TP 12705E

# IMPROVING TRANSPORTATION INFORMATION: Design Guidelines for Making Travel More Accessible

Prepared for the

**Transportation Development Centre**
**Transport Canada**

by

**TransVision Consultants Ltd.**

**October 1996**

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The contents of this report reflect the views of the authors and not necessarily the official view or opinions of the Transportation Development Centre of Transport Canada.

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16. Abstract


The objective of this project was to research and delineate guidelines for the improvement of information provision in vehicles and transportation terminals. The overall goal is to enhance accessibility for elderly and disabled persons.

Transportation is particularly sensitive to the need to inform and be informed. Throughout the travel process, access to information is vital if the traveller and the service provider are to have complete awareness and understanding. People with cognitive, sensory, intellectual or physical disabilities must not be barred from receiving the information required. Without it they will miss important clues to the current situation and to their environment.

Environmental communications is a term used to describe the information people need to understand where they are and how to reach a given destination. The term covers general information about the setting, directions to and identification of destinations and information about operational procedures.

Environmental communications can be provided by visual, auditory or tactile means. This report considers each means, and offers guidelines for the provision of information in ways that are accessible to all travellers.


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16. Résumé


La recherche avait pour objet d'élaborer des lignes directrices visant à améliorer la qualité de l'information accessible dans les véhicules ainsi qu'à l'intérieur des installations terminales, dans le cadre plus général d'une accessibilité améliorée des transports pour les personnes âgées et les personnes ayany une incapacité.

L'information est vitale dans le domaine des transports : savoir informer et bien comprendre le message sont essentiels à la bonne marche des transports. Il faut aussi éviter que les personnes ayant une incapacité cognitive, sensorielle, intellectuelle ou physique se sentent exclues du processus informationnel. L'information véhiculée doit permettre à cette catégorie de voyageurs de savoir à tout moment où ils se trouvent et dans quelle direction se diriger, faute de quoi, ils risquen de s'égarer.

L'information contextuelle est le terme choisi pour décrire l'ensemble des informations visant à permettre aux voyageurs de s'organiser, de se repérer et de s'orienter dans l'installation terminale, et à les aider à se rendre vers la destination de leur choix. Elle vise en outre à les renseigner sur les formalité à accomplir.

Cette information se communique par voie visuelle, auditive ou tactile. La présente étude examine tous les moyens de transmettre l'information par ces trois voies et propose des lignes directrices sur les moyens de s'assurer que l'information véhiculée atteigne les publics visés.


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# PREFACE

Well designed information systems in transportation terminals and vehicles can do much to reduce barriers to travel, especially for persons with perceptual or cognitive disabilities, and can make transportation more convenient for all travellers.

Of the 3.8 million Canadians with disabilities, 2.2 million have transportation-related disabilities, i.e. their ability to travel is reduced. Seventy-five percent of these 2.2 million Canadians have moderate or severe disabilities. Almost sixty percent have perceptual disabilities (hearing, speaking or seeing impairments), and almost forty percent have cognitive disabilities (learning, memory or mental health impairments). Seventy-five percent are agility disabled. Many have multiple disabilities, particularly those over 64 years of age. Twenty-nine percent of those over 64 who are mobility disabled are also cognitively impaired, and thirty-nine percent are sight or visually disabled. Eighty-nine percent of those who are speaking disabled are also mobility disabled. Eighty-three percent of those who are agility disabled are also mobility impaired *(TransAccess Ref).*

Well designed and well positioned information systems benefit travellers with sensory or cognitive related disabilities. Signage (passive or active), audio, and interactive systems can benefit most of these travellers; supportive, suitably trained staff can provide the remaining requirements. Travellers with mobility or agility disabilities and all elderly travellers benefit from such information formats and from well designed information content. Often essential information, such as accurate time, directions to departure gates and washrooms, directions for returning rental cars at airports, etc., is not provided, causing considerable confusion, frustration, stress and even anger.

In addition to removing barriers to travel, effective information can also make travel safer.

This manual is intended to aid planners, operators, carriers, designers and manufacturers involved in the organization and management of transportation facilities. It provides guidelines for making such facilities more accessible for all. The guidelines consolidate past and current research and experience, presenting what is considered best practice in the design of the form and content of effective information systems in all modes of transport, including some suggestions for improving information displays in personal vehicles, the preferred mode of travel for people with disabilities.

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# LIST OF EXHIBITS

# 1. INFORMATION CLASSIFICATION

The issue of accessibility by disabled persons to various modes of transportation has received increasing attention in recent years. Considerable energy, funding and research have been directed toward environmental access needs. Much of this attention has been directed toward removing the architectural barriers impeding travellers who use wheelchairs or are otherwise mobility impaired. However, similar efforts for Canadians with perceptual (vision or hearing) or cognitive impairments have been lacking.

The environmental access needs of perceptually and cognitively impaired travellers must be identified so that they may travel with an efficiency, convenience, and dignity comparable to that experienced by the general public. Specifically, efforts must be made to assist perceptually and cognitively impaired persons to travel independently, taking into consideration the effects of the environment on safe and efficient movement. Transportation planners are only beginning to recognize and acknowledge the needs of persons with perceptual or cognitive impairments.

The limited focus on access issues for perceptually and cognitively impaired persons may be due, in part, to the fact that they are not normally denied access to transportation facilities because of architectural barriers. Rather they have accessibility difficulties due to the problems of orientation to new, and often large and confusing, transportation terminals. Persons with perceptual and cognitive impairments need to know where they are and how to reach a desired destination quickly and safely; or how to obtain needed information.

