BUILDING PERFORMANCE

1. Building user activity: Designing buildings for access and usability

To ensure the right conditions for all building users, the built environment should be designed, constructed and managed with three activity processes in mind – how people gather information with their senses, how they process that information to make decisions, and how they put those decisions into action.

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Of interest to Building owners, Designers, Developers

How building users gather information

The built environment needs to communicate that information in a variety of ways to suit the needs of all building users.

Spatial awareness and identification of elements

Elements of the built environment, from the largest of buildings to the smallest of controls such as lift buttons, should be differentiated from their backgrounds, surroundings and each other so they can be located and identified easily.

Building users need to be aware of the environment around them so they can make decisions, take action and move in an independent, safe and controlled manner.

Sight, hearing, touch and smell
Building users pick up information by four of their five senses - sight, hearing, touch and smell. Of these, sight can potentially pick up the most information fastest.
Where a building user has a sensory limitation they may rely more on their other senses. For example:

- someone who is blind or has low vision may use their sense of touch
- someone with a hearing impairment may rely on vision to lip-read

Someone who is blind or has low vision perceives the environment by interacting with and moving through it. They rely on sensory input (visual, tactile, auditory, olfactory, and from balance, body position and movement information) for their orientation and mobility. Most people who have vision loss have some functional sight so contrast and choice of colours are important.

Information about the built environment should be presented in as many sensory forms as possible.

Information is often picked up subconsciously. For example, a person:

- in a lift may appreciate an approaching floor level from hearing announcements
- may recognise a building from a picture they have seen
- may anticipate the end of a flight of steps from the change in pitch of the handrail
- may know they are approaching a cafe from the smell of food being prepared.

Building users generally prefer to be independent and a physical solution to how information is presented is better than a management solution where staff have to be both trained and available.

Familiar landmarks
Landmarks that are known to the building user are particularly important. These are familiar objects, sounds, and smells, as well as tactile or visual clues that are recognised, constant and have separate, permanent locations in the environment. Things that are not constant (such as the smell from a coffee shop or the sound of a fountain that gets turned off) are helpful but are only clues.

Touch screens
It is important to remember that touch screens may be challenging for some building users who rely on tactile identification of controls. Touch screens have no tactile facilities and unless lighting is particularly well controlled, present reading difficulties due to reflections. Touch screens should not be used as the only form of input.

Design considerations

- Help building users orientate themselves by ensuring large elements such as buildings contrast in colour or luminance with their surroundings.
- Make elements that form part of a building, and critical surfaces such as ceilings, walls, floors, doors and staircases different from each other through luminance contrast.
- Make small elements such as handles, controls and buttons, different from each other and their backgrounds through luminance contrast and, where possible, tactile means.
- Ensure spatial orientation is logical with a layout that is easy to navigate, interpret and remember.
- Do not rely on graphic signage for wayfinding but include embossed print and braille, and where possible, audible systems.
- Consider incorporating textures and surface contrast to define routes and destinations within buildings.

Provision and location of facilities

Facilities that a building user could normally expect to find in a building should be provided in logical positions and their provision and location communicated to building users by a range of means.

Good spatial design leads the building user by providing information in the right way at the right level of detail at the right time.

Facilities placed in logical locations that are easily identifiable from main entrances and circulation routes provide valuable information to building users, reducing stress and the need to ask for assistance.

Prior knowledge is the key to independence. Relevant and easily accessible information available before starting out on a journey allows a potential building user to plan their visit or change their destination.

Visual, aural and tactile information made available to building users on the site allows them to remain independent and well informed, thus avoiding unnecessary exertion and stress.

Design considerations

- Make facilities that a building user could normally expect to find in a building such as toilets, lifts and stairs easily recognisable and provide them in sufficient numbers and logical locations.
- Provide visual, aural, directional and information signage at decision points around the environment.
- Assist potential building users by incorporating into the design unique features that can be easily communicated to them prior to their visit.

Building elements and fittings

Information should be provided in sufficient detail to allow a range of first time building users who may be unfamiliar with an element to easily understand its function and use.

Inexperienced building users need to be able to easily recognise and understand how to operate and use elements and fittings within the built environment.

