Accessible Facilities – Facilities that are designed for all users of a building or external environment, including the young and old, and those of all sizes, abilities, and disabilities.

Acoustics – Characteristics relating to sound.

Building – A permanent or temporary structure of any size that accommodates facilities to which people have access.

Building user – A person regardless of age, size, ability, or disability using facilities in a building or associated external environment.

Coir matting – A coarse kind of carpet made from coconut fibre usually used as a floor mat in matwells at building entrances.

Matwell – Entrance door matting systems set into a frame in the floor.

Reverberation – The reflection of sound within a room or space.

Wayfinding – A collective term describing features in a building or environment that facilitate orientation and navigation.

4.3 Design Issues

Although all sections of this booklet cover specific aspects of the internal environment in detail, all are interrelated and require consideration alongside broader design issues, such as the overall building layout and elements of structure.

The acoustic environment of a building is not only influenced by the geometry of a room or space and its surface finishes, but by the relationship of the building to external noise sources and the impact of noise generated in adjoining areas. Construction elements, such as the floor, wall, and roof structure typically provide the backing or mounting surface for finishes, but can vary considerably in form and have a direct bearing on the acoustic characteristics of a space. The desired acoustic qualities for each area of a building should be considered from the earliest planning stage to mitigate problems caused by noise pollution. Acoustic qualities should also be considered throughout all of the detailed design stages, in order to create an acoustically balanced environment through the use of appropriate materials and construction.

The appropriate selection of surface finishes, particularly floor finishes, has a direct impact on usability and functional performance, and is essential for the safe movement of everybody around a building. By successfully optimising the visual and textural characteristics of surface finishes, designers can also facilitate identification of spaces, routes, features or services, as well as potential hazards. Suitable, uncluttered surface finishes, combined with good lighting, also aid visual communication, an essential tool for many people particularly people with cognitive and mental health difficulties.

Effective wayfinding and orientation within a building often require the use of a well-designed system of signage. However, other factors have a significant impact on the legibility of a building layout; many other features of an environment can be used to navigate and direct people to particular features. A logical internal arrangement of rooms and spaces within a building can greatly enhance the ability of people to navigate independently and predict the location of particular areas without reliance on signage. Other characteristics of an environment, such as the sound of voices, the presence of lighting at a bar, or the fragrance from plants around an entrance, should be considered beneficial features and an aid to wayfinding, particularly for people with cognitive, mental, or visual difficulties.

Many features that are often principally considered as defining the aesthetics of a building interior, such as the wall and floor finishes, the colour scheme, and the position of lights, can have a wide-ranging effect on the usability of an environment. Considered together, these features can be used to optimise the visual and acoustic characteristics of a building and contribute to the creation of an environment that is safe, comfortable, and enjoyable for everyone to use regardless of age, size, ability, or disability.

This booklet should be read in conjunction with others in the series, but in particular **Booklet 2: Entrances and horizontal circulation** and **Booklet 3: Vertical circulation**. The development of a logical and effective system of wayfinding involves the provision of suitable routes for horizontal and vertical circulation, and a central focal point for information, such as a building entrance and associated reception area.

Checklist – Broad planning and interrelated detail
• Consider the detailed aspects of the internal environment alongside broader design issues.
• Think about how detailed design issues may affect other aspects of the internal environment and the relationship between them.

4.4 Surface Finishes

Surface finishes have a significant and wide-ranging impact on the safety, usability, legibility, and comfort of spaces within the built environment, in addition to the obvious issue of defining the building's aesthetic characteristics.

The selection of surfaces finishes should be considered as an integral part of the overall building design and should be undertaken in conjunction with the design of lighting, general acoustics, signage, and information.

Suitable surface finishes will assist building users in orientating themselves, navigating and moving comfortably around a building, identifying features and obstacles, and communicating effectively in an acoustically-balanced environment.

Acoustically-balanced environments are particularly beneficial for people with hearing difficulties and for those who have cognitive, mental health or visual difficulties.

4.4.1 Floor finishes

Floor finishes in buildings should be selected with regard to a number of criteria including safety, functional performance, durability, visual characteristics, acoustic performance, and environmental issues.

Safety is paramount for all building users. The key safety issue in buildings is the slip resistance of the floor finish. Effective slip resistance reduces the likelihood of a person slipping and provides a firm foothold and wheel grip. Slip resistance characteristics should be maintained when the surface is both wet and dry and when spillages occur.

The degree of slip resistance of a floor finish is directly related to the surface roughness, or coefficient of friction, and is represented by the Slip Resistance Value (SRV).

A smoother surface provides less slip resistance and a rougher surface provides greater slip resistance.

Where there is a change in floor finish and the slip resistance characteristics of adjacent materials are significantly different, there is an increased risk of tripping or slipping. The risk can be reduced by ensuring that changes in surface finish occur out of the direct line of travel, for example, to the side of an access route or in a location, such as a doorway, where people are alerted to a potential change by other features.

The risk of tripping or slipping is a consideration in the use of tactile warning surfaces at the top and bottom of internal steps. Tactile hazard warning surfaces are typically manufactured from relatively hard, non-slip materials that have different frictional, or slip resistance, characteristics from floor finishes commonly found in internal environments, such as carpet and linoleum.

The potential risks involved in the use of such surfaces should be fully explored in the form of a risk assessment prior to specification. Where it is not considered appropriate to use a tactile hazard warning surface, floor finishes that contrast visually should be used as an alternative to highlight the change in level. Refer also to **Booklet 3: Vertical circulation, Section 3.5.3**.

Ease of movement is important for all building users and the provision of suitable floor finishes that are firm, even, securely fixed, and non-directional are considered universally designed. Anyone using a mobility aid, such as a stick or a walking frame, or who has difficulty lifting their feet, will be much more likely to trip on a deep pile carpet than a more solid floor covering. Where carpets are used, consideration should be given to the type of underlay, pile height, and density to ensure the surface is sufficiently firm.

Directional floor coverings, such as deep-pile carpets and coir matting, should be avoided. Such floor coverings tend to direct wheels in the direction of the weave or pile, requiring much greater effort to propel a wheelchair, pushchair, trolley, or other wheeled device.

Loose-laid mats should be avoided as they present a potential trip hazard to all building users. They are also prone to ‘creeping’ across the floor surface, which increases the likelihood of a person slipping. Where supplementary mats are required, they should be firmly fixed to the floor along each edge.

Image 4.1 Example of correct floor mat at building entrance.

All floor finishes should be durable and selected with regard to the likely volume of use. The slip resistance of floors may reduce as the surface becomes worn. Fraying edges, loose tiles, sheets or boards and poor quality mats will cause tripping and slipping. Floors need to be maintained so that they remain in a safe condition and should be easy and quick to clean in the event of a spillage.

Visual contrast between surfaces and features in a building is important to enable people with visual difficulties to navigate safely around an environment and to identify features and potential obstacles.

Visual contrast between the floor, wall and ceiling surfaces in a room or space enables people to assess the shape and extent of the area. Visual contrast is also beneficial for people who have cognitive, mental health or visual difficulties.

The use of a contrasting floor finish can also be used to identify potential hazards, such as change in level, or an obstacle, such as a column or barrier.

Image 4.2 Example of junction between carpet and linoleum-type flooring, which differentiates the circulation route from the seating area.

The use of visually contrasting floor finishes and changes in texture can be used creatively to assist with wayfinding and navigation, and to define different areas within a building. Floors can be colour coded to identify different floor levels or a particular department or area of a building. Floor finishes can incorporate a coloured line to lead people, for example, from a hospital reception desk to a particular outpatient clinic. Changes in the type of floor finish, texture, colour, and tone can be used to delineate between different areas, such as an access route and adjacent seating area. Carpet borders and highlighted areas can define particular areas or room entrances.

Expansive floor finishes that are shiny or reflective should be avoided as they can be visually confusing and are a potential source of glare. Reflections from windows or from the sky through an atrium roof can be particularly disorientating if the floor finish is not specified appropriately. Glare caused by reflections of direct sunlight or other bright light sources is likely to be a source of discomfort for some people.

Shiny floor finishes may also be perceived as being wet, which can cause anxiety for many people who will not want to cross the floor surface for fear of slipping.

Floor finishes with a matt or satin finish are preferred in the majority of circumstances. Shiny or reflective materials may be acceptable when used carefully for small details within a floor surface, but not for large areas .

The design and placement of natural and artificial light sources should be considered alongside the selection of floor finishes to reduce the likelihood of glare and reflection and to ensure the floor surface is adequately and evenly illuminated. Refer also to **Section 4.5**.

The use of large or bold patterns on floors should be avoided as they can be visually confusing and may make it difficult for people to identify potential obstacles and changes in level. The use of stripes, or strong contrasting lines in particular, should be avoided as these can be perceived as the edge of a step and cause a person to trip. Plain surfaces or a small pattern using complementary colours are preferred.

The acoustic characteristics of floor finishes and the surfaces on which they are installed can affect the level of background noise in a space and the overall quality of sound within an environment. A good acoustic environment will enable people to hear speech and other desired sounds clearly, and is particularly beneficial for people with hearing difficulties.

For people with visual difficulties, audible clues within an environment can aid navigation and wayfinding, but they need to be clear and not masked by excessive reverberation or echo.

A good acoustic environment is one in which the level of background noise is low and the reverberation time is suitable for the size and purpose of the space, as **Section 4.9**.

In general, a balance between hard and soft surfaces within a room or space will contribute to a good acoustic environment. Hard floor finishes include timber, ceramic tiles, stone, metal, and glass. These will reflect sound and increase reverberation within a room. Softer surfaces, such as carpet, vinyl, rubber, and cork, will absorb some sound and reduce reverberation time.

The use of materials with contrasting acoustic characteristics can be used to advantage to define areas within a building or space. For example, a hard surface, such as a timber floor set within an area of carpet, could be used to delineate a circulation route through a hotel reception area. The timber and carpet will make a different sound when walked upon and provide audible clues as to the different areas of the building. However, care should be taken to ensure that adjacent materials that have different slip resistance characteristics do not present a hazard, as discussed above. Wherever there is a change in material, the finished floor surface of both materials should be level.

Some floor finishes may directly or indirectly aggravate allergic reactions or sensitivities in some people by harbouring dust, hair, and other particles, or by affecting indoor air quality. Carpets, for example, will harbour dust and hair more readily than smoother surfaces that can be more effectively cleaned and washed. Synthetic floor finishes that generate static electricity also have a tendency to attract dust and other particles that are harder to remove. Where this may be an issue, the use of natural floor coverings should be considered.

Table 4.1 Key desirable characteristics of floor finishes for different areas of a building and situations to avoid:

Building element	Characteristics of floor finishes	Things to avoid
Entrances	• Hard wearing. • Firm, dense and non-directional. • Effective in removing and retaining water and dirt from feet and wheels, to avoid transfer to other internal surfaces. • Easy to clean. • Surface flush with adjacent floor finishes. • All edges firmly fixed. • Visually contrasts with wall surfaces. • Slip resistant when both wet and dry.	• Any form of compressible or directional matting, including coir. • Loose-laid mats. • Changes in level between entrance mats and adjacent floor finishes. •
Corridors and access routes	• Firm, level and securely fixed. • Flush with adjacent surface finishes. • Slip resistant when both wet and dry. • Matt or satin finish. • Plain, mottled, or small pattern with complementary colours. • Even level of illumination. • Visually contrasts with wall finishes. • Possible use of colour coding to aid orientation and wayfinding.	• Soft, compressible floor finishes, such as deep pile carpet. • Changes in level between adjacent floor finishes. • Bold patterns and stripes. • Large areas of shiny or polished surfaces that create glare and reflection. • Lighting design that causes dark shadows.

<table>
<tr><td>Stairs and ramps</td><td>

Firm, level and securely fixed.
Slip resistant when both wet and dry.
Greater slip resistance for ramps and inclined floors than for horizontal surfaces.
Ramp slope to visually contrast with landings.
The top and bottom of a flight of steps to visually contrast with the tread and riser surfaces.
Where different materials are used to highlight a change in level, at the top and bottom of the flight, the slip resistance characteristics of each to be similar.
Floor finish for treads, risers, and step nosings to be consistent throughout a flight.
Floor finishes to extend the full width of each step.
Step nosings to be firmly fixed and extend to the full width of each step.
Matt finish with plain, mottled, or small patterns using complementary colours.
Adequately and evenly illuminated.

</td><td>

Warning surfaces that have different slip resistance characteristics.
Floor finishes that do not extend the full width of a flight of steps, such as carpet runners.
Lighting design that casts a shadow obscuring the step edges.
Large areas of shiny or reflective surfaces.
Bold patterns and stripes.
Shiny or polished surfaces that create glare and reflection.

</td></tr>
<tr><td>Lifts</td><td>

Firm, level, and securely fixed.
Slip resistant when both wet and dry.
Similar slip resistance characteristics to landing floor finishes.
Light colour or tone.