*Environmental communications* is a term used to describe the information used by individuals in the understanding of where they are and of how to reach given destinations in their everyday environment. Signage is only one aspect of this information; people are also a vital source of information, as is a building itself and its layout. Stairs or elevators communicate the way to other levels without any signage at all. Hallways communicate the directions to other areas. The understanding of where a person is and of how to reach destinations is referred to as orientation and wayfinding. *Orientation* is the means of adjusting to a situation -- determining your current location and surroundings. *Wayfinding* refers to the means of getting around a building. Information identifying destinations and procedures for using equipment and facilities is also an important aspect of the overall environmental communications system.

In addition to understanding the needs and requirements of travellers, factors related to information processing and the environment itself have to be considered in planning an environmental communications system that can be used by an individual to form a generalized mental representation of the physical world, which is a product of immediate sensation plus the memory of past experience.

Everything that can be imparted in a setting (or that one may wish to know) falls into one of four types of environmental communications, differentiated according to content: general information about the setting, directions to destinations, identification of destinations, and information about operational procedures (see Exhibit 1).

***Exhibit 1:  Types of Environmental Communications***

| ***Information type*** | ***Description*** | ***Examples*** |
|---|---|---|
| Orientation and general information about the setting<br>? | Orientation information that gives users an overview of what 'shape' the building has, where they are, and where the destination lies, as well as other relevant information about the general setting. | Maps, floor plans, exploded views, and models, all with you-are-here arrows on them, and clear identification of corridors and destination zones.<br>Building directories. |
| Directional information to destinations<br>→ | Wayfinding information that guides people along a designated or pre-selected route to a destination. | Signs with arrows or plain-language descriptions involving the use of building features or landmarks.<br>Floor directories in elevator lobbies.<br>Coloured lines on walls or ceilings leading to destination zones. |
| Identification of destinations<br>□ | Information provided at the destination. | Signs with names or pictographs at entrances to destinations.<br>Sometimes safety colours will help to identify equipment.<br>Signs identifying local hazards. |
| Description of operational procedures<br>○ | Information relating to operational procedures at the destination. | General do's and don'ts that affect behaviour in the building, including safety information.<br>Emergency signs that provide information on the location of emergency exits, equipment, and procedures within the building. |

# Orientation Information

Orientation is the means of determining one's current location and surroundings in the physical environment. Maps in the conventional sense, three-dimensional or otherwise, can provide orientation while giving visitors an idea of how complicated or simple a building may be. Maps may also display the building's shape, where the traveller is currently situated and where the destinations lie. Another useful device is a 'spoken map' that briefly describes the building and the current location of the traveller. These are environmental communication systems that enhance the representation that people have of their surroundings.

### *Cognitive Mapping*

The representation that people have of their surrounding environment is often called a mental image or a *cognitive map*. A cognitive map is a sort of mental road map that represents the environment. Yet it is also different from a road map in that it varies from person to person and may be distorted and personalized. Also, strategies for developing and using cognitive maps vary from person to person.

Cognitive mapping is a mental structuring process that integrates into a whole what has been perceived in parts. It underlies the notion of spatial orientation.

### *Spatial Orientation*

Spatial orientation refers to a person's ability to determine their location in a setting. From a cognitive perspective, spatial orientation is based on the ability to form a cognitive map. A person is considered spatially oriented if they have an adequate cognitive map of the surrounding setting and are able to situate themselves within that representation.

*Spatial orientation* is therefore the process of devising an adequate cognitive map of a setting along with the ability to situate oneself within that representation. It is the static relationship to space. It does not encompass the dynamic aspects of people's movement (i.e., the process involved in reaching chosen destinations).

# Wayfinding Information

The term *wayfinding* refers to ways of getting around a building. It encompasses a number of processes, including decision making, decision execution, and information processing. It is the process of reaching a destination, whether in a familiar or unfamiliar environment. It is perhaps best described as spatial problem solving. Travellers depend on one of two strategies for spatial problem solving: a *sequential strategy* or a *spatial understanding*.

### *Sequential Strategy*

Visually and cognitively impaired people who are just getting to know a facility typically use a *sequential* strategy for finding their way. For example, to get from the entrance to a ticket counter, a visually impaired person may not know the overall spatial relationship of the terminal, but may be able to find the way by following a memorized route from a specific entrance. This sort of sequential strategy emphasizes a string of landmarks without providing the relationship between them.

Sequential understanding can be compared to considering a building in terms of its destination routes. When we travel the routes, we require environmental information. In buildings, these routes are formed by vertical and horizontal circulation (corridors, elevators, stairs, etc.). Routes in buildings require, among other information, signs. For successful wayfinding, signs have to be presented in a particular way. This has to do with how we assimilate information when we are finding our way around.

### *Spatial Understanding*

Alternatively, a traveller may use their cognitive map that incorporates an understanding of the interrelationships between points in the environment. In general, this interrelated strategy is built up over time. Many travellers begin by learning paths and landmarks, then build them into an integrated whole. They develop a *spatial understanding* of the building's environment, usually after some experience and a number of trips through the building.