Design considerations

- Ensure the design of any element or fitting allows an intuitive approach to be successful.

Visible information

The built environment should provide a continuing opportunity to pick up information visually and avoid situations which would restrict or prevent a building user's ability to do so.

Most building users pick up information mainly by visual means. Designs need to consider how the visual environment will be perceived so that effective communication can occur.

Apart from an individual's visual acuity, the ability to see objects will be dependent upon the time available to focus where an object is moving, the size of the object, its positioning, its distance from the viewer, the brightness of the object and its contrast with its background.

There are some environments, such as in swimming pools or during a building evacuation at night, where building users may not be wearing their prescription lenses. Signage that may be relied on in these circumstances (for instance, identifying the correct gender changing room or exits) needs to be larger and clearer than usual.

Lighting
In order to gather visual information, an adequate amount of light is essential. The light received by the eyes is dependent on the amount of light falling on the object (illuminance) and the amount reflected back (luminance).

As light falling on an object will vary in intensity, the only constant is the reflectance of the object. This is related to its colour which can be attributed a Light Reflectance Value (LRV). The LRV of pure black is 0% and pure white 100%. Paint manufacturers often quote the LRV of their colours for easy reference.

Appropriate lighting without glare or shadows will make work tasks easier and reduce eye strain and headaches. It will also enable hazards to be seen earlier.

Good lighting is also important where people with hearing impairment may lip-read or watch sign language interpreters.

Ageing
Eyes lose sensitivity with ageing and someone in their 60s may need three times the amount of light required by someone in their twenties.

Eyes also lose flexibility with ageing and this can mean that it takes longer to adapt to light changes. Sudden changes in light levels can present adaption difficulties for both sighted people and those with low vision. For example, coming out of a dark building into bright sunlight can be hazardous if there are entrance steps to negotiate. Transitional lighting between dark and light areas can assist the eye to adapt.

It is usually brighter outside a building than inside during the day, with the reverse at night. This can have an impact on safety markings on glazed entrance doors.

With ageing the lens in the eye clouds and the transmission of light is reduced. This can result in some scattering of light over the retina causing "flare glare" (the equivalent of looking through a dirty windscreen towards the sun). Where light sources are not shielded, particularly externally at the entrance to a building, glare can cause significant problems.

Pools of light and dark can create problems for a number of users both because of the need for the eyes to adapt to different light levels, and the interpretation of the dark area of floor as a change in level.

Some building users may also be hyper-sensitive to light levels and therefore the ability to control natural and artificial levels is important.

Some building users may also be vulnerable to the sub-visible flicker of direct fluorescent lights.

Surface finishes
Most people with vision impairment have some degree of sight. While they may not be able to pick up details at any distance, information about the surrounding environment such as the size and shape of a room, and the location of doors and staircases may be communicated if sufficient contrast in the luminance of critical surfaces is achieved.

Research in the UK has identified likely values of LRV difference where this can usually be achieved. This is generally referred to as "colour contrast" but it is actually the difference in light reflected that is relevant, not necessarily the colour difference itself.

Too much visual information (for instance, numerous colours, complex patterns and design changes, too many permanent and temporary signs)

can make the perception of available information a challenge and lead to misinterpretation.