</td><td>

Soft, compressible floor finishes, such as deep pile carpet.
Bold patterns and stripes.
Dark floor finishes.
Surfaces with different slip resistance characteristics to landing floor finishes.

</td></tr>
</table>

General rooms (Including waiting rooms, meeting rooms, classrooms, offices)	• Firm, level and securely fixed. • Adjacent surface finishes to be flush. • Slip resistant when both wet and dry. • Matt or satin finish. • Plain, mottled or small patterning with complementary colours. • Even level of illumination. Visually contrasting with wall surfaces and other fixtures.	• Soft, compressible floor finishes, such as deep pile carpet. • Changes in level between adjacent floor finishes. • Large areas of shiny or reflective surfaces. • Bold patterns and stripes. • Shiny or polished surfaces that create glare and reflection.
Wet rooms (Including bathrooms, showers and changing rooms)	• Slip resistant when both wet and dry. • Non-abrasive. • Comfortable underfoot. • Easy to clean. • Laid to recommended falls (1 in 50) away from circulation routes. • Incorporating flush drain covers.	• Surfaces that become slippery when wet. • Profiled surfaces that can be uncomfortable to walk on • Channel drains and recessed drains that may present a trip hazard.
Kitchens (Non-domestic)	• Slip resistant when both wet and dry or when contaminated with spillages of grease and dry goods. • Easy to clean.	• Surfaces that become slippery when wet or after spillages. • Surfaces that are difficult to clean and pose a risk to hygiene.

Refer also to **Booklet 2: Entrances and horizontal circulation**, **Section 2.4** for door thresholds and **Section 2.4.1** for matwells.

Checklist – Floor finishes
• Ensure slip resistance is maintained when the floor is wet and dry and when spillages occur.
• Ensure changes in floor finish occur away from the direct line of travel or in a doorway.
• Use tactile warning surfaces with 3mm ridges as they are detectable indoors due to surrounding smooth floor finishes.
• Use tactile warning surfaces only for internal stairs after all risks have been considered in the form of a risk assessment.
• Highlight the change in level using floor finishes that visually contrast where tactile warning surfaces are not suitable.
• Install floor finishes that are firm, even, securely fixed, and non-directional.
• Avoid the use of deep pile carpets and coir matting.
• Avoid the use of loose-laid mats.
• Make sure floor finishes are durable and well maintained.
• Optimise visual contrast between floor and wall finishes and other features, such as obstructions.
• Use changes in the colour, texture and acoustic characteristics of floor finishes to delineate areas and contribute to a system of wayfinding.
• Avoid shiny and reflective floor finishes.
• Avoid large and bold patterns.
• Consider the placement of natural and artificial light sources to provide an even level of illumination.
• Consider the use of natural floor coverings to avoid the potential for aggravating allergic reactions.

4.4.2 Wall and ceiling finishes

The selection of wall and ceiling finishes should be fully considered alongside floor finishes to optimise the visual, acoustic, and aesthetic qualities of an environment. This is of particular concern for people with hearing difficulties and for those who have cognitive, mental health, or visual difficulties.

As with floor finishes, bold patterns should be avoided as they may cause visual confusion and mask features, such as a change in direction or a useful wall-mounted fixture. Patterned wall surfaces can also be distracting for people who lip read or who use sign language and for those who have cognitive, mental, and visual difficulties. It is particularly important that walls forming a background to staff at reception counters and information desks, or to speakers in a lecture room, provide a plain, even, and non-distracting surface.

Wall finishes of different colours can be used to differentiate between, for example, floor levels or departments in a large building to help people to orientate themselves, in the same way as for floor finishes. A brightly coloured or contrasting band can be used along walls to assist with navigation, as an integral part of a signage and wayfinding system, with the contrasting band linking subsequent signs.

Wall finishes of different textures can also be used to define areas by touch, although wall finishes up to a height of 2000mm above floor level should be non-abrasive.

Image 4.3 Example of skirting painted as a wayfinding guide for people with visual difficulties.

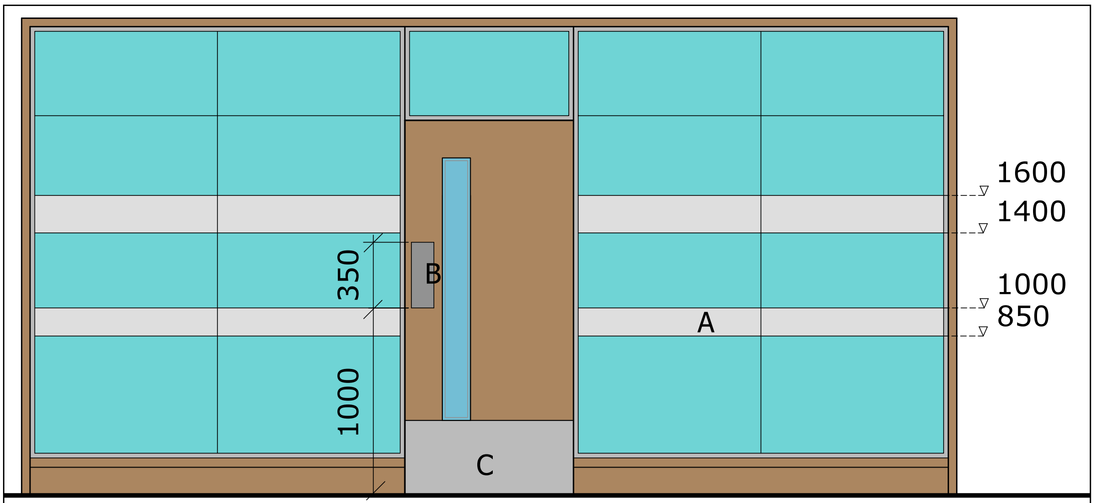
Image 4.4 Example of wall painted as a wayfinding guide for people with visual difficulties.

Polished and shiny wall finishes that are likely to cause glare and reflection should be avoided as these can be visually confusing and a source of discomfort. Walls with windows should be pale in colour so as to minimise the glare of the bright window when viewed against the surrounding wall. Generally speaking, ceilings should be bright so that both artificial and natural light sources are reflected and distributed evenly.

Where walls consist of a glazed screen, the glass should incorporate permanent markings so that its presence is clearly apparent to people at a range of eye levels. The markings should be at two levels, 850mm to 1000mm and 1400mm to 1600mm above floor level, as **Figure 4.1**. The markings should contrast visually with the background surfaces viewed through the door in both directions and in all lighting conditions. The use of two-tone markings often improves visibility.

Whatever style or colour is adopted, it is imperative that the presence of glass is clearly highlighted, as otherwise it presents a significant hazard to all building users.

Figure 4.1 Glazed screens - markings for safety and visibility.



Key

A. Frosted glass manifest or two tone manifest as safety and visibility strip
B. Push plate
C. Kickplate

Note: All dimensions in millimetres

Image 4.5 Example of glazed screen/partition with markings for visibility and safety.

Image 4.6 Example of floor pattern as visual guide.

Image 4.7 Alternative example of floor pattern as visual guide.

Checklist – Wall and ceiling finishes
• Consider wall and ceiling finishes alongside floor finishes.
• Avoid shiny and reflective surfaces.
• Avoid large and bold patterns.
• Consider the use of colour coding for large or complex buildings as an aid to wayfinding.
• Consider the use of changes in texture to differentiate between internal features or areas.
• Ensure the placement of windows and artificial lighting minimises glare and reflection.
• Incorporate permanent markings in glazed walls and screens, as **Figure 4.1**.

4.4.3 Visual contrast

Visual contrast between surfaces is a common theme in the selection of surface finishes and benefits all building users.

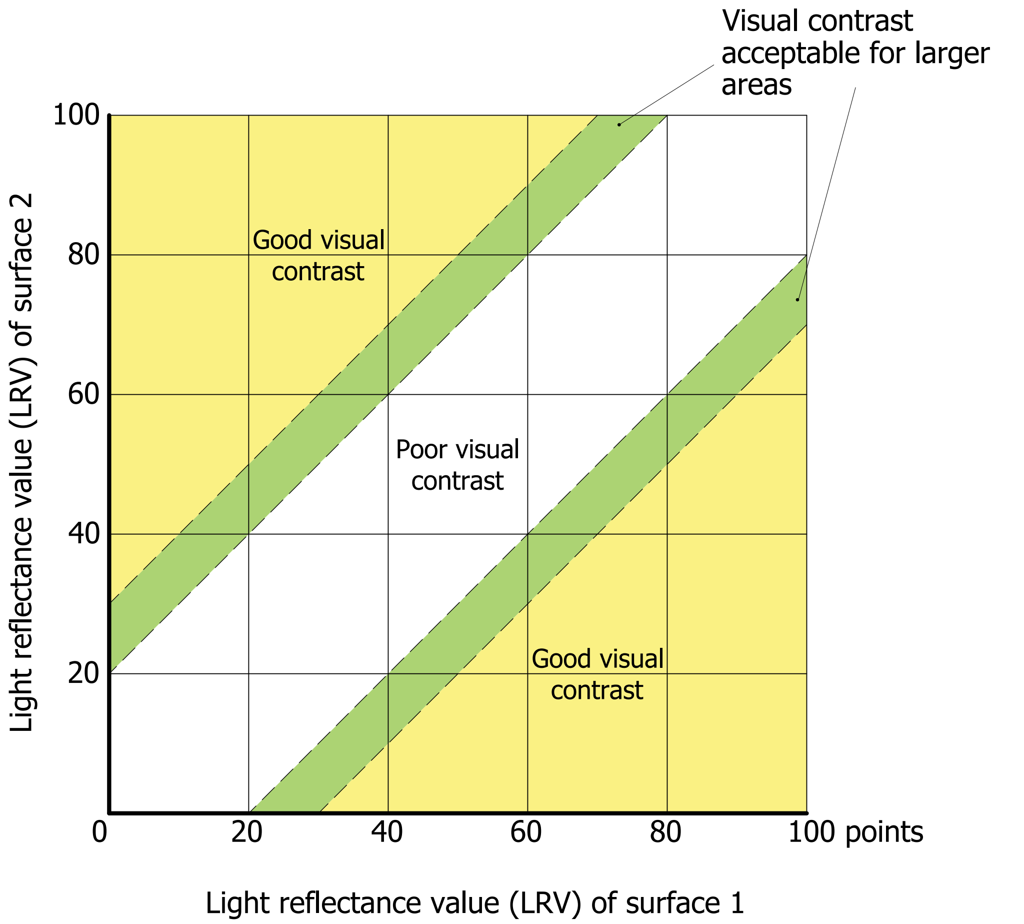
Effective visual contrast promotes visual clarity; orientation; the perception of space; and the identification of surfaces, features, and potential obstacles.

Visual contrast can be assessed by comparing the light reflectance value (LRV) of different surfaces, such as walls, floors, ceilings, and doors. The LRV is a measure of the amount of light that a surface reflects and is represented by a scale from 0 to 100, where 0 represents a fully absorbing surface (black) and 100 a fully reflecting surface (white).

Research has been undertaken to establish the degree of difference required by people with visual difficulties between the LRV of two adjacent surfaces to provide adequate visual contrast. The results drawn from the research are illustrated in the graph in **Figure 4.2** and can be used as a guide for the initial selection of colours and surface finishes in an interior environment.

Note: Part M states that lux levels should be measured at floor level on corridors.

Figure 4.2 Graph illustrating the perceived degree of visual contrast based on the light reflectance value (LRV) of two adjacent surfaces.



Graph illustrating the perceived degree of visual contrast based on the LRV of two adjacent surfaces

The graph indicates that where the LRV of two adjacent surfaces is 30 points or more, effective (good) visual contrast will be achieved. Where the LRV of two adjacent areas is less than 20 points, visual contrast is likely to be insufficient (poor). Where the difference between the LRV of two adjacent surfaces is between 20 and 30 points, visual contrast may be adequate in some circumstances.

The general view, is that smaller items or surfaces require a greater difference in LRV in order to achieve an adequate level of visual contrast and that larger items or surfaces require less. For example, the difference in LRV between a light switch and the surrounding wall should be greater than the difference in LRV between the floor and wall surfaces in a room.

During the design stages, the LRV of different colours and surfaces can be established by reference to manufacturers' product data, where provided, or by comparison with colour swatches that include LRV measurements.

Checklist – Visual contrast
• Optimise visual contrast between surfaces and features.
• Ensure visual contrast between smaller surfaces and objects is greater than for larger surfaces.

4.5 Lighting

Good lighting is essential for everyone. It enables people to move safely and independently around a building or external environment. Good lighting aids the perception of space, colour, and texture. It facilitates identification and reading of signs and instructions. It also makes lip-reading and visual communication easier.