Spatial understanding refers to the total dimensions of the building; its walls enclose space and *elements* such as escalators, elevators, etc., help to break up the space. People notice and remember these objects as they move about a building. The building's *organization principle*, another component of spatial information, describes the architectural layout of the building. This arrangement may be in the form of a square, a rectangle, a line, etc. To be useful as wayfinding information, the organization principle must be visible from the outside, expressed in the shape of the walls, and from the inside, when entering the building. The organization principle is normally communicated by using a display of an information map of the building. The combination of elements and organization principles helps a visitor create an image. This notion of imagery is extremely important in wayfinding.

Orientation and wayfinding is an important but sometimes unnecessarily problematic task for travellers with disabilities or communication difficulties. As a result of certain functional limitations, they may depend heavily on their mental image of the environment, their *cognitive map*, and whatever landmarks and cues are useful to them.

The difference between using a sequential understanding and a more integrated cognitive mapping strategy with a spatial understanding is in the flexibility the two strategies permit. Consider the problem with following sequential directions of the "turn left at the second corridor" variety. When a turn has been forgotten, or when there is a detour, it is very easy to get lost. If the traveller knows the building well and understands the relationship between areas, it is easier to change the route when necessary.

This raises the importance of good environmental communications for travellers with disabilities. First-time users of a transportation terminal may find sequential wayfinding easiest. Terminals can provide for this by supplying clear signs and landmarks that people can follow in a point-to-point strategy. Travellers who are more familiar with the setting may find integrated cognitive maps more usable. Buildings can provide for this by employing tactual and visual graphics and simple circulation patterns that allow an overall understanding of the building. People with visual difficulties need sequential and spatial wayfinding information, such as a textured path to the information desk where verbal information can be given out by the attendants.

# Identification Information

The design of an environmental communications system has to be based on people's behaviour. It must contain all the necessary information for them to make and execute decisions along a given route. Therefore, information must be provided, not only at decision points for wayfinding, but also at destinations, to confirm that the individual has reached their destination.

Environmental communications not only refers to the visual mode, but also includes the audible and tactile modes. To be perceived and understood, all environmental communications must correspond to basic laws of environmental perception and cognition.

Perception and cognition are the components of information processing: the former relates to the process of obtaining information through the senses, the latter to the understanding and manipulation of information.

***Environmental Perception***

Environmental perception is based on a process of scanning and glancing. When moving through a complex setting, the eye scans the visual field. This pre-attentive perception serves to identify objects or messages of interest. These objects or messages are then focused upon for a short period of time. During this short focus or glance, the eyes rest on the item of interest for some tenths of a second. The image thus obtained is held in a short-term visual memory until it is translated into memory of longer duration.

The environment, however, is not perceived through vision alone. Sound, tactual and kinesthetic perception is also used, especially to proximal objects.

The process of obtaining information about one's environment involves all the senses and is used to identify and record destinations and landmarks.

***Environmental Cognition***

The meaning of cognition is knowing and understanding. In the process of mapping a new environment, some researchers showed that people tended to start by identifying and recording destinations and landmarks and using them as anchor-points to subsequently fill in the paths. Others have assumed paths and areas to be the original structuring element, that is, the points where they change direction, the angle of directional change, and a measure of the distance from one point to another.

Environmental communications affect cognitive mapping. The legibility of key architectural elements (such as entrances, horizontal and vertical circulation, and major landmarks) is a prerequisite to understanding spatial organization.

Destinations and key decision points have to be identified, although many objects themselves do not need signs or identifying marks.

# *Operation Information*

When at the destination, a person may need instructions on certain procedures, whether it is buying a ticket at the check-in counter, operating the water tap in the washroom, paying for a parking ticket, or operating a vending machine.

Environmental communications can therefore also be used either to solicit a response from a person and control their actions or to obtain some feedback, for example, at a self-help phone. Onboard a vehicle, operation information is particularly important with respect to emergency procedures.

***Control Actions***

Generally, there are relatively few regulatory or warning signs in most public buildings. Onboard vehicles, there may be a few more such signs and these may be considered very important in particular circumstances. Regulatory signs may be either prohibition or mandatory signs and are usually in the form of circle. Warning signs may be caution or danger signs and are usually in the form of an equilateral triangle. These are the do’s and don’ts that travellers need to know.

Regulatory signs are generally prohibitory and deal with such subjects as smoking or entry into restricted areas. In addition to regulatory signage, there are warning signs, particularly in relation to hazardous areas. Consideration has to be given to providing warning information that will be equally useful to sighted and sight-impaired visitors.

***Solicit a Response***

Finally, environmental communications may be used to obtain a response or feedback from the traveller, such as in an emergency situation, at a multi-media information display, or through a self-help telephone.

There has to be a purpose to information; that is, what is to be done with the information? Is it to solicit a response or feedback, or is it just received by the traveller for immediate interpolation or memory storage?

If a response is desired from the information, is the response to be emergency, immediate, rapid, or delayed? These concerns will help determine the form, content and media of the message to be conveyed.

***Obtain Feedback***

If feedback is desired from the provision of information, consideration has to be given to method of feedback. Feedback can be provided through a number of senses: visual, auditory, tactile or kinesthetic. With multi-media displays, touch-screen computers provide feedback. With a self-help telephone, auditory messages provide feedback.

In the transportation environment, operation information is extremely important to control actions, solicit response and obtain feedback. The speed, accuracy, setting, adjusting, and tracking of both the information and the response are important considerations. These, in turn, are affected by the capabilities of the traveller whose skills, comprehension, understanding, and interpolation of information may vary considerably. The functional abilities of the traveller should be a major concern in the design of information systems.