Design considerations

- Specify the design and positioning of elements to take into consideration the viewpoint of the building user, the space surrounding those elements and how unique each element is.
- Ensure that signage design reflects situations where building users may not be wearing their prescription lenses.
- Provide a safe and comfortable environment by installing lighting that has good colour rendering characteristics.
- Ensure there are no unshielded lights, or pools of light and dark.
- Provide transitional lighting between areas of differing light levels (e.g. inside a building to outside).
- Make identification of the location and details of elements such as stairs, ramps and slopes easy by ensuring they are suitably illuminated both day and night and discernible from both directions.
- Ensure that critical surfaces such as ceilings, walls, doors, floors, and stairs are suitably differentiated in luminance (Light Reflectance Value or LRV) to allow them to be identified.
- Ensure that elements such as furniture, controls, fixings, and handles are suitably differentiated in luminance (LRV) from their background so that they can be easily located and identified.
- Help reduce potential glare by installing shielded lights
- Ensure lights that are likely to be switched on and off frequently by manual or automatic means are not of the type which take time to reach their full brightness.
- Allow building users to control direct sun and natural lighting levels by installing appropriate window treatments.
- Allow building users to control localised and task lighting.
- Assist those that are vulnerable to sub-visible flicker by avoiding the use of direct fluorescent lights.
- Help building users identify manifestation on glazed entrance doors by installing both light and dark patterns to cater for the different day and night background light conditions.
- Ensure all glazing is easy to identify and highly visible in all lighting conditions against their immediate background.
- Ensure floor finishes are not shiny as they may appear to be wet and slippery.
- Ensure floor finishes do not contain patterns that could be misinterpreted as steps.
- Ensure that designs include non-visual information such as tactile and auditory information that is permanent, as well as visual contrast.
- Ensure information for educational or entertainment purposes is kept separate from that necessary for the use of the built environment.

Aural (sound) information

Acoustics
Where aural information is expected to be passed and received, the acoustic environment should be designed to permit the reception of normal speech.

All building users may experience hearing problems when noise levels are high and when surrounding surfaces are hard. Poor acoustic environments can make communication almost impossible.

Hearing aids do little more than amplify, and in some cases filter, sounds that they receive. Consequently, some wearers will remove them or turn them off in noisy environments, resulting in a significant reduction in their ability to detect aural information.

People who are blind or have low vision may rely on auditory clues for orientation and route planning.

Design considerations

- Provide a good acoustic environment to enable aural communication.
- Use sound absorbing materials to cut reverberation times to acceptable levels.
- Where not immediately installed allow for the provision of sound absorbing materials for installation at a later date.
- Position noisy equipment away from occupied areas.
- Unless security requirements dictate, avoid the use of glazed screens between staff and building users.
- Provide lighting environment and background colour schemes that are supportive for people who may need to lip-read.
- Position a number of loudspeakers around the listening space set to operate at a lower volume rather than a central loudspeaker set at a higher volume.

- Use a range of flooring materials that give different auditory as well as textural feedback to define routes and destinations.

Hearing assistance systems

Where appropriate, a properly specified, installed and fully maintained hearing assistance system should be available in spaces where aural information is expected to be conveyed.

Building users with hearing impairment face a significant problem when trying to receive aural information. This is particularly the case in noisy environments such as theatres and conference centres.

The provision of hearing assistance systems is widespread around the world and of immense value to a large number of people.

Hearing assistance systems are continuing to develop with some now linking to individual smartphones.

Only a proportion of those who would benefit from a hearing aid actually wear one. Of these, not every hearing aid has a “T” switch to pick up induction loop transmissions.

When the “T” position is activated, the normal operation of the hearing aid is not available. If an induction loop is not working, selecting the “T” switch will reduce a building user’s ability to detect aural information.

Design considerations

- Ensure that the specification of any hearing assistance system matches the requirements of the particular location and function of the space.
- Avoid the installation of building services and features which may interfere with the operation of a hearing assistance system.
- In places such as theatres, cinemas and conference centres, visual methods of passing aural information can assist people with hearing impairments. These methods may include sign language interpreters, and open and closed captioning.
- Where systems are installed, include maintenance and testing procedures in the Operation and Maintenance Manual for communication to onsite staff.
- Where hearing assistance systems are installed it is essential they are tested at regular intervals. This requires the provision of compatible testing equipment, and management of the testing regime.
- Building users need to be informed of places where a hearing assistance system is installed, both before starting their journey and when they arrive. This will help them select appropriate destinations and be aware of available facilities.

Building Code requirement

Building Code clause G5 Interior environment:

G5.3.5 Buildings shall be provided with listening systems which enable enhanced hearing by people with hearing aids. Performance G5.3.5 applies only to: (a) communal non-residential assembly spaces occupied by more than 250 people, (b) any theatre, cinema, or public hall, and (c) assembly spaces in old people’s homes occupied by more than 20 people.

Tactile (touch) information

Tactile information should be provided where it will be of benefit to building users.