Poor or unsuitable lighting may render a building or environment inaccessible to some people. If lighting levels are too low, some people may not be able to differentiate between features in a building or along an external route, and therefore may be unable to navigate independently. If lighting is positioned so that it creates sources of glare and reflection or strong shadows, it may cause physical discomfort for some people and may also be visually confusing. The provision of good lighting is of particular concern for people with visual difficulties.

Visual contrast between surfaces can be enhanced or minimised by light; the design and selection of surface finishes and lighting should always be considered together.

If light sources are positioned in the wrong place, they may cause glare on a surface, which can make it appear as having a much lighter tone than it actually does. Poorly positioned lights can also appear to wash the colour from surfaces, again, reducing or eliminating any intended contrast with adjacent surfaces or features. Inadequate levels of light may make it difficult to differentiate between surfaces altogether.

4.5.1 Internal lighting

Internal lighting in buildings includes all sources of natural and artificial light, including windows, roof lights, glazed doors, glazed walls, and light fittings. These should all be considered as contributing to the overall lighting design. However, the artificial lighting installation should be designed to provide an adequate and even level of light on its own so that the building can function as intended during the hours of darkness.

Sources of natural or artificial light within a building should be carefully considered at the earliest design stages. Windows and lights should not be positioned at the ends of corridors or behind people at reception areas or counters. Such light sources place people in silhouette, which creates difficulties for people who lip-read and for people with visual difficulties who cannot identify the proximity of oncoming people or objects. Wherever communication is important, such as at reception counters, lighting should be positioned to illuminate a person's face.

Lighting design that creates strong shadows on walls and floors should be avoided, particularly if there is a change in level or direction. Strong shadows can mask step edges or give the impression that there is a step when in fact there is not. Both situations are potentially dangerous and may cause a person to trip and fall.

The use of natural light to illuminate building interiors is encouraged for several reasons. Natural light provides a beneficial connection with the external environment and has an inherent quality that is difficult to replicate with artificial light. Windows and other glazed components enable people inside a building to monitor the weather conditions, and may also help them orientate themselves or gain a sense of the time of day. However, some aspects of natural light need to be controlled; this requires detailed consideration at the design stage. Issues, such as orientation, should be considered at an early stage.

Image 4.8 Example of natural light used to light a corridor.

Features, such as sun-shading devices, solar-control glass, and blinds, may need to be incorporated to reduce the potential for glare; the creation of strong shadows; and any overheating that may be caused by direct sunlight entering a building.

White window frames and window reveals assist in throwing light deeper into a room, which is likely to be beneficial in most circumstances. Dark frames and dark window reveals tend to reduce the amount of light being reflected into a room. Dark frames and reveals around a bright light source, such as a window or glazed door, are also more likely to cause glare and should be avoided wherever possible. Surfaces around rooflights and other sources of natural light should preferably be pale in colour.

Light should be distributed evenly throughout rooms and in all circulation areas.

In corridors, a suitable distribution of light that is comfortable to the eye can be achieved by fixing light fittings in a line down the centre of the corridor. Fluorescent fittings fitted transversely across a corridor are not satisfactory. Careful consideration should be given to the direction of natural and artificial light in workspaces to avoid glare, reflection, and silhouetting. This is particularly important where people use computers as a screen can be rendered unusable by reflections of if viewed against a strong light source.

Many tasks have optimum light levels. Too much light can cause discomfort, while too little will be inadequate for clear viewing. A lighting design that allows flexibility and control is ideal and will suit the widest range of building users.

The design of a lighting system will depend very much on the nature and use of a particular space. In deep-plan environments where background lighting is provided by artificial means, local lighting and task lighting should be provided. This will enable people to supplement and control the lighting levels and direction of light in their immediate environment to suit their own requirements. This approach will be more energy efficient than simply providing a high degree of illumination over large areas.

The use of dimmer switches may be appropriate in some locations, although the location of the switches should be carefully considered so as not to interfere with any hearing enhancement system (refer to **Section 4.10** below). Passive infrared sensors can also be used to increase light levels automatically.

The 'colour temperature,' or colour rendering characteristics, of artificial lighting should be as close as possible to that of daylight wherever possible. This facilitates the true reproduction of colour and will optimise the perception of colour and visual contrast. Good lighting provision is of particular concern for people with hearing difficulties and for those who have cognitive, mental health, or visual difficulties. Lights that give poor colour rendering will reduce the effectiveness of LRV differentials. Strobe lighting should not be used as this may induce seizures in some people with epilepsy.

Light fittings should be selected to suit their particular function and location. Downlighters should always have diffusers to avoid the potential for glare and reflection. Uplighters positioned at floor level should not be used as they can cause glare and obscure, rather than enhance, visibility.

All lighting installations should be designed to be compatible with other electronic installations and radio-frequency equipment. Some types of fluorescent lighting (but not high-frequency lamps) can cause interference with hearing enhancement systems and should be avoided.

The recommended levels of illumination for internal areas of buildings are given in **Table 4.2**.

Table 4.2 Recommended levels of illumination in internal environments	
Location	**Recommended level of illumination (lux)**
Entrances	150[B]
Corridors, passages, and walkways	150[B]
Steps, ramps, and landings	200[B]
Lift landings and lift cars	200[A]
Lift control panels	100[B]
Toilets, shower rooms, and bathrooms	200[A] to 300[A] (the 300 is as per Part M)
Offices	300[A]
Service counters	250[B]
Telephones	200[A and B]
Switches and controls	100
Directional signs, maps, and information displays	200[A and B]

All figures are based on recommendations in the Canadian (City of London) guidelines except the figure for steps, ramps, and landings, which is based on guidance in BS 8300:2009. (The Canadian guidelines recommend 30 lux for steps and ramps.) Note: Part M states lighting levels should be measured at ramp, tread, and landing levels on stairs and ramps.

The figures are based on recommendations in either the Canadian (City of London) guidelines (figures marked A), or Department for Transport UK - Inclusive Mobility (figures marked B).

Checklist – Internal lighting
• Consider all sources of natural and artificial light.
• Avoid positioning windows or lights at the end of corridors and behind a person at a reception desk.
• Ensure a person's face is well lit wherever communication is important.
• Avoid the creation of strong shadows on floors and walls.
• Ensure all rooms and spaces benefit from some natural light, wherever possible.
• Consider the use of sun-shading devices and blinds to reduce glare from direct sunlight.
• Make sure all rooms and surfaces are evenly illuminated.
• Consider flexibility within lighting design to enable people control individual lighting levels.
• Use lighting that enhances colour rendering of surfaces.
• Avoid the use of strobe lighting.
• Use downlighters that incorporate diffusers.
• Avoid the use of uplighters positioned at floor level.
• Consider the potential for some fluorescent lights to interfere with hearing enhancement equipment.

4.5.2 External lighting

External lighting is important for personal security, safety, and to enable people to read signs and directions. Lighting enhances visual clarity and should be provided at all entrances and building exits; along pedestrian access routes that are in regular use; at bus and tram stops; in car parks; at all outdoor facilities that are in regular use; and to illuminate external signage. The recommended levels of illumination for particular features, as measured at ground level, are given in **Table 4.3**.

Table 4.3 Recommended levels of illumination in external environments

Location	**Recommended level of illumination (lux)**
Entrances	100
Pedestrian access routes and walkways	30
Steps, ramps, and landings	100
Designated car parking spaces	30
Passenger setting-down points	30

External lighting at the approach to a building should clearly highlight and define the entrance area. Good lighting design will help people identify the entrance from a distance during the hours of darkness and will also provide a safe, well-illuminated route for people to approach the building.

The level of external lighting around an entrance should be considered in conjunction with the internal lighting to provide a gradual transition for people entering or exiting a building. Sharp changes in the level of illumination can cause discomfort for some people. Good lighting provision is of particular concern for people with hearing difficulties, and for those who have cognitive, mental health, or visual difficulties.

Lighting to external steps and ramps should be positioned to clearly highlight the tread and riser surfaces and ramp slopes. Lights should not cast shadows on steps or across ramps as this may mask changes in level and present a hazard. Low-level recessed lights should be positioned so that only the light, and not the light source, is visible, otherwise they are likely to create glare. The use of floodlights should also be avoided.

Checklist – External lighting
• Use lighting to highlight the location of a building entrance.
• Provide a gradual transition between internal and external lighting levels around an entrance.
• Ensure external lighting illuminates steps and ramps, without causing shadows.
• Position low-level recessed lights to avoid creating glare.
• Avoid the use of floodlights. When using floodlights to light a building care should be taken to avoid glare reaching the street or road level.

4.6 Power Supply

Electrical cables, such as incoming electrical mains and parts of equipment emanating electromagnetic fields, can interfere with the use of hearing aids and some hearing enhancement equipment. They should be sited away from areas where audible communication is important, such as telephone and reception areas, and meeting and consulting rooms.

Refer to **Section 4.7** below for details of power outlets.

Checklist – Power supply
• Locate electrical mains cables where they will not cause interference with hearing enhancement systems.

4.7 Outlets, Switches and Controls

Outlets, switches and controls should be immediately apparent, easy to reach, simple to operate, and consistent in design. They should visually contrast with their background or surrounding surfaces so that they are easy to identify. When used for similar operations in the same location, control panels and switches should function in the same way or sequence.

All outlets, switches and controls should be positioned in a logical and consistent arrangement throughout a building so that they are easy to locate.

Light switches should be positioned a consistent distance away from door frames, and preferably at the same height as the door handle. Where building occupants are likely to follow a particular route through the building, such as from an entrance to a lobby, then via a circulation area and into individual rooms, the position of light switches should enable people to activate lights in sequence as they move through the building. Similarly, when leaving a building, occupants should be able to switch off lights as they leave an area.

People should never have to move through an unlit area in order to locate a light switch. In many cases, this will require the use of two- or three-way switching. The use of two-way switching is also recommended in locations, such as hotel bedrooms, so that people can control the lights from the bed as well as when first entering the room.

Automatic lights provided in buildings, such as in stairwells and corridors, should be set to ensure that the timings suit the needs of all users.

All outlets, switches, and controls should be positioned a recommended distance of 500mm from any obstructions and the internal corners of a room. The recommended height ranges for different types are given in **Table 4.4**. A clear floor area, at least 900mm wide x 1370mm long, should be provided in front of control panels and the operating mechanism of machines, such as vending or dispensing machines.

Consideration should be made for future options for cabling with power supply to internal doors, above and beside window heads, and at skirting level to provide for future automatic devices, such as ceiling hoists, automatic curtain / blind openers, and door-opening devices.

Table 4.4 Location of outlets, switches and controls

Type	Recommended height range above floor level (mm)	Other considerations
Light switches	750-1200	Wall-mounted light switches should align horizontally with door handles and be a consistent distance from the door edge so that they are easy to locate
Electrical sockets, television and telephone outlets	400-1000	Where plugs are likely to be frequently inserted and removed, sockets should be positioned towards the top of the range to avoid the necessity for people to bend and stoop
Switches and controls (including intercom buttons, switches for extract fans, and heating controls)	750-1000	Controls that require precise hand control should be positioned within easy reach of people in a seated and standing position
Permanently wired switches (including fused spurs and alarm reset switches)	750-1200	
Electricity and gas meters (where the visual indicator is required to be read, but not touched or manually operated)	1200-1400	Meters should be positioned where they can be read by a person at a range of eye levels, but as they do not generally need to be touched or operated, the height range is higher than that for other controls

All height ranges are based on guidance in BS 8300:2009. The majority of height ranges concur with guidance in the Canadian (City of London) guidelines, but where they differ, the lower range or height has been selected.

There should be adequate visual contrast between all switch and socket housings, the adjacent wall, and rocker switch so that each can be clearly differentiated from the others. Where a switch is not available in a colour that contrasts with its surroundings, coloured margins, which are capable of providing the necessary contrast, are available for some of the more common switch types, such as lights or sockets.

All controls and switches should be capable of being operated using one hand and without the need for gripping or twisting. The force required to operate any switch or control should not exceed 22 Newtons.

To operate lights, large rocker-type switches are preferred as they are considered the easiest to operate. Multi-gang switches should be avoided wherever possible as the plethora of switches can be confusing.

Passive infrared light switching, which activates automatically, may be beneficial in some circumstances and obviates the need for people to manually operate individual switches.

Where switched-twin socket outlets are installed, the switches should be on the outside of the unit, rather than between the two plug positions, to avoid confusion.

In dwellings, it is recommended that wall-mounted lighting switches incorporate 20mm-deep switch housings in lieu of the usual 10mm, to facilitate possible future installation of remote control switches.

Switches on inclined surfaces are generally easier to operate than those on vertical surfaces. Inclined surfaces should be tilted up by 15 degrees.

Wherever colour is used to indicate that a switch or appliance is ‘on’ or ‘off,’ the status should also be indicated using text or a pictogram. The use of red and green can be particularly confusing as many people find it difficult to differentiate between these colours.

Any visual information associated with a switch or control, such as instructions or a reference, should be provided in the form of a pictogram and should be embossed to enable tactile reading.