# 2. INFORMATION CONCERNS

This chapter addresses different types of functional abilities in terms of their effect on the design of information systems. The organization of these abilities/impairments into distinct categories is convenient but could be somewhat misleading. Many people have more than one functional impairment, and many functional impairments have secondary effects. For example, low vision can affect a traveller's mobility and balance, limiting their range of motion or their stamina and thus affecting their ability to perform a specific task. Therefore, design features intended to assist travellers with one functional impairment may often provide secondary benefits to travellers with other functional impairments.

The goal of accessible information systems is unequivocal: independence. Other objectives include safety and security. The design of information systems should be based on the simple question: Will the proposed system allow the person with disabilities to travel more independently, more safely, more securely, and more purposefully? If the answer is yes, the environment thus created has the added benefit of also being a better environment for the general public.

# For Visual Information

***Vision Impairments***

About 558 thousand persons in Canada have restricted vision, which makes seeing and reading difficult, even with corrective lenses *[Turnbull and McKenzie, 1995, pg. 6]*. Restrictions to vision result from a number of medical conditions, each of which affects vision in different ways. Travellers can experience loss of visual acuity, reduced colour discrimination, loss of night vision, tunnel vision, clouding, distortion, or poor vision in conditions of bright light or glare. About 224 thousand people are legally blind, have very little sight, or are unable to see at all. Blindness, and even low vision, can affect mobility.

***To travel***, individuals who are blind use canes, guide dogs, or sighted guides. Long canes are used in two ways: the touch technique (the cane is moved from side to side, touching the floor 200 mm outside each shoulder) or the diagonal technique (the cane is held stationary with the tip just above the ground outside the opposite shoulder). The touch technique is generally used in unfamiliar environments, such as sidewalks or parking lots. The diagonal technique is typically used in more familiar and controlled environments, such as terminal buildings. Guide dogs are less commonly used. Some blind travellers use sighted guides and seldom travel independently; however, many individuals with low vision travel without canes or guides.

***Nonvisual senses*** are important to travellers with restricted vision. Sounds from traffic, automatic doors, and telephones, for example, can provide important clues to location. Smells from a restaurant can aid in orientation and a temperature change or draft can often indicate the location of doors. Tactile patterns can be used for guidance and warnings. For travellers who are blind, negotiating a corridor is part of a larger problem that includes orientation and cognitive mapping (developing a mental image of the environment). These tasks are easier in simple, clearly organized spaces that use cues to indicate location and direction.

We do not all have good vision, yet environmental communications are almost entirely based on the assumption that it will be read with normal vision. It is only now that we are beginning to respond to the needs of those who rely on touch and sound, i.e., persons with visual and cognitive impairments. The sound of elevators, for example, is information for people who can't see; a large entrance hall may also contain sounds that, for people who are alert to it, indicate how large the space is that they have to traverse. Other sounds and cues can indicate the locations of restaurants, shopping and so forth. To provide assistance in sequential wayfinding, large signs, effective lighting, and other visual strategies are important.

***Assistive Techniques***

Travellers with low vision and travellers who are blind can be assisted by:

- A simple organization of circulation routes and corridor systems to make cognitive mapping easier.
- Circulation routes free of obstacles and obstructions that may not be detected by travellers with long canes.
- Visual and tactile cues that use colour and textures to define routes, edges, and interfaces.
- Aids to balance such as grab bars and handrails.
- Acoustic environments that enhance auditory information and minimize ambient noise.
- Uniform general illumination with higher levels of task lighting, diffused and aimed to reduce glare.
- Clear signs with large lettering and graphic symbols on contrasting backgrounds, displayed so readers can move closer or further away, as necessary.
- Visual information and signals that are also communicated in audible and tactile form.
- New technology, such as talking signs, audio pathfinders and audio descriptions.

# For Audible Information

***Hearing Impairment***

Hearing impairment is one of the *invisible* disabilities, since it is often difficult to recognize individuals with hearing impairments. Hearing impairment, ranging from a slight loss of hearing in specific frequency ranges to profound deafness, affects about 1 171 000 people in Canada *[Turnbull and McKenzie, 1995, pg. 6]*. Many of these individuals are hard-of-hearing (hearing is limited) but are functional for most daily living activities with the help of a hearing aid. With profound deafness, sounds have no meaning in ordinary living. There are an estimated 310 000 profoundly deaf individuals in Canada.

***Hearing aids*** are the most common assistive device for people with impaired hearing, but these devices can only amplify sound; they do not enhance clarity. Hearing aids are most effective when the user is face-to-face with the speaker. They are less useful in large groups of people, rooms with high levels of background noise, rooms in which sound reverberates, and situations in which the speaker or sound source is distant from the listener. High- or low-frequency sounds and static electricity can interfere with hearing aid performance.

***Assistive devices*** for travellers with hearing impairments include telecommunication devices, guide dogs, and signaling devices that use light or vibration to serve as emergency alarms. Induction loop or infrared assistive listening systems can provide assistance in some areas of a transportation terminal, and open or closed-caption decoders can be used with televisions. Telephone handset amplifiers can be made available for travellers who are hard-of-hearing, and telecommunication devices for the deaf (TDDs) or text telephones should be available for non-auditory telephone communication.

Several types of assistive listening systems (ALS) that can provide audible information to individuals with either hearing or visual impairments. These systems accept input from existing public address systems, thereby reducing cost. A variety of listening attachments (inductive telecoil couplers called neckloops and the typical earbud or headphone type accessories) permit users of telecoil equipped hearing aids to join others in understanding more with the use of ALS. These systems include FM and AM radio systems, induction loops and infrared systems.