Tactile features provide information to people who are blind or have low vision that they may not be able to pick up by other sensory means. Tactile features can also be helpful to building users with good sight especially where lighting conditions may be variable.

- Tactile ground surface indicators can provide directional guidance and warning
- Tactile maps can provide layout information
- Tactile elements such as distinct buttons and switches can help locate and identify controls
- Tactile letters, numbers and braille can provide details that sighted building users (in good light) would be able to read.

Braille is the presentation of written text in a tactile form. Pictures alone should not be relied on to convey information.

People who are blind or have low vision, and especially long cane users, obtain information from parallel surfaces such as walls and buildings, detectable depth changes such as full height kerbs, textural changes such as the edge of sealed pathways and landscaping, ground surface changes such as smooth concrete and rough aggregate.

People who are blind or have low vision may not be able to identify the transition between a pavement and a road where there is no full height kerb.

Tactile signage
Many people with vision impairment have some degree of sight. While they may not be able to read the written words on signage, if it is designed properly they may recognise the presence of a sign. Tactile information on such signage that is within reach can be important and convey information otherwise not detectable.

Most people who are blind or have low vision would have lost their sight during their lifetime and are probably familiar with letters, numbers and symbols. These indications need to be raised from the surface to be read. Engraved information is not able to be picked up by the finger tips.

Tactile surfaces
Tactile surfaces finishes are installed where environmental features and design do not provide sufficient wayfinding and orientation information for those who have vision impairment.
Stainless steel blisters installed in pavements are sometimes difficult to identify visually and may have very little slip resistance.

Tactile surface changes such as carpet to vinyl tiles can provide distinction between areas dedicated to specific uses and adjacent pedestrian routes. Some flooring finishes such as concrete and wooden flooring may not provide tactile distinction but may provide auditory awareness to long cane users.

Design considerations

- Provide tactile information in logical positions where sighted building users would read printed information, get directional guidance or be visually warned of hazards.
- Use tactile means to differentiate controls from their surroundings and from other controls.
- Tactile surface finishes should contrast with their surroundings. This allows their presence to be picked up earlier by those with some vision.
- Ensure duplicate and equivalent non-touch screen facilities are provided where touch screens are considered appropriate.
- Ensure signage and wayfinding are accessible.
- Provide other design solutions to avoid hazards such as the underside of stairways to prevent building users walking into them from different approach angles.
- For New Zealand it is recommended that tactile ground surface indicators in outdoor installations are in Safety Yellow. Indoors they need to meet the LRV colour contrast requirements to provide adequate visual warning.

Olfactory (smell) information

The provision of information by olfactory means should be taken into account when specifying the details of the built environment.

Most people gain some advantage from picking up olfactory information such as the smell of coffee when looking for a café. For people who are blind or have low vision smells can also provide specific locational information about the environment around them. For example, smells from shops selling fragrant products can help them know where they are in a mall.

Where such information is not permanent these become only cues to location and not landmarks.

Design considerations

- Incorporate cues to location by olfactory means (smell) wherever possible.

Protection from hazards

Where physical protection is not practical, visual, tactile and auditory cues should be provided to enable building users to identify and locate a potential hazard in sufficient time to take avoiding action.

Those that manage the built environment need to protect building users from hazards. If this is not possible, they need to effectively communicate the nature and location of the hazard in a timely fashion.

The safest way to protect a building user is to provide a physical barrier that will keep them away from harm. However, some potential hazards such as stairs cannot be fully protected.

Information on unprotected hazards needs to be both registered and processed by a building user in sufficient time for them to take action and

remain safe. However, not all building users may be able to do this. This may include children, people with cognitive processing difficulties, those who do not understand written English, people who are alcohol or drug impaired, or those who are distracted.

Design considerations

- Protect potential hazards and locate them away from circulation routes and expected paths of travel.
- Where isolation of permanent hazards is not practicable, incorporate physical barriers into the design.
- Where temporary hazards can be anticipated, such as wet floors due to cleaning, ensure the Operation and Maintenance Manual provides guidance for the Building Manager.
- Provide visual, tactile and auditory cues to warn building users where isolation of hazards and provision of physical barriers is not possible.