Switching by sensors is increasingly common, with sensors being activated through movement, temperature change, the sound of a voice, or a break in electronic circuitry or infrared beams. Such arrangements can be used for a range of facilities including automatic water taps, light switching, and door opening, which all promote universal design and are important for people with mobility difficulties or restricted hand functions.

For advice on telephones, ATMs, and ticket and vending machines, refer to **Booklet 6: Facilities**.

Checklist – Outlets, switches and controls
• Ensure all outlets, switches, and controls are clearly visible, and easy to reach and operate.
• Use consistency in arrangement, position, style and sequence.
• Locate light switches logically along a route.
• Use two- or three-way switching for lights where flexibility is required.
• Avoid placement of any outlet, switch, or control within 500mm of the corner of any room.
• Ensure clear, unobstructed floor area for approach.
• Make sure switches, background, and mounting surface contrast visually.
• Avoid switches that have to be turned or gripped.
• Keep in mind that large rocker switches are preferred.
• Ensure all switches require a force no greater than 22 Newtons to operate.
• Consider the use of automatic passive infrared operation.
• Provide supplementary text and a pictogram wherever communication is important.
• Use embossed symbols and text to allow for tactile reading.

4.8 Ventilation

Adequate ventilation is required in all habitable areas of a building and may comprise natural ventilation, mechanical ventilation, air conditioning, or a combination of different types, depending on the room or building type and size.

Generally, the most acceptable way of achieving ventilation is through the provision of suitably sized and easily accessible window openings that are positioned so as to avoid draughts. This method gives the user complete control and has inherent environmental benefits.

The design and position of windows for ventilation purposes should be considered in parallel with the provision of windows for natural light, as **Section 4.5.1** above. Windows must not open into circulation spaces where they will cause obstruction and reduce the effective width. Clear access to window controls should be provided at all times.

Mechanical ventilation and air-conditioning systems should be maintained so as to achieve acceptable standards of filtration and dust extraction. Effective maintenance also helps to reduce the tendency of mechanical ventilation systems to vibrate and generate unwanted noise. This may cause annoyance to many building users, but may also make it difficult for some people to hear speech, announcements, or a performance. All systems should be well maintained and cleaned regularly so that they are able to operate as quietly as possible and to maximum effectiveness. The choice of ventilation system should be made with effective acoustics in mind.

Checklist – Ventilation
• Provide adequate ventilation to all rooms and spaces.
• Ensure windows that open are accessible and controllable by building users.
• Make sure mechanical ventilation and air-conditioning systems are well maintained.

4.9 Acoustics

The acoustic design of spaces within a building should suit their intended function and enable people to hear speech, music, or other intended sounds clearly. Good acoustic design will enable sound to be heard without interference or distraction from background noise or excessive reverberation.

The location of a building in relation to external noise sources; the internal layout; the size and shape of individual rooms; and the acoustic performance of the building fabric and its furnishings can all influence the acoustic environment and should be considered fully at each design stage.

Rooms in a building that benefit from a quiet location, such as individual offices, meeting rooms, counselling rooms, and prayer rooms should be located away from external noise sources. Within a building, quieter areas can be buffered from potentially noisier areas with the use of lobbies, screens, or other rooms.

Within each room, good acoustic design can be achieved by ensuring a low level of background noise coupled with an optimum reverberation time for sound generated within the room.

Optimum reverberation times vary according to the room's intended use, such as by a single speaker, for audiovisual presentations or music performances. Generally, rooms designed for speech only require a relatively low reverberation time. Rooms designed for music require a longer reverberation time, with choral music requiring a longer reverberation time compared to contemporary music. Understanding speech is more difficult in areas with longer reverberation times.

Reverberation time is affected by the size of the space and the amount of reflective or absorptive surfaces within the space. A space with highly absorptive surfaces will absorb the sound and stop it from reflecting back into the space. This would create a space with a short reverberation time in which sound may appear to be 'deadened'. Harder reflective surfaces will reflect sound and will increase the reverberation time within a space, resulting in a 'live' acoustic environment. In general, larger spaces have longer reverberation times than smaller spaces. Therefore, a large space will require more absorption to achieve the same reverberation time as a smaller space.

Hard surfaces, such as concrete, brick, plaster, and timber, all reflect sound and will contribute to the creation of a reverberant, potentially noisy, and echoing internal environment.

Softer surfaces, such as carpets, curtains, mineral fibre suspended ceiling tiles, and upholstery, will tend to absorb sound and therefore contribute to a quieter internal environment.

Checklist – Acoustics
• Consider the acoustic requirement of rooms at the earliest planning stage.
• Locate quiet rooms away from external noise sources.
• Use a buffer zone, such as a lobby or foyer, to separate quiet and noisy rooms.
• Establish the desired acoustic characteristics of a room with reference to its intended function.
• Select finishes and methods of installation to achieve a balance of hard and soft surfaces.
• Select ventilation system with minimal noise impact.

4.10 Hearing Enhancement Systems

Hearing enhancement systems enable people with hearing loss to receive amplified sound via their hearing aid or other device, without interference from background noise. They are an essential provision in areas of buildings where audible communication is an inherent aspect of the space, such as in theatres, cinemas and other auditoria; spectator areas in sports venues; meeting rooms, lecture rooms and classrooms; places of worship and confessionals; interview rooms; and at reception, service and information counters. They are particularly beneficial in busy areas where there is background or conflicting noise nearby.

Venues, such as concert halls, theatres, cinemas, other auditoria, and large classrooms or meeting rooms, should have a permanently installed hearing enhancement system. This type of system should also be present in rooms or areas that accommodate more than 50 people; or have audio amplification systems; or have a floor area of more than 100m sq m; and have fixed seating.

In smaller classrooms and meeting rooms, and at the site of other facilities, such as reception desks, payment counters, and interview rooms, either a permanently installed hearing enhancement system or a portable device should be provided.

Wherever hearing enhancement systems are provided, whether permanently installed or portable, the number of receivers available should be equivalent to at least 4% of the total number of seats with a minimum of two receivers.

Lip-reading and sign language are only feasible within a 15m range of the speaker and require particularly good lighting. To facilitate people who use a combination of lip-reading or sign language and a hearing enhancement system, it is important that the hearing enhancement system can be used within a range of 15m of any speaker.

Once installed, hearing enhancement systems should be commissioned and thereafter tested at regular intervals by a number of people with a hearing difficulty to ensure optimum performance. Where the hearing enhancement systems provided are not linked to any other public address or loudspeaker system, they should incorporate or be linked to a sound monitor or sound-enhancing loudspeaker. This is to enable the speaker or any person managing a performance to detect microphone faults.

Specialist advice should be sought prior to the specification and installation of any hearing enhancement system.

Checklist – Hearing enhancement systems
• Provide hearing enhancement systems where audible communication is an inherent aspect of the space.
• Install permanent systems in larger spaces.
• Consider portable systems for some smaller areas and where flexibility is required.
• Ensure regular testing of systems by a selection of people with hearing difficulties.
• Incorporate a fault-detection system in all hearing enhancement systems.
• Obtain specialist advice for all systems.

4.10.1 Induction loop systems

Induction loop systems consist of a sound pick-up device, an amplifier, and a loop. The loop is an insulated wire within which a signal can be received by a personal hearing aid. The loop can be positioned around a room or area, or hung around a person's neck, and may be permanently installed or portable.

Image 4.9 Example of international symbol for induction loop systems.

Image 4.10 Alternative international symbol for induction loop systems.

The amplifier can be connected directly to a sound source, such as a television; DVD or video player; radio; or a microphone. The sound received is amplified and transmitted through the loop. When the hearing aid user is within or close to the loop area, the hearing aid picks up the transmitted signal and converts this into sound.

Image 4.11 Example of signage indicating that there is an induction loop facility in a reception area.

To benefit from an induction loop, a hearing aid wearer must select the induction pick-up facility on their hearing aid. This is commonly achieved by switching the hearing aid to the 'T' (telecoil) position, or by programming the hearing aid to receive the signal.

A hearing aid microphone amplifies all the sound sources around the hearing aid wearer, which can make it difficult to hear speech, particularly if there is simultaneous background noise. An induction loop system is able to amplify a single sound source through a person's hearing aid to facilitate comfortable listening and to effectively eliminate background or incidental noise.

Image 4.12 Example of induction loop sign at a reception desk.

Induction loop systems have the potential for overspill into adjacent areas, and this may be problematic in some circumstances.

Overspill is caused by signals being picked up outside the loop wire. In some situations, this may present confidentiality issues, or may simply render the system unusable. Where an induction loop system is installed in an interview or consulting room, for example, hearing aid wearers seated in an adjacent waiting area may be able to hear confidential discussions by picking up signals close to, but outside, the loop.

It has also been known for hearing aid wearers in one meeting room to receive signals via the induction loop system in an adjacent meeting room, where induction loop systems have been installed in both areas. To avoid such potential problems, the type of system and position of the loop wire should be carefully considered.

In some cases, the provision of a portable system with a smaller, adjustable loop wire or an alternative type of hearing enhancement system altogether may be appropriate.

4.10.2 Permanent induction loop systems

The loop wire in permanently installed systems can be installed within the building structure, for example, within the floor structure or on top of the floor surface. To avoid being damaged, wires should be protected by a non-metallic enclosure, such as a PVC conduit.

The loop should be sited very carefully to avoid metal objects and anything that emits a magnetic field. The loop wire should not be positioned close to reinforcing bars, metal-framed seating, digital cordless telephone systems, fluorescent lighting, dimmer switches or any control that incorporates a transformer coil, all of which may adversely affect the quality of the signal.

Visual display units are a common source of electromagnetic interference and may affect induction loops, particularly portable desk systems and those fitted at counters. The use of flat screen TFT monitors instead of traditional VDUs may alleviate this problem.

4.10.3 Portable induction loop systems

Induction loop technology is relatively small scale and lightweight and lends itself well to portable applications. Portable induction loop systems can provide flexibility in the use of rooms or spaces, particularly in larger buildings. Instead of having to have meetings in one particular room fitted with a permanent induction loop, the availability of a portable system enables many different rooms or areas to be set up for use.

Portable loop systems typically comprise a loop amplifier, one or two microphones, and a loop cable. The loop cable is usually supplied in varying lengths and can be clipped together to suit rooms or areas of different sizes. Loop cables should always be fixed into position so that they do not present a tripping hazard. Portable loops are usually supplied in a carry case or with a purpose-designed storage shelf.

Portable desk loop systems are suitable for one-to-one communication and are often used at information counters or desks where there is no permanent loop system installed. The systems comprise a single integral unit that has no wires and requires no setting up other than switching on. The units are powered by mains-rechargeable batteries, which should be kept fully charged so that the unit is ready for use when required. Portable desk loop systems are positioned at counter or desk level, with the front of the unit facing the hearing aid wearer. With a hearing aid switched to the 'T' position, the loop system feeds amplified speech from the person behind the unit directly into the hearing aid.

Portable clipboard loop systems are available and are suitable for use by people who need to move freely around an internal environment and be able to easily carry the system with them for use when required. Clipboard loops are particularly beneficial for people, such as hospital consultants; people undertaking market research; by conductors or guards on trains; and in many other circumstances.

Portable guide loop systems are also available, which can be carried or worn by tour guides in historic buildings or visitor attractions. They enable hearing aid wearers to receive amplified speech from the guide directly through their hearing aid, within a range of around 5m.

There are also loop systems available that can operate in mobile situations, such as in taxis and buses.

Checklist – Induction loop systems
• Consider the likelihood of overspill into adjacent areas.
• Consider a smaller or adjustable loop wire or alternative type of system, particularly where confidentiality is paramount.
• Protect permanently installed loop wires in a non-metallic enclosure.
• Avoid placement adjacent to any metallic components or electromagnetic equipment.
• Ensure room loop cables for portable systems are fixed in position to avoid creating a trip hazard.
• Consider the most appropriate type of portable system, such as desktop, clipboard, guide loop, or vehicle-based Induction loops that are designed, installed, and commissioned to comply with IEC 60118-4.

4.10.4 Infrared systems

Infrared hearing enhancement systems are based on light and use a transmitter that relays signals capable of being received by headphones. The systems can be portable or fixed. Portable receivers resemble a small radio, with communication via headphones. The headphones can be worn to provide amplified sound directly to the wearer. Alternatively, an infrared receiver can be linked to a portable induction loop worn around a person's neck, which will transmit amplified sound via their hearing aid.

Infrared systems are particularly beneficial where multilingual communication is required, for example, where a voiceover audio description can be provided on one channel and a translation service on another. They are suitable in venues where headsets can be issued from and returned to a central point, such as a ticket office, reception desk, or cloakroom in a theatre, cinema, conference hall, or meeting room. Where this is the case, staff should be trained in using the equipment and should be able to explain instructions effectively to customers. There should also be procedures in place for regular testing and maintenance, for cleaning the headsets between each use, and for safeguarding against loss.