When hearing is impaired, there is an increased dependence on other sensory information, particularly visual information. For travellers who are deaf, oral or auditory information can be visually communicated through electronic message boards, speech-reading, sign language, or finger spelling. Sign language continues to be the preferred mode of expressive communication among the deaf.

***Assistive Techniques***

Travellers with hearing impairments can be assisted by:

- Acoustic environments that minimize interference, background noise, and reverberation.
- Displays, signals, and warning systems that communicate information in visual as well as audible form.
- Assistive devices such as text telephones, open- or closed-captioned decoders, and telephone amplifiers with push button volume controls.
- Assistive listening systems connected to the PA system, such as induction loop, FM radio, and infrared systems.
- Volume controlled handsets for personal communications with information agents and ticket personnel in noisy environments, such as transportation terminals.
- Suitable lighting to aid communication through speech-reading, sign language, gestures, and body movements.
- Ticket counters and rest areas configured to allow close face-to-face communication.
- A notepad and a pencil for communication.

# For Understanding Information

***Cognitive Impairment***

Cognitive problems are complex and varied, manifested by delays in the development of, or difficulties related to, attention, memory, reasoning, co-ordination, reading, writing, spelling, calculation, communicating, social competence or emotional maturity. It is inherent in the definition of persons with cognitive disabilities that they would likely be considerably affected by deficiencies in information systems.

Many conditions result in impaired cognitive abilities, affecting an estimated 1 137 000 people in Canada *[Turnbull and McKenzie, 1995, pg. 6]*. These persons are limited in their activities of daily living due to a learning disability, a mental health condition, a mental handicap, or labelling by others. In addition to cognitive difficulties, people with learning disabilities are also more likely to have physical disabilities. Cognitive impairment, particularly for older people, can also result from organic dysfunction or Alzheimer's disease.

Persons with cognitive disabilities may have trouble absorbing aural information and/or processing that information; they may experience an involuntary reaction to too much information; they may have trouble distinguishing directions or remembering specific facts.

*Developmentally impaired persons* experience other difficulties with environmental communications that are not directly connected with vision, hearing, literacy, or speech problems. This large group of persons may have any one of a wide variety of disorders. Estimates of learning disabled persons run as high as 10 percent of our population; mentally impaired persons are estimated at 4 percent of Canadians.

*Situationally impaired persons* are those who would, under other circumstances be described as 'unimpaired'. Due to a stressful situation they may be apprehensive or angry at having to be where they are, and become situationally impaired. The visitor will consequently experience difficulty with signs, no matter how good they are. For obvious reasons, there is no data on situationally impaired persons; however, it is fair to say that all of us will be, or have been, in this situation at one time or another.

*Literacy impaired persons* constitute up to 20 to 25 percent of our adult population. Even if a sign is perfectly legible because of the size of the letters, this group may not be able to read it. The problems of travellers with illiteracy or foreign language difficulties can be considered in this context. Their needs also have to be recognized in wayfinding and orientation systems:

***Assistive Techniques***

Travellers with impaired cognitive abilities can be assisted by:

- Good common sense and understanding.
- Simple and clearly organized circulation systems with cues (other than written signs) for orientation such as symbols, colours, and identifiable spatial characteristics.
- Plain language in signs, simple words, and as few of them as possible, as well as consistency in the display of signs.
- Environments that are not confusing or intimidating.
- Environments free from visual misdirection or illusion such as mirrored passageways or railings that are the same colour as the background.
- Redundancy which involves saying things in different ways until the visitor acknowledges that they understand.
- Designs that do not require travellers to simultaneously perform multiple activities, such as opening a door while climbing a step, or to perform activities in rapid succession, such as passing through a series of closely spaced doors.

# For Acting on Information

***Mobility Impairment***

About 2 271 000 Canadians have a mobility impairment *[Turnbull and McKenzie, 1995, pg. 6]*. More than 137 thousand individuals in Canada use wheelchairs or scooters for personal mobility, and 142 thousand persons rely on some form of walking aid. Mobility may be limited due to paralysis resulting from spinal cord injuries, amputation, arthritis, polio, multiple sclerosis, or injuries to the legs or feet. For individuals who experience one or more of these conditions, a number of assistive devices are available, including wheelchairs, leg braces, crutches, canes, prostheses, and walkers.

Many individuals have a limited range of motion or lack of strength in the upper extremities that restricts activities such as lifting, reaching, kneeling, or bending. About 2 067 000 Canadians have difficulty lifting or reaching with their arms, or have difficulty bending, kneeling, or sitting. These conditions can result from injuries, arthritis, heart conditions, inner-ear and balance problems, or the use of prosthetic devices.

Age can affect some travellers' capabilities to perform certain activities. Many older people have difficulty reaching, bending or kneeling because of stiff joints, arthritis, or dizziness associated with inner-ear problems. Impaired balance can also limit high-vertical reach.

A traveller's range of motion can also be limited by prosthetic devices, such as rigid casts or leg braces. Travellers in wheelchairs must perform activities from the seated position, which greatly reduces their range of motion. Similarly, ambulatory travellers who must maintain balance with assistive devices such as crutches or walkers have difficulty with a low- or high-vertical reach.

Because of age, illness or accident, these travellers may have difficulty in walking and may be concerned about going any distance to read a sign. They will also want reinforcement or confirmation that once they set out to a destination, they are in fact going in the right direction.