How building users process information and make decisions

The design of the built environment should avoid causing stress to building users, and help them make rational choices for their well-being.

The built environment

Environments which are visually complex, or have too much visual or auditory stimulation can be distressing for some, making it difficult for them to be aware of relevant information. Not only does this mean that they become less efficient in achieving their goals but it also affects their perception of hazards which has health and safety implications.

Design considerations

- Simple, logical layouts
- Quiet areas away from crowds
- Waiting rooms where seating is not all in close proximity
- Good ceiling heights
- Corridors with varying widths
- Shorter corridors preferably without dead ends
- Wayfinding information that is provided in a timely and uncomplicated manner
- Good colour contrasts
- Tactile surface changes
- Good even lighting levels
- No large open spaces without clear detectable continuous accessible paths of travel

Design elements

The built environment should be easy to understand and use, with standardised features and predictable details that assist first time building users.

Building users differ in the way they process available information. As a general rule, keeping the elements and details of the built environment as standardised, predictable and simple as possible will benefit everyone.

Design considerations

Include design elements that help building users to understand and use the built environment. For example:

- Logical layouts with standardised features
- Doors and controls where the operation is easy to identify

- Designs and finishes appropriate to building users' age and culture
- Colour schemes that reflect the use of a space
- Lighting which resembles natural light as far as practical
- Levels of illumination on the walking surface which will not be mistaken as a change in floor level.
- Standardised unambiguous symbols and words on signage
- Where possible, limiting changes within an existing environment to small scale alterations implemented incrementally
- Vision panels in solid doors where practical
- Finishes that are not shiny or reflective

Navigation and wayfinding

The built environment should be designed to be as simple and logical as possible with information presented to allow all building users to make appropriate wayfinding decisions.

Planning
Visitors to a location are likely to arrive with some form of mental model of the place they are approaching. This mental model may be limited if they have no advance information, theoretical if they have obtained prior information from maps, guides, web-sites or invitations, or developed from their memory if they are a returning visitor.

Wayfinding problems can be experienced when a building user's mental model differs from that encountered on the ground. In some cases this mental model cannot be built on due to the lack of suitable and accessible information onsite.

To plan a route, building users need to know both the location of their destination and where they currently are. This should be achievable independently without input from others. The more difficult this is the more stress building users will experience.

Knowing where facilities are located is essential to minimise "hit or miss" searching, having to ask for assistance or requiring undue effort which is important for those with limited strength or endurance.

Information appropriate to the decision making process, including confirmation that the building user is going in the right direction, needs to be available in the correct locations.

Consistent information throughout a site makes navigation easier and reduces confusion and stress.

Memory
When someone returns to a previously visited location, their memory of barriers, details and features can assist in the wayfinding process. Many people who are blind or have low vision may have to rely on memory to navigate. While landmarks and memorable elements are important to incorporate into any design, the environment should cater for a first-time visitor with no previous knowledge or experience.

Routes
Diagonal and curved routes can make orientation difficult. Wayfinding is much easier with right angled designs.

In wide open spaces such as large lobbies leading to different activities, people who are blind or have low vision can benefit from clear pathways that can be conveyed by tactile means using changes in floor surface.

Technology
New technologies are now developing that can provide localised way finding information to people who are blind or have low vision. These can include the use of phones but this type of technology should be in addition to and not replace physical wayfinding information.

Design considerations

- Plan the overall arrangement of access routes to be logical, understandable, useable, and as straight and direct as possible.
- Ensure that information about all methods of travel through the built environment (e.g. stairs, ramps, lifts, escalators, travellators) and their respective locations are easy to find and able to be accessed by all building users.
- Make wayfinding information available at decision points and orientate it in the direction that the building user is facing.
- Signage should be accessible and positioned appropriately for viewing height, detection and decision making.
- Install non-visual features such as audible and tactile devices to convey important information about the site to users who are blind or have low vision.
- Ensure building users are able to maintain visual contact with key features to confirm their routing is correct.
- Restrict signage to that required to travel to the next decision point to prevent overload.