Image 4.13 Examples of infrared hearing enhancement systems.

Infrared systems have the advantage of high-quality sound reception that is comparable to hi-fi quality if they are correctly installed and operated. Infrared systems cannot overspill into adjacent areas and are therefore useful in areas where confidentiality is an issue.

Checklist – Infrared systems
• Consider for use where multi-channel communication is required and where headsets can be borrowed from a central location.
• Ensure procedures are in place for cleaning and maintaining the system.

4.10.5 Radio systems

Radio hearing enhancement systems comprise an FM microphone/transmitter that is worn around the speaker's neck and a receiver worn around the user's neck. Amplified sound is transmitted to the receiver, which sends the signal to the person's hearing aid. The system effectively reduces background and peripheral noise and increases the sound level of the speaker's voice. People who have hearing loss but who do not wear hearing aids can benefit from the system by wearing headphones connected directly to the receiver.

As with infrared systems, radio systems are particularly beneficial where multi-channel communication is required, for example, to provide voice-over audio description and translation services. The availability of different channels also enables radio systems to be used in adjacent rooms without the potential for overspill. However, where confidentiality is an issue, this type of system should not be used as receivers could inadvertently be tuned into transmitters in an adjacent area.

Radio systems are portable and suit use in environments, such as schools and colleges, where students move between different rooms. They are also suitable in venues where headsets can either be issued from and returned to a central point, such as a reception desk, or retained by regular users, such as students in a college. Whatever the circumstances, staff and building managers should be trained in using the equipment and should be able to explain instructions effectively to first-time visitors or customers. There should also be procedures in place for regular testing and maintenance, for cleaning the headsets between each use, and for safeguarding against loss.

Checklist – Radio systems

- Consider radio systems where they may benefit people with a hearing difficulty who do not wear a hearing aid.
- Consider radio systems where multi-channel communication is beneficial and where headsets can be borrowed from a central source.
- Ensure procedures are in place for cleaning and maintaining the system.

4.10.6 Soundfield systems

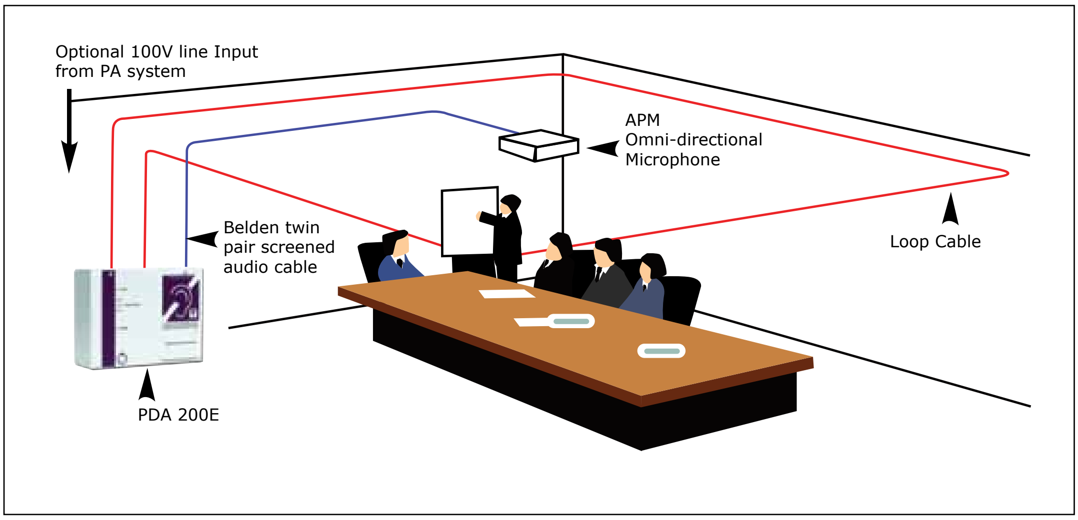
Soundfield hearing enhancement systems are amplification systems designed to give an even level of sound around a room. They comprise a microphone linked to a transmitter (either FM radio or infrared), a receiver/amplifier, and a number of speakers positioned around a room. The speakers can either be wall- or ceiling-mounted. Hearing aid wearers can listen via their own personal FM receiver. The systems can also be used to transmit multimedia output including television, CD, and DVD using auxiliary connections.

Soundfield systems are increasingly being installed in classrooms and environments, such as lecture theatres where they improve audibility for all pupils and students. The systems improve the quality and distribution of sound throughout the room, regardless of the volume of the teacher's or lecturer's voice, or the direction they are facing. The positioning of speakers around the room ensures an even distribution of sound at an appropriate volume, without the teacher having to strain their voice.

People with hearing loss who do not wear hearing aids may also benefit from the improved sound quality provided by a soundfield system.

People who do wear hearing aids are able to wear their own FM receiver and hear amplified sound directly through their hearing aid.

Image 4.14 Example of a soundfield system.



Soundfield systems can use either infrared or FM radio transmission systems. However, there are certain limitations concerning the environment in which infrared soundfield systems can be installed. As transmission is based on infrared beams, the physical environment in which the system is installed requires suitable surface finishes. Rooms with glazed partitions, large or numerous windows, or windows shared with an adjacent classroom are not suitable and neither are rooms with surfaces that either do not reflect light or that are dark in colour, such as drama rooms. Such areas are better suited to FM radio systems.

Checklist – Soundfield systems

- Consider where they may benefit people with hearing difficulties who do not wear a hearing aid.
- Avoid the use of glazed partitions, large windows and dark surfaces where infrared transmission is required.

4.10.7 Signage for hearing enhancement systems

Wherever hearing enhancement systems are permanently installed or available as portable equipment, appropriate signage should be displayed to indicate that the equipment is available. The presence of the equipment should be signed on the approach to and within the room or space so that building users are aware of its presence. If a meeting room is equipped with an induction loop system, for example, the appropriate sign should be clearly displayed adjacent to a meeting room door and also within the meeting room.

Image 4.15 Example of induction loop and staff assistance sign.

If induction loop facilities are available at a payment counter in a shop, a sign should be clearly displayed at the counter, as well as in the shop window or on the entrance door. Any signs or instructions relating to the hearing enhancement system should incorporate the appropriate symbol, as **Image 4.15**.

The four main types of signage are information signs, directional signs, identification signs, and mandatory safety signs. Refer to **Table 4.5** for more information.

Checklist – Signage for hearing enhancement systems

- Ensure signage is clearly displayed to indicate the presence of a hearing enhancement system.

4.11 Signage and Information

In all non-domestic buildings and, where appropriate, in external environments, signage and information should be provided to enable people to clearly understand the layout and function of a space or environment and to find their way around independently. Signage and information should be usable and informative to everyone and include information in visual, tactile, and audible formats. It should be simple and easy for everybody to understand.

Image 4.16. Example of wall signage with Braille.

All signs and information should be clear, consistent and unambiguous. Messages and directions should be concise and use familiar words, symbols and language. Information that is too complicated or that uses unfamiliar language or terminology is likely to be difficult for some people to understand. The over-provision of signage and the use of very complex signs should be avoided as they are likely to cause confusion and will be of minimal benefit.

Clear signage is particularly valuable for people who may have difficulty communicating and for people who prefer not to have to ask for directions. Signs incorporating pictorial symbols are beneficial for people who have learning disabilities, people who have difficulties reading text, and for people who are not familiar with the English language.

Image 4.17 Example of information signage in a large building.

The four main types of signage are information signs, directional signs, identification signs, and mandatory safety signs. Refer to Table 4.5 for more information.

Audible information, such as public address systems and personal messaging devices, should be provided in addition to visual signs and information. At tourist attractions, heritage centres, and in other similar venues, the use of pre-recorded information is also useful for describing displays and presentations.

Table 4.5 Types of sign

Type of sign	Function and characteristics
Information signs	• An aid to overall orientation within a site or building. • Cover information relating to a site, including internal and external areas. • Examples include maps, diagrams and directory signs.
Directional signs	• Provide directional guidance within a site or building. • Signs include arrows. • Examples include sign boards with several named destinations and a series of arrows and signs with a single name and accompanying arrow.
Identification signs	• Identify particular destinations, such as a an individual building, a single room, facility or service. • Do not incorporate arrows. • Examples include building name signs, room name or number signs.
Mandatory signs	• Required by regulation for the safety of all building users. • Type, style and colour of signs prescribed by European standards. • Examples include fire safety signs and notices, emergency exit signs and health and safety notices. • Public bodies have legal obligations to provide signage in Irish. It is important that obligations on bilingual signage are met in a way that respects universal design and are not achieved at the expense of adequate type size.

In large buildings, such as museums, shopping centres, art galleries, hospitals, and hotels, where visitors may not be familiar with the layout, a floor plan or map should be displayed to enable people to orientate themselves. This is also important in external environments, such as parks, gardens and outdoor visitor attractions. Maps and plans should indicate key facilities including information areas; sanitary facilities; refreshment areas; paths and other circulation routes; car parking facilities; and any other relevant spaces particular to the building or external environment.

The use of tactile maps and models provides valuable orientation and wayfinding information for people with a visual difficulty.

Image 4.18 Example of a building plan. Note the use of Braille on the sign.

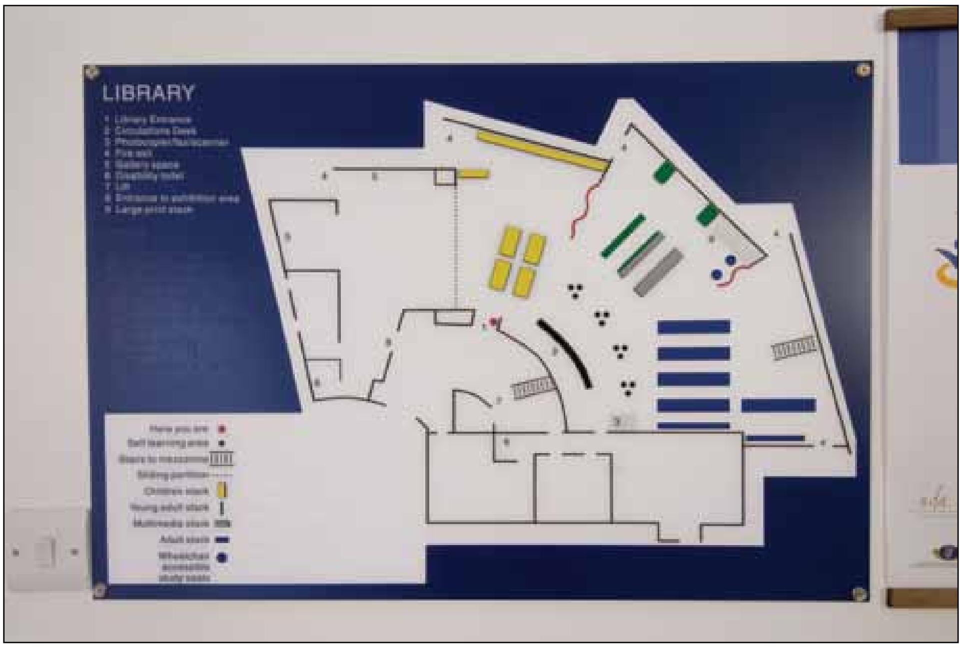
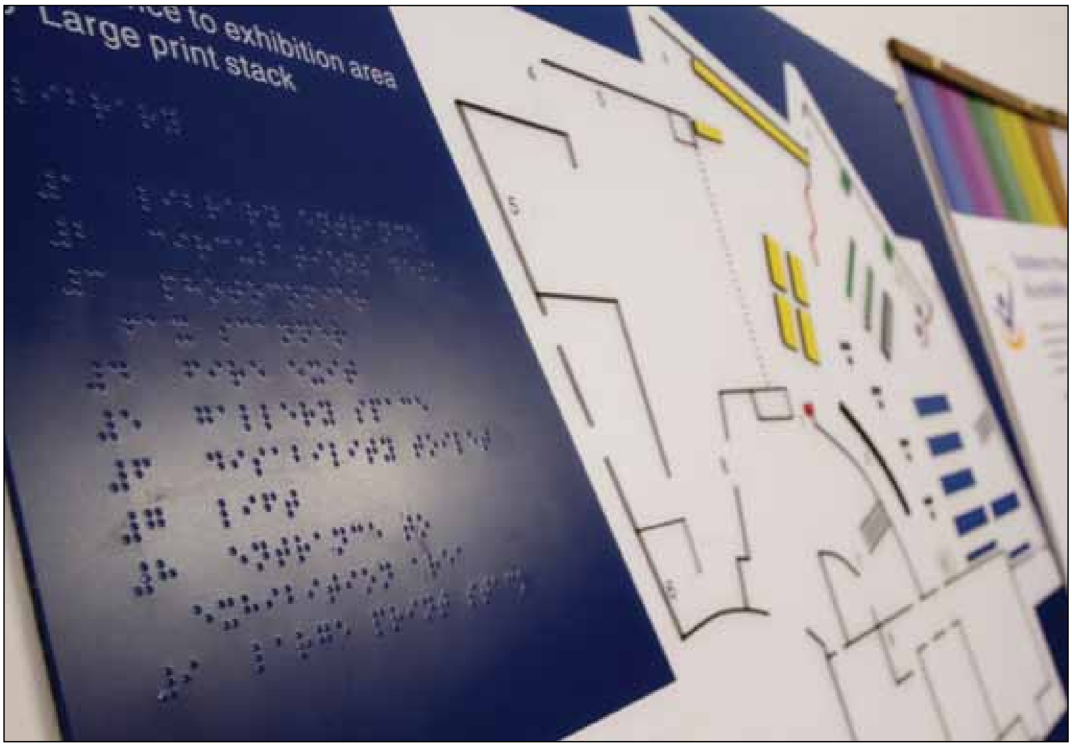


Image 4.19 Alternative example of a building plan.