***Assistive Techniques***

Travellers with a limited range of motion can be assisted by:

- Switches, controls, drawers, and other equipment and furnishings mounted at convenient vertical heights.
- Ticket counters, tactile maps, and displays that do not require a horizontal reach greater than 600 mm.
- Aids to balance, such as grab bars and handrails, and chairs with armrests to aid in sitting and rising.
- Signs and informational displays mounted near eyelevel to avoid vertigo or balance problems.
- Doors, openings and corridors with adequate maneuvering clearances for assistive devices.
- Functional arrangements that limit travel distances between activities.
- Automated systems and equipment that do not require rapid movement or agility on the part of users.
- Controls within convenient vertical and horizontal reach of travellers in wheelchairs or those using assistive devices.
- Switches and controls that do not require fine hand control or a strong grip to operate.

It is worth bearing in mind that some travellers will have multiple disabilities. A deaf person may also use a wheelchair, for example. This underlines the importance of an information system that is able to accommodate itself to the orientation and wayfinding needs of people with disabilities and of those without disabilities.

Much of the information and communication that guides the traveller is conveyed by print, signs, or audio messages, or through dialogues with employees of the carrier. Problems are therefore created for sight, hearing and speech impaired travellers who do not have full access to the information provided by carriers and terminal operators.

Sight impaired travellers face both communication and mobility problems. These travellers rely heavily on audio and tactile sources of information. As a result, sight impaired travellers are often unable to use printed schedules and maps, and have difficulties with orientation in terminals, and with identification and pick-up of baggage. They rely on audio announcements and may have difficulties if these are unclear or incomplete.

On the other hand, hearing impaired travellers rely primarily on visual and tactile sources of information and must often communicate using visual signals. This group of travellers has special needs for those aspects of inter-city trips where information is orally transmitted, such as making reservations by telephone or being informed of changes in departures and/or arrivals through audio announcements. Speech impaired travellers have similar needs since they rely on visual and tactile methods to communicate their requests and responses to ticket agents and other service personnel.

Cognitively disabled travellers may have trouble absorbing or processing information, they may experience an involuntary reaction to too much information, and/or they may have trouble distinguishing directions or remembering specific facts. Their needs span the entire spectrum of information and communication systems and their needs may be similar to persons who experience foreign language or illiteracy problems.

Physically disabled travellers may have few communication problems attributable to their disability but may have difficulties in communicating their needs to the carrier's personnel and ensuring that those needs are communicated internally to the appropriate personnel throughout all stages of the journey. If the needs cannot be met, new information from the carrier must be communicated to the traveller.

# 3. INFORMATION COMPONENTS

Aside from meeting the environmental communications requirements of a variety of travellers with varying abilities, information can be used for other purposes: to affect individual behaviour, to alleviate fears and anxieties, to change attitudes, to improve the image of the transport operation, or to increase ridership and revenues.

Every information system consists of several components that must be coordinated in their content, form and media. Content, form and media are the irreducible, basic components of all information:

- The **content** is primarily what is being expressed, directly or obliquely; it is the character of the information, the message. The message is composed for a purpose: to tell, express, explain, direct, inspire, affect.
- The **form** is the method of presentation: the design and arrangement of the basic elements of the message.
- The **media** is the location and method of conveyance of the message. It is the interface, the channel of communication between the operator and the user.

Form is affected by content; content is affected by form. The message is cast by the transport operator; received and modified by the traveller.

# Information Content

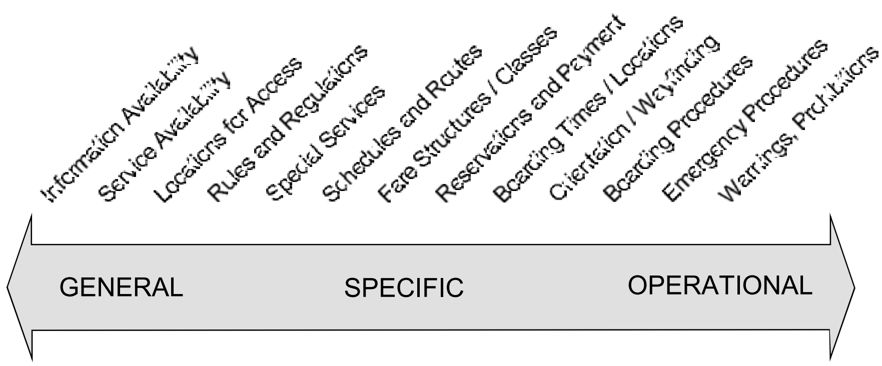
***Levels of Information***

For any transportation system, several levels of information are required by the travellers. The particular level depends on the purpose of the information and the purpose, naturally, tends to dictate its function:

- **general information**, which exists independently of a specific service and refers to transportation in general;
- **specific information**, which concerns a specific service, including its schedule, fares, reservation and payment methods and other conditions;
- **operational information**, which concerns the routing and current timing for an actual trip, including connections, status and emergency instructions.

The information content does not have to be thought of as only operating in distinct levels, but can be expanded in subtle steps on a continuing basis from one level to the next, ranging from basic service instructions to routing, schedule and fare information to detailed technical instructions for specialized equipment, services and facilities (see Exhibit 2).

***Exhibit 2: Various Levels of Information Content***



General information is provided to increase awareness and to improve attitudes towards the service. This information is oriented towards the occasional traveller with the ultimate purpose of increasing patronage. Information about the service and instructions for obtaining more specific directions are generally consistent throughout the system and can be treated in a long-range informational or educational manner.