- Ensure that wayfinding plans are uncluttered and clearly indicate the building user's current position.
- Identify constraints to full accessibility and provide appropriate wayfinding guidance to alternative routes.
- Provide visual, tactile, auditory and olfactory cues to enable building users to easily identify their current position.
- Divide large open spaces into smaller spaces. Where this is not possible, provide tactile pathways to assist people who are blind or have low vision.
- Make available appropriate technology that assists wayfinding.

Building Code requirement

Building Code clause F8 Signs:

F8.2 Signs must be provided in and about buildings to identify: (a) escape routes, (b) emergency related safety features, (c) potential hazards, and (d) accessible routes and facilities for people with disabilities.

How building users act on decisions

The built environment should be designed and constructed to make movement between locations as easy as possible with the minimum of effort.

Movement within the building

In general, everyone will want to take the most direct and easiest route to their destination.

Some building users will be restricted by a lack of stamina or issues relating to joint movement. Others may require the use of a walking aid or a wheelchair.

Changes in surface level such as steps and ramps and inappropriate surface finishes may present significant problems to a range of users.

Design considerations

- Ensure that paths of travel between destinations and facilities are direct and require as little effort as possible.
- Wherever possible, design all routes to be level, with appropriate width and headroom.
- Avoid including steps or ramps in a design wherever possible.
- Ensure gradients of ramps and the pitch of stairs are as low as possible, and changes in level restricted.
- Provide equivalent alternatives where step free routes are not possible.
- Co-locate options to change level (e.g. lifts, ramps, and stairs).
- Provide handrails for support and balance on both sides of all ramps and stairs, and where they are needed because of the environment.
- Ensure walking surfaces are even, firm and slip-resistant with low rolling resistance for wheelchair users.
- Provide opportunities to rest in appropriate locations.
- Ensure surfaces against which someone might stumble or fall limit abrasion.
- Ensure public spaces are well ventilated with controlled temperature and humidity.
- Avoid the use of materials which may have high emission levels.

Building Code requirement

Building Code clause D1 Access routes:

D1.3.1 Access routes shall enable people to: (a) safely and easily approach the main entrance of buildings from the apron or construction edge of a building, (b) enter buildings, (c)move into spaces within buildings by such means as corridors, doors, stairs, ramps and lifts.

Features, fixtures and fittings

Features, fixtures and fittings should be designed and installed to enable them to be approached, reached and used easily.

Suitable space is required for building users (including wheelchair and mobility scooter users, parents with double buggies and those with luggage) to approach a selected feature and operate it easily without inconvenience.

Some users may have hand, arm or dexterity impairments which make gripping objects, twisting and turning them, or using small controls very difficult. A simple rule is that if an element requires a physical input it should be able to be operated by a clenched fist and not require the use of both hands.

Generally it is easier for most building users to push a component such as a door rather than pull it towards them.

Door closers can cause significant problems. They are often set at too high an operating force which becomes higher still if they are not maintained.

Having elements within easy reach is particularly important to avoid people over-balancing. For some wheelchair users, impaired balance makes leaning forward difficult.

Where a feature requires two-way communication, a visual means of response will enable those with speech or hearing impairments to operate the system.

Design considerations

- Ensure suitable approach routes and spaces are available to elements of the built environment that require interaction from a building user.
- Wherever possible, ensure elements such as controls, toilet flushes, and door handles can be operated with a clenched fist, wrist or elbow.
- Provide handrails and elements designed to give support that can be easily grasped without the hand slipping.
- Position components and controls within easy reach of all users to prevent over-balancing.
- Ensure all fixtures and fittings are operable with one hand (whether right or left).
- Avoid controls and fittings that need to be turned or twisted.
- Remove unnecessary doors and door closers.
- Maintain required door closers at the lowest closing force possible.
- Consider the use of automatic sliding doors where doors are required to resist wind forces.
- Counter-balance vertical sliding sash windows to reduce the lifting force necessary.

Building Code requirement

Building Code clause D1 Access routes:

D1.3.4 An accessible route, in addition to the requirement of Clause D1.3.3, shall: (f) have doors and related hardware which are easily used.