Image 4.20 Alternative example of a building plan with Braille.



Checklist – Signage and information
• Incorporate visual, tactile and audible information in signage.
• Ensure all signage is clear, consistent, and easy to understand.
• Keep messages concise and use familiar language and symbols.
• Provide maps, plans and models for larger buildings, including tactile information.

4.11.1 Typeface and lettering

The clarity and legibility of signage is significantly enhanced by the use of suitable sans serif display typefaces, including Johnston Underground, Gotham, Helvetica, Avant Garde, Arial, and Futura. These typefaces are clear and uncomplicated, and incorporate good letter spacing.

Typefaces that are highly decorative, complicated, very bold, condensed or italicised should be avoided as they can be difficult to understand and detract from the readability of the sign.

The use of a particular typeface should be consistent for all signage within a building or environment, and on each sign.

Single words and short sentences should begin with a capital letter and continue with lower case letters.

Where signs give a person's name or the title of a particular department, each word should commence with a capital letter and continue in lower case. Where initials are included in a person's name, full stops should be omitted. In this arrangement of capital and lowercase letters, word shape is easier to recognise and the word becomes more memorable, making text easier for many people to read.

The use of wholly capitalised words should be avoided.

Wording on signs should be as simple as possible. Single words or a short sentence should be used to identify a facility or give direction. Where two or more words are used in a name or sentence, they should be clearly separated from one another. Text should be ranged from the left (left aligned).

The use of abbreviations should be avoided as they may not be widely understood. Long sentences, very long words and words placed close together on a sign should also be avoided as they can be difficult to read.

Information on signs should either be listed alphabetically or grouped logically, for example, by department or floor level. To avoid having too much information on any one sign, the adoption of a hierarchy may be appropriate, with more detailed information being provided in subsequent areas of a building or environment.

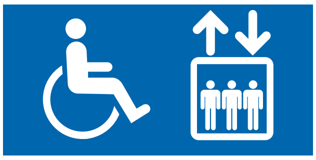
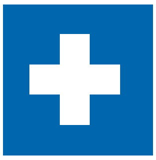
Where numbers are used on signs, they should be in Arabic format (1, 2, 3, and so on). Roman numerals should be avoided as they are not universally recognised.

Checklist – Typeface and lettering
• Use a clear, sans serif typeface.
• Avoid typefaces that are complex, italicised, too bold, or condensed.
• Ensure the selected typeface is consistent throughout a site or building.
• Capitalise the first letter of names and messages with all other letters lowercase.
• Keep wording brief.
• Avoid the use of abbreviations.
• Align wording to the left.
• List names and messages alphabetically or group them logically, for example, by floor level.
• Consider using a hierarchical system to avoid over-complex signs.
• Use Arabic numbers (1, 2, 3), not Roman numerals.

4.11.2 Symbols and arrows

The use of symbols is beneficial to many people including children, people whose first language is not English, and people who have learning difficulties. Symbols that are universally recognised, such as the standard public information symbols illustrated in **Image 4.21**, may be used in place of text. Where other symbols are used, they should be accompanied by text.

Image 4.21 Examples of standard public information symbols.

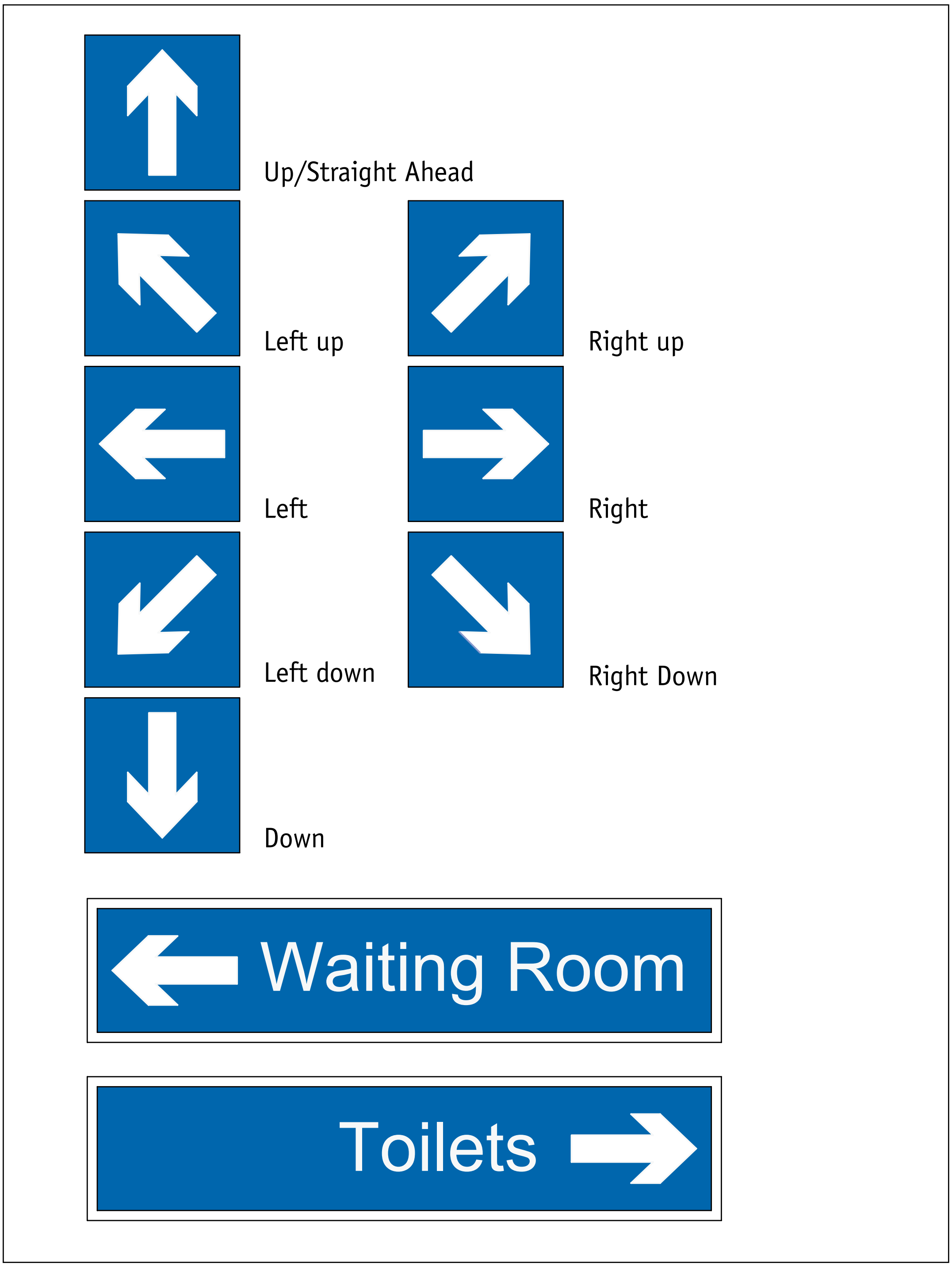
	Accessible slope
	Accessible parking
	Accessible WC
	Accessible lift
	Medical service / First aid
	Sign-language service (*)
	Park
	Accommodation
	Pool
	Restaurant

Symbols are particularly beneficial on dual-language signs as they enable quick recognition of information .

Symbols or icons designed for specific buildings can be used to identify particular facilities or departments, such as in a hospital, museum, or visitor attraction. These can be used in conjunction with a system of colour coding to create a recognisable and memorable identity that is universally accessible.

Pictorial devices, such as arrows, are essential for directional signs. Arrows should be used consistently throughout a system of signage and are recommended to be shaped as illustrated in **Figure 4.3**. Where signs include a list of destinations, such as on a directory sign in an entrance area, arrows should be arranged in the following order:

Figure 4.3 Arrow placement on directional signs.



Where a number of destinations are located in the same direction, they should be grouped together on a sign and share a single arrow. Repeated arrows are likely to clutter a sign and make it more difficult to read.

The position of arrows on a sign in relation to the location name should correspond with the direction in which it is pointing. Where an arrow points to the left, it should be positioned to the left of the name and where an arrow points to the right, it should be positioned on the right of the name. This placement reinforces the directional information.

Checklist – Symbols and arrows
• Use symbols in place of text or to supplement text wherever possible.
• Consider the use of symbols or icons in conjunction with colour coding to identify areas of a building.
• Use arrows to indicate direction, as **Figure 4.3.**

4.11.3 Letter and symbol size

The size of letters on signs should relate to the type of sign and the viewing distance. **Table 4.6** provides guidance on the recommended letter height for a range of viewing distances.

Table 4.6 Recommended letter heights in signs

Viewing distance (mm)	Recommended letter height (mm)
6000	200
4600	150
2500	100
2300	75
1500	50
750	25

The size of symbols should suit the size and space available, subject to a recommended border height of 150mm.

Checklist – Letter and symbol size
• Select a letter size to suit the viewing distance.
• Ensure symbols have a recommended border height of 150mm.

4.11.4 Tactile signs and Braille

Signs that provide directional information and those that identify particular functions and activities in a building should be embossed so that they can be read by touch.

Embossed letters should be raised above the surface of a sign by between 1mm and 1.5mm and have a stroke width between 1.5mm and 2mm. The edges of embossed letters should be sufficiently well defined to enable both sides of the stroke to be felt with a finger, but should be slightly rounded to avoid sharp edges.

Engraved and indented letters and symbols are difficult to read by touch and should be avoided.

The letter height of embossed signs should be between 16mm and 50mm. The typeface should be sans serif. The letter spacing should be increased by between 20% and 30% above the standard arrangement so that each individual letter can be clearly identified. Word spacing should be increased by 25%, again so that each word can be read distinctly.

Where Braille is used on signs, single words should use grade one Braille and signs with several words should use grade two contracted Braille. Grade 1 Braille consists of the 26 standard letters of the alphabet and punctuation. It is only used by people who are first starting to read Braille.

Grade 2 consists of the 26 standard letters of the alphabet, punctuation, and contractions. The contractions are employed to save space because a Braille page cannot fit as much text as a standard printed page. Books, signs in public places, menus, and most other Braille materials are written in Grade 2 Braille.

Braille should be located directly below the text to which it relates and ranged to the left. Where arrows are included in the sign, a small embossed arrow can be used to indicate direction and placed either to the left (to indicate left) or right (to indicate right) of the Braille.

The presence of Braille on a signboard should always be indicated by a marker or notch on the left hand edge.

It can be difficult to read embossed signs and Braille when they are mounted on a vertical surface. Most people will find it easier to read signs by touch if they are mounted on an inclined surface that is between 45 and 60 degrees above the horizontal in the direction of the user.

Image 4.22 Example of signage with Braille.

Image 4.23 Alternative example of signage with Braille.

Checklist – Tactile signs and Braille
• Use embossed signs to enable reading by touch.
• Ensure embossed letters are between 16mm and 50mm in height.
• Increase letter and word spacing to ensure they are easily identified.
• Use sans serif typeface for embossed letters.
• Position Braille below related text.
• Use Grade 1 Braille for single words.
• Use Grade 2 contracted Braille for signs with several words.
• Provide a Braille locator or notch to the side of the sign board.
• Consider locating Braille signs on an inclined surface to aid reading.

4.11.5 Tactile maps and models

The provision of tactile maps and models should be considered for public buildings as an aid to orientation. It can be difficult to read embossed signs and Braille when they are mounted on a vertical surface. Most people will find it easier to read signs by touch if they are mounted on an inclined surface that is between 45 and 60 degrees above the horizontal in the direction of the user. They are particularly beneficial in buildings, such as railway stations, visitor attractions and shopping centres, as they facilitate independent navigation for many people with visual difficulties.

Tactile maps are a particularly useful way of representing the internal layout of a building and can be produced in a form that can be easily carried by a person as they move around. Tactile models are less portable, but are well suited to representing three-dimensional landscapes and larger sites.

The basic principle of tactile maps and models is to present a simple version of a visual image that can be read by touch.