Specific information oriented to regular travellers must be provided to ensure that users know where to access the system and how to use it. This includes detailed information for users that are familiar with the transportation system but need to know route specific details concerning the system, such as those contained in timetables and maps.

Operational information is provided to travellers to reduce difficulty in obtaining a ticket and to improve the confidence of users in the service. The information is oriented towards both the regular and occasional users and can include trip planning or itinerary details. The most important factor with the provision of operational information is that it be provided at the decisive moment for the traveller.

# *Information Form*

### *Form of Information*

The content of the information (that is, the message) largely dictates the form (the design and arrangement) that the information will take. The provision of warnings, prohibitions or orders will take an entirely different form than instructions for using the service or advertisements to increase ridership. The form for alarms is usually standardized.

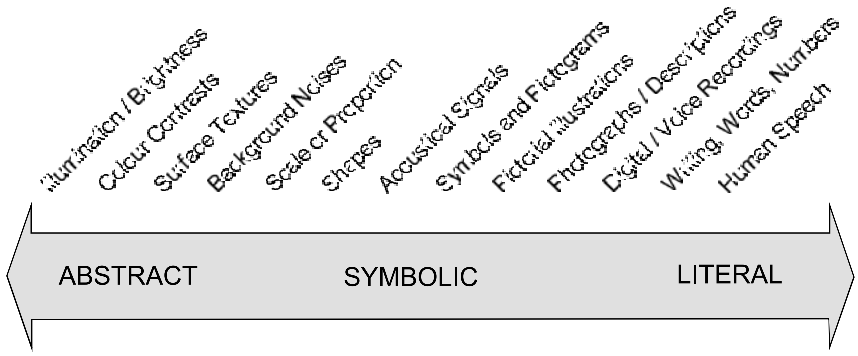
The forms of information can be thought of as falling within three distinctive and individual levels:

- **abstract forms**, which are the understructure or environmental aspects of the message, the compositional forces that reinforce the information experience;

- **symbolic forms**, which are the representational level of the information, consisting of signs, signals, symbols and pictograms, used to represent specific messages; and
- **literal forms**, which are the informational material requiring no intervening coded systems to facilitate understanding and no decoding to delay comprehension.

The various forms of information and their levels are illustrated in the Exhibit 3.

***Exhibit 3: The Different Forms of Information***




The basic elements of information combine to form a particular message. The elemental forms contained within the message should be intelligible by themselves. For passengers with sensory or cognitive disabilities, abstract forms such as colours and surface textures may be more meaningful than literal forms of information.

Easily understandable symbols and pictograms are less demanding with respect to intellectual powers than written information and do not presuppose any knowledge of the language by foreigners. They also may be more meaningful to individuals that are illiterate and certain individuals with cognitive disabilities. Literal forms, such as audio descriptive recordings, written directions and human speech, on the other hand, are more precise.

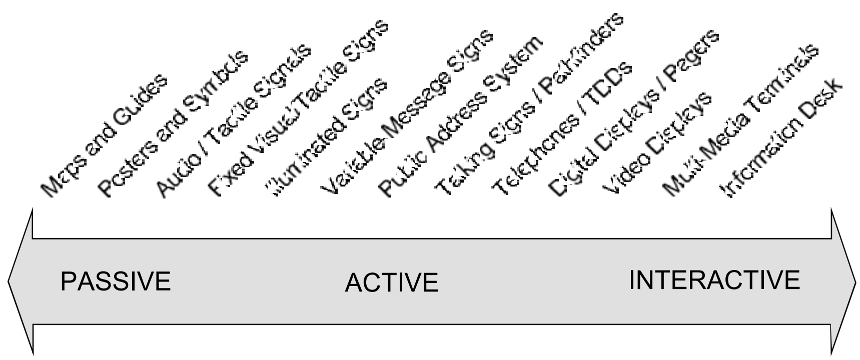
# Information Media

***Information Media***

The provision of information or instructions for travellers can be carried out aurally or visually by humans or by various technological devices. The traveller may or may not be able to interact with the communication medium. Media include:

- **passive media**, or static media, in which limited information is conveyed in the same way to all users;
- **active media**, which convey specific and changing information to users, but cannot be questioned by the user;
- **interactive media**, which allow the traveller to ask questions to obtain the desired information (see Exhibit 4).

***Exhibit 4: The Varying Types of Information Media***




Passive media provide static or open communication with no facility for feedback or interrogation. The information is conveyed in the same way to all users.

Active media are more dynamic, but still open, systems. They also do not provide any feedback to the information transmitter, but allow for broader content.

Interactive media are dynamic and closed and provide the user with the opportunity for feedback and interrogation. While the possibility for interaction makes such systems more expensive, they allow the traveller to determine whether the information is clear and complete and meets their needs.

Individual information, as well as the entire information system, must be limited to the essential. Too much information is confusing. Lack of information endangers the success of the system.

The information provided should guide travellers through the network as easily as possible. For this reason, information devices must be logically configured for the particular purpose, and consistently arranged, and the content and form of the message must be carefully coordinated with the medium used.

# Interaction and Design

***Internal Interactions***

Although providing information for travellers is complex, complexity need not be a hindrance to understanding the process. True, it is easier to have one set of common definitions, but simplicity has negative aspects. The simpler the formula, the more limited the potential for creative variation and expression. The three-dimensional functionality of information and communication outlined in the previous section -- content, form and media -- offers harmonious interaction. The striking feature of this typology is its simultaneity. Each dimension is linked to the other and interaction is integral.