Maps and models should be uncluttered and designed to enable clear differentiation between lines, symbols and other features. The provision of explanatory and contextual information, such as a symbol key, bar scale, north arrow or other reference point should be provided. Audible instructions explaining how to use the map or model may be appropriate in some circumstances.

Checklist – Tactile maps and models
• Provide tactile maps or models to aid orientation and wayfinding for people with visual difficulties.
• Ensure maps and models provide clear, uncluttered information.
• Ensure effective differentiation between lines, symbols and other textured surfaces.
• Provide explanatory and reference information in tactile form.
• Consider the provision of audible instructions or supplementary information.

4.11.6 Surface finishes and visual contrast for signage

The surface finish of signs should be matt or satin to enable easy viewing. Finishes that are shiny or reflective are likely to be a potential source of glare and may be difficult to read due to the presence of reflections.

All signs should be evenly illuminated, with a lighting level of 200 lux.

Letters and symbols on signs should contrast visually with the signboard to maximise readability. The signboard should also contrast visually with any adjacent surface, such as a wall or door, so that is it easy to identify. The use of a contrasting border to the perimeter of a sign may help to highlight the location of the sign if the background surfaces are similar to the board.

Where colours are used as part of a system to differentiate between floor levels or departments in a building, the colours used should be very different. Colours that are similar, such as orange and red or blue and purple, may be difficult for some people to differentiate. This is of particular concern for those who have colour differentiation difficulties, as well as people who have cognitive, mental health, or visual difficulties.

Checklist – Surface finishes and visual contrast
• Ensure signs have a matt or satin finish.
• Avoid shiny and reflective surfaces.
• Evenly illuminate all signs to 200 lux.
• Make sure letters and symbols contrast visually with the sign board.
• Ensure sign boards contrast visually with any mounting or background surface.
• Use colours that are easy to differentiate where colour coding is used.

4.11.7 Safety signs

Safety information and warning signs should use the universally established colour code of green for safety, yellow for risk alert, red for prohibition or danger, and blue for mandatory action, as follows:

Image 4.24 Examples of safety information and warning signs. The following image gives further examples of using the proper combinations of colours for safety and warning signs.

- Yellow triangles indicate the presence of a potential hazard. The triangle outlines a black symbol or text.
- Green rectangular signs indicate a safe condition, for example, ‘Exit’ or ‘Push bar to open’. Text should be white on green background, or green on white background.
- Red circles indicate prohibition. A red diagonal line through the symbol indicates the prohibition, for example, ‘No smoking.’
- Blue circles indicate mandatory action to be taken, for example, ‘Keep door shut’. The text of the symbol should be coloured white on the blue background.

Image 4.25 Examples of safety colours and contrasting colours.

Safety colours and contrasting colours

The meaning of Safety Colours, with some examples, is as follows:

Red	Prohibition

- stop signs
- emergency shutdown devices
- prohibition signs
- this colour is also used to identify fire-fighting equipment

Yellow	Caution

- identification of dangers (fire, explosion, possible danger, radiation, chemical hazard etc.)
- identification of steps, dangerous passages, obstacles

Green	No danger	First aid

- identification of emergency routes
- emergency exits
- safety showers
- first aid stations and rescue points

Blue	Mandatory signs

- obligation to wear individual safety equipment
- information
- location of telephone

Blue counts as a safety colour only when used in conjunction with a symbol or words on a mandatory sign or information sign bearing instructions relating to technical prevention.

Text and symbols should be in colours which contrast with the background safety colour.

Text Colour	*Symbol Colour*
White	■ ■ ■
Black	■ ■ ■
White	□ □ □
White	□ □ □

Checklist – Safety signs

- Ensure safety information and warning signs follow the universally established colour code.

4.11.8 Location and positioning

The suitable placement of signage is essential in ensuring it is visible at all times; within a comfortable viewing distance; and, for embossed and Braille signage, within easy reach.

Signs should be located at strategic points along a route and wherever routes intersect or diverge. Where routes are long, signs indicating the direction to a room or facility should be repeated to provide confirmation along the way.

Signs that may require a significant period of time to read should be located where users will not obstruct the passage of others.

On circulation routes, signs should be in accessible locations, taking into consideration the angle of vision of people standing or using a wheelchair.

Any system of signage should enable people to move easily around a whole site or building, without the need to retrace their steps to the main entrance in order to locate comprehensive directory and directional information.

Table 4.7 Guidelines on the location and positioning of different types of signage.

Table 4.7 Location and positioning of signs	
Signs requiring close viewing	**Recommended location and positioning**
Directory signs Room identification signs	• Height 1400-1700mm above floor level. • Wall-mounted signs should not project more than 100mm from the wall surface. • Signs to be mounted on the wall adjacent to the leading edge of room doors rather than on the door face so that they are visible at all times and to ensure that the door is not opened while someone is reading the sign. • Embossed signs to be positioned where a person can approach and touch the sign without being obstructed or causing an obstruction to other people.
Detailed signs and instructions Fire safety notices Health and Safety Act notices	• Duplicate signs to be provided at 1000mm to 1100mm and 1600mm to 1700mm to suit close viewing by people at a range of eye levels.
Detailed maps, diagrams and timetables	• Centred 1400mm above floor level, with the lower edge no lower than 900mm and the upper edge no higher than 1800mm above floor level.
Signs accompanying a control panel or an item of equipment	• Signs and instructions to be provided adjacent to an associated control panel or items of equipment. • Height range 900mm to 1200mm to suit people at a range of eye levels.

Signs for medium-range viewing	
Suspended directional or identification signs Wall-mounted projecting signs Post-mounted signs	• 2300mm clear headroom to the underside of the sign. • Wall-mounted signs should not project more than 100mm from the wall surface. • Where a sign may be temporarily obscured by other people, it should be positioned at least 2000mm above floor level.
Signs for long-distance viewing	
Directional signs Identification signs	• In large spaces ,and where visibility of signs may be obscured by crowds, the height should be greater than 2300mm.

Positioning heights and other guidance is common to BS 8300:2009, Sign Design Guide (RNIB, UK) and Department for Transport (UK) – Inclusive Mobility.

Checklist – Location and positioning
• Position visual signs for ease of reading.
• Position tactile and Braille signs within reach.
• Position signs where people reading them will not cause an obstruction.
• Ensure directional signs enable people to retrace their steps and identify alternative locations within a building, without having to return to the main entrance.

4.11.9 Audible information

The provision of audible information should be considered for public buildings to supplement visual and tactile signs or maps.

There are certain audible wayfinding and information systems available that provide individual messages to building users wearing either infrared or radio frequency receivers linked to a headset or earphone. Messages and information about a building or external environment are programmed into the receivers, which are activated by signals at pre-programmed locations.

Public address systems can be used for pre-recorded or live announcements that need to be clearly audible in all relevant areas of a building or environment.

Public address systems that are used for performances or to make announcements should incorporate a hearing enhancement system suitable for people with a hearing difficulty, as **Section 4.10**.

Checklist – Audible information
• Provide audible information to supplement visual and tactile signs and maps.
• Consider the use of individual receivers to provide wayfinding and visitor information.
• Ensure public address systems are clearly audible in all relevant areas of a building.
• Incorporate a hearing enhancement system in public address systems.

4.12 Fire Detection and Alarm Systems

Fire detection and alarm systems in buildings range considerably in scale and complexity. Small buildings may have only one or two manual call points and alarms. Larger buildings, however, may require intricately networked systems that incorporate a large number of automatic fire detectors, manual call points, and alarms, connected to numerous inter-communicating control and indicating panels.

Whichever system is used in a building, it should be effective at alerting all building occupants in an emergency. Where fire detection and alarm systems incorporate manual activation devices, such as break-glass call points, these should be easy to operate and should be positioned within reach of all building users.

The sound level of an audible alarm should be maintained throughout a building. Alarm signals louder than 120dB should not be used, as they can be painful and induce disorientation and anxiety. Very loud alarms can also cause severe discomfort and mask other sounds used by people with visual difficulties to aid orientation, such as the tapping of canes.

It is preferable to have a larger number of quieter alarms rather than a few very loud ones, in order to achieve a more even distribution of the signal. This will also make verbal communication easier for everyone during an emergency.

The provision of supplementary devices that provide visual and tactile indication of alarm activation is essential in ensuring that all building occupants are alerted simultaneously, including those with hearing difficulties.

The use of visual alarms (also termed strobe lights, xenon beacons, flashing beacons, or high-intensity beacons) should be provided in buildings to which members of the public have access.

The location of visual alarms should be carefully considered so that perception of the flashing light is not masked or screened by partitions or furniture. In some areas, multiple visual alarms may be necessary.

There is a significant drawback in the use of visual alarms: some people are susceptible to certain frequencies of flashing light systems and, as a result, may experience disorientation, confusion and, in some cases, epileptic seizures. To reduce the likelihood of this occurring, the frequency of the flashing light should be between two and four hertz, with units synchronized wherever the light from two or more units may be viewed from a single area.

Pager devices, which provide tactile indication that the alarm has been activated, are useful in buildings, such as offices and colleges where staff and students can be issued with a pager programmed to receive alerts. Such radio-based alarm systems comprise a central transmitter that is permanently connected to the fire alarm control panel. When activated, the transmitter sends a warning to individual pager devices worn by people in the building. The pagers can also be used for public address messaging, personal on-site text messages, equipment alarm warning, and security staff messaging.

Personal paging devices can be linked to a cradle or docking device for use at night and may be suitable in buildings, such as hotels, halls of residence, and other residential accommodation. When activated, a high-intensity strobe light and vibrating pillow pad or mattress pad are activated, providing supplementary visual and tactile means of alerting people who have hearing difficulties.

Building Designers should consider the size and layout of the building to see how many break glass units are required. However, in general, a number of break glass units at regular intervals is preferred to the provision of a single unit.

Break-glass units should be positioned between 900mm and 1200mm above finished floor level, and 500mm from any internal corner. They should be positioned where the adjacent floor is unlikely to be obstructed and with a recommended 900mm wide clear space to enable a person to approach and activate the unit .

Image 4.26 Examples of break glass units.

Break-glass units should be capable of being operated by simple hand, arm or general limb movement. Systems that require the use of keys or dexterous hand movements should be avoided. Break-glass units should be green, easily identifiable, contrast with their background, and generally should be located near exit points. Consideration should be given to how far people with mobility difficulties must travel to reach one. No specific advice can be given in this regard, save to say that more, and not fewer, should be provided in any given building whenever possible.

For details of assistance alarms in toilets and bathroom accommodation, refer to **Booklet 5: Sanitary facilities, Section 5.10**.

Checklist – Fire detection and alarm systems

- Ensure alarm systems are effective at alerting all building occupants.
- Incorporate audible, visual, and tactile alarms or alerting devices.
- Limit the sound level of audible alarms to 120dB.
- Ensure alarms sounders achieve an even distribution of the signal.
- Locate visual alarms so that they can be seen from all areas in a building.
- Employ a frequency between two and four hertz for visual alarms, with units synchronized.
- Consider the use of pager devices to provide tactile alerts.
- Provide vibrating mattress or pillow pads in bedroom accommodation.
- Position manual call points within reach of all building users and ensure they are operable with a simple hand or arm movement.

A1 Definition of Universal Design

Universal Design

'Universal Design refers to the design and composition of an environment so that it can be accessed, understood and used to the greatest extent possible by all people, regardless of their age, size, ability or disability.'

Synopsis of the Disability Act, 2005.

A2 Human Abilities and Design

The following piece of text is an extract from European Ref: CEN/CENELEC Guide 6 'Guidelines for standards developers to address the needs of older persons & persons with disabilities'.

It states that: Physical, sensory and mental abilities vary from person to person and for individuals as they get older. Diversity is normal. Designers need to be aware of difference across the range of human abilities, and of associated design considerations.

(a) Physical abilities

This includes walking, balance, handling, pulling, pushing, lifting and reaching. Many activities involve simultaneous use of more than one of these skills. Physical strength and stamina may also affect people's abilities to perform these actions.

Walking

For some people walking on the level or up gradients is difficult. Some people may have a limited walking range, may have difficulty with turning movements or may use mobility devices, such as crutches or a walker. They may need to stop frequently, to regain strength or catch breath. Design considerations include provision of handrails, seats at regular intervals, convenient set-down parking and adequate time for slower pedestrians at road crossings. Designers should also consider the needs of people walking and engaging in sign language when designing access to and from buildings plus within the buildings themselves.

Balance

Balance limitations can affect someone's gait or control of hand movements. Design considerations include handrails, regular seating, and providing controls within easy reach. A surface against which a person may stumble against or walk into should be designed to limit abrasion.

Handling

A significant minority of people are left-handed. Some people may have restricted use or no use of one or both hands, or may have limits on strength or precision. Facilities and components should be designed to be suitable for use with either hand or with one hand only. Handling includes gripping, grasping and manipulation. Each of these has a different purpose with specific design considerations. For instance, components should be designed to be easily held. The circumference of the supporting structure and stability are critical. Manipulation involves the moving, turning and twisting of components with a hand or hands. For those who have limited manipulation abilities, size and shape and ease of movement are critical. Another option to consider is to design for manipulation by using a pushing, pulling or pressing action using a clenched fist, or by using the wrist or the elbow.

Strength and endurance

Strength and endurance may be required on sloping paths and floors, stairways and long travel distances, when sustained effort may be needed.

For those with limited endurance, frequent resting-places are essential.

People generally find it easier to push a component, than to pull it. This is particularly so if the individual uses a wheelchair. Self-closing devices on manual doors can be difficult for some people to operate, particularly if the doors are required to resist wind forces. For these reasons, doors that open and close automatically are preferred.

Lifting

Activities, such as opening a vertically sliding sash window and an upward opening access gate, should be designed to be easily operated with minimal force.

Reaching

Design has a role to play in ensuring that key components in a building or environment are in easy reach, bearing in mind the range of people's sizes and abilities. Having components within easy reach is particularly important for those with more severe limitations in mobility. The reach range is dependant on the height and arm length of the person, use of the arms, and the balance and mobility of the upper body. A 'comfortable reach range' has been defined as one that is appropriate to an activity that is likely to be frequent and in need of precise execution and that does not involve stretching or bending from the waist. Putting things within comfortable reach can ensure use by a greater number of people. An 'extended reach range' has been defined as one that is appropriate to an activity that is likely, neither to need precision nor to be frequent and that can involve stretching or bending from the waist.

(b) Sensory abilities

Speech

Some conditions affect the capacity for or quality of speech. Two-way communication can be facilitated by environments designed to minimise barriers to hearing low or indistinct speech.

Hearing

People differ in their capacity to hear sound, to determine its direction, its source, to discern pitch, frequency, volume and variation and to separate out different sounds. Hearing quality is important for communication, for information, and for detection of hazards, such as traffic. Many people with hearing difficulties use a hearing aid which amplifies all sounds caught by the microphone, making communications very difficult in noisy environments. Keeping background noise level low is essential. The selection of structural and surface materials can make a substantial difference in audibility. Auditoriums, meeting rooms and reception areas can benefit from additional sound enhancement, such as a loop system. The careful design of illumination can assist in communication, such as lip reading and sign language. Provision of visual information and visual alarm systems can communicate information to those who have hearing difficulties or who cannot hear. Designers should also consider the colour and size of rooms and even the furnishing arrangement as this is very important for visually based communication. Also the use of vibration as means of sensing others should be considered.

Sight

Vision allows an individual to be aware of the luminance of surfaces, objects, form, size and colour. For people who are blind or who have visual difficulties the provision of suitable tactile walking surface indicators and tactile or acoustic warnings at hazardous locations, should provide information on using the built environment and should limit the risk of injury. The built environment can be designed for orientation by providing sound cues and tactile cues. An easily discernible system of 'way finding' should also be considered. For people with limited, but low vision, effective visual contrast between surfaces or objects helps to identify critical locations. Warning markings on glass surfaces, and markings on the edges of stair treads, help minimise hazards.

Differences in friction between one floor surface, or one stair tread surface, and the next should be avoided. Therefore, adjacent surfaces that display different standards of slip-resistance, or that depend on raised surfaces, should be carefully considered

Touch

In selecting surfaces in the built environment that people will need to touch (such as handrails, handles, knobs and controls, tactile information), it is important to select materials that avoid distress, injury or allergies. Surfaces should be free of abrasions. Metals that may cause adverse reactions when touched should be avoided.

(c) Mental abilities

Mental abilities include cognition, intellect, interpretation, learning and memory. People differ in their knowledge, their capacity to understand, reason, or interpret information. Designing for differences in these capacities helps provide a usable environment for the population at large, from the very young to the old, and people of diverse abilities. Means of communication in the environment should be designed to be immediately and easily understood, and correctly interpreted. As people age, some experience loss of memory or find it increasingly difficult to absorb new information, so changes in the environment should be carefully considered before implementation.

Design considerations that take account of mental abilities

Aural and visual messages should be simple, clear and have immediate impact. Figures, symbols and simple words are likely to be the most effective. Symbols should be instantly recognisable as representing images seen and activities undertaken in everyday life.

Way finding should be simple, such as tactile, graphic, audible or architectural cues that are easy to follow. Signage should be large and clear. Way-finding maps should be clear, indicate the person's whereabouts in the building or facility, and be free from extraneous information.

(d) Age and size

Accommodating the developing child

It is important to create environments that are safe, accessible and useable for children. Individual components should be safe and useable as age-appropriate. Learning to manage risk is an essential part of a child's development.

Accommodating ageing adults

Life span within the human population is increasing. More and more we expect to maintain an economic and social life within both the public and private domains as we age. However, many human faculties are in decline as we age, such as mobility, dexterity, stamina, strength, hearing, sight, or memory. Familiarity with a particular environment is important.

Diversity of size

The population contains a diversity of sizes and heights, from children, to the diversity in the height of fully-grown adults. The positioning of components and the heights of building elements, such as steps should recognise the diversity of height. Increased weight and girth is now also a feature of the population.

Ref: CEN/CENELEC Guide 6 'Guidelines for standards developers to address the needs of older persons & persons with disabilities'.
http://www.cen.eu/cen/Sectors/Sectors/ISSS/About_ISSS/Documents/cclcgd006.pdf

A3 Further Reading

National and international standards and codes of practice

AS 1428.1-2001 Design for access and mobility. General requirements for access – New building work.

AS 1428.2-1992 Design for access and mobility. Enhanced and additional requirements – Buildings and facilities.

AS 1428.3-1992 Design for access and mobility. Requirements for children and adolescents with physical disabilities.

AS 1428.4-2002 Design for access and mobility. Tactile indicators.

BS 4800: 1989 Paint colours for building purposes (whilst the colours in this standard cannot be seen on CD-ROM or online the text can still be used).

BS 5395-1:2000 Stairs, ladders and walkways – Part 1: Code of practice for the design, construction and maintenance of straight stairs and winders.

BS 5588-8:1999 Fire precautions in the design, construction and use of buildings – Part 8: Code of practice for means of escape for disabled people.

BS 5776:1996 (incorporating amendment No.1) Specification for Powered stairlifts

BS 6440:1999 (Incorporating amendment No.1) Powered lifting platforms for use by disabled persons – Code of practice.

BS 6440:1999 Powered lifting platforms for use by disabled persons – Code of practice (partially superseded by BS EN 81-40:2008. The remainder of BS 6440:1999 will eventually be superseded by EN 81-41: 2009 Safety rules for the construction and installation of lifts – Special lifts for the transport of persons and goods – Part 41: Vertical lifting platforms intended for use by persons with impaired mobility).

BS 6465-1:2006+A1:2009 Sanitary installations. Code of practice for the design of sanitary facilities and scales of provision of sanitary and associated appliances.

BS 6571-4: 1989 Vehicle parking control equipment – Part 4: Specification for barrier type parking control equipment.

BS 7036-1:1996 Code of practice for Safety at powered doors for pedestrian use – Part 1. General.

BS 7036-4:1996 Code of practice for Safety at powered doors for pedestrian use – Part 4. Low energy swing doors.

BS 7997:2003 Products for tactile paving surface indicators – Specification.

BS 8300:2009 (Incorporating amendment No.1) Design of buildings and their approaches to meet the needs of disabled people – Code of practice.

BS 8493:2008 (+A1:2010): Light reflectance value (LRV) of a surface – Method of test.

BS 8501:2002 Graphic symbols and signs – Public information symbols (AMD 16897).

BS EN 115:1995 Safety rules for the construction and installation of escalators and moving walkways.

BS EN 15838:2009 Customer contact centres, Requirements for service provision.

BS EN81-70:2003 Safety rules for the construction and installation of lifts – Particular applications for passenger and good passengers lifts – Part 70: Accessibility to lifts for persons including persons with disability.

Building Regulations (Part M Amendment) Regulations 2010 (S.I. No. 513 of 2010).

Citizens Information Board – Accessible information for all (2009).

DD 266:2007 (Draft for Development) Design of accessible housing – Lifetime home – Code of practice.

I.S. EN 1991-1-1:2002 – Eurocode 1: Actions on structures Part 1-1: General actions – densities, self weight, imposed loads for buildings (including Irish National Annex: 2005).

I.S. EN 81-1: 1999 Safety rules for the construction and installation of lifts – electric lifts (Amd 1) (+A3:2009).

I.S. EN 81-2:1999 Safety rules for the construction and installation of lifts – hydraulic lifts (Amd 1) (+A3:2009).

I.S. EN 81-70:2003 Safety rules for the construction and installation of lifts – Particular applications for passenger and good passenger lifts. Accessibility to lifts for persons including persons with disability (Amd A1:2005).

I.S. EN 997:2003 (+A1:2006) WC pans and WC suites with integral trap (AMD Corrigendum 14805) (AMD 16965).

IEC 60118-4:2006 Electroacoustics. Hearing aids. Induction loop systems for hearing aid purposes. Magnetic field strength (ISBN 978 0 580 50047 3).

International standard for Induction loops. IEC 60118-4.

Irish Code of Practice on Accessibility of Public Services and Information Provided by Public Bodies www.nda.ie/website/nda/cntmgmtnew.nsf/0/3DB134DF72E1846A8025710F0040BF3D/$File/finaldrcode_nda.htm

Key cards should conform to EN 1332. For further information on key cards please see: http://www.universaldesign.ie/useandapply/ict/itaccessibilityguidelines/smartcards/guidelines/smartcardguidelines/cards

Lifetime Homes Standard: http://www.lifetimehomes.org.uk

Norwegian Universal design of building standard, 2009.

Passenger Lift Design: The Machinery Directive 2006/42/EC; Lifts should conform to BS 6440.

National and international reference documents

2020 Vision – Sustainable Travel and Transport: Public Consultation Document. Department of Transport.

Bus Based Park and Ride – A Pilot Scheme. A Report to: Dublin Transportation Office. The TAS Partnership Limited, 2002.

City of London 2006 Facility Accessibility Design Standards. London, Canada, 2006 Promoting Safe Egress and Evacuation for people with Disabilities - National Disability Authority.

Gallaudet DeafSpace Design Guidelines 2010.

Department of Transport & the National Disability Authority Guidelines for Accessible Maritime Passenger Transport http://www.nda.ie/website/nda/cntmgmtnew.nsf/0/45AA46D1F77D7EF2802576DC005C5954?OpenDocument

Department of Transport, UK 'Traffic Signs Manual'.

Dublin City Council (2007) Variation (No. 21) of the Dublin City Development Plan 2005 – 2011. Available from: http://www.dublincity.ie/Planning/DublinCityDevelopmentPlan/VariationstotheDevelopmentPlan/Documents/AdoptedVariationNo21Spec.pdf.

Guidance on the use of tactile paving surfaces. Department for Transport, UK.

Guidelines for an accessible public administration. Towards full participation and equality for people with disability. Office of the Disability Ombudsman, Sweden.

Inclusive Mobility. Department for Transport, UK.

International Best Practices in Universal Design. A Global review. Canadian Human Rights Commission, 2006.

Irish Wheelchair Association: Best Practice Access Guidelines 2010.

Joseph Rowntree Housing Trust.

Parking for disabled people. Department for Transport, UK.

Promoting Safe Egress and Evacuation for people with Disabilities - National Disability Authority.

Rail Park and Ride Strategy for the Greater Dublin Area. Dublin Transportation Office, 1994.

Regulation of Bus services outside the Greater Dublin Area. Department of Transport.

"Sign Design Guide and Inclusive mobility," Oxley, P. (2003), Inclusive Mobility. Department for Transport, UK. www.mobility-unit.dft.gov.uk

Smarter Travel 'A Sustainable Transport Future' – A New Transport Policy for Ireland 2009 – 2020. Department of Transport.

List of Illustrations

Image acknowledgements:

Images 4.1, 4.2, 4.3, 4.4, 4.6, 4.7 and 4.8 courtesy of Irish Guide Dogs for the Blind.

Index

I

L

M

N

P

R

S

T

NDA

Lárionad Foirfeachta
i nDearadh Uilíoch
Centre for Excellence
in Universal Design

Lárionad Foirfeachta
i nDearadh Uilíoch
Údarás Náisiúnta Míchumais
25 Bóthar Chluaidh
Baile Átha Cliath 4
Teileafón (01) 608 0400
Facs (01) 660 9935
www.nda.ie

Centre for Excellence
in Universal Design
National Disability Authority
25 Clyde Road
Dublin 4
Telephone (01) 608 0400
Fax (01) 660 9935
www.nda.ie

The Building for Everyone Series has been printed on environmentally friendly paper stock.

designed by catalysto°