***External Interactions***

But the complexity of providing information to travellers has to be considered in light of the variations involved in its reception. When we perceive a message, we are doing many things at once. We are seeing an enormous field peripherally. We are decoding all manner of symbols. We are imposing on the message our own compositional forces. The reception of information is a multidimensional process that is influenced and possibly modified by psychological moods and cultural conditioning and by environmental expectations. How we view the world frequently affects what we perceive. The process is a very individual one.

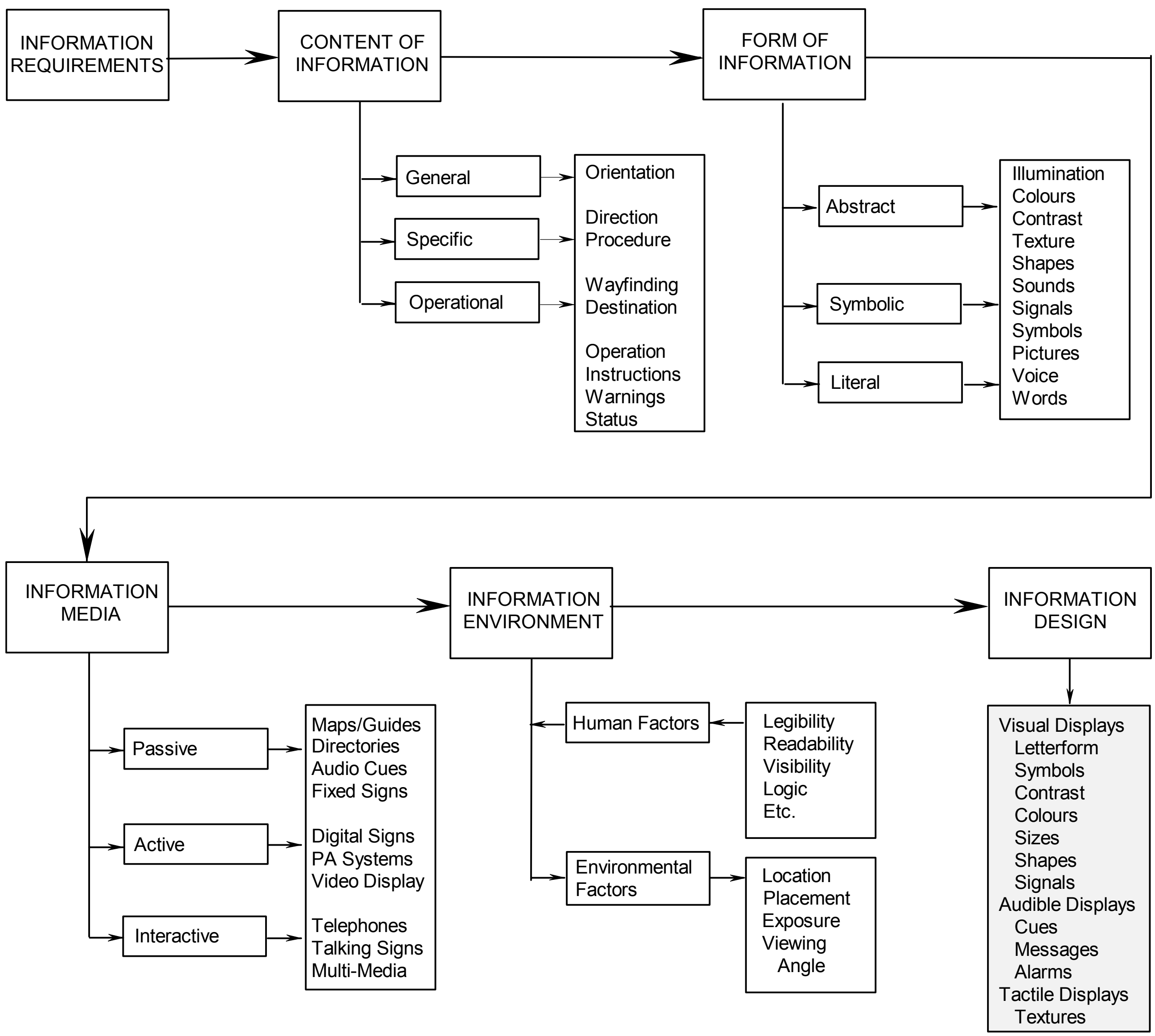
***Information Design*** In designing information systems, the choices are overwhelming. The options are vast and the forms and media many; the three dimensions of information interact and it is through this interaction that the character of the message takes form. In Exhibit 5, the process of defining information content, media and form is outlined. In reviewing specific systems, we must concern ourselves with form and content, their interactive relationship, and the character of the individual elements. In addition, information systems are governed by intended meaning for individual personal and cultural environments. And the last consideration is the medium itself, which through its own character and limitations will often determine the type of system.

***Need for Guidelines***

Usually these travel information and communication systems are developed by different parties with little standardization or uniformity; groups with different needs access the travel information systems -- varying disabilities, experienced versus inexperienced travellers, travel agents.

Improved travel information systems that meet certain standards or guidelines should provide benefits for ***all*** travellers in terms of increased ridership, safety and convenience for the travelling public, and complementary benefits for the travel industry.

***Exhibit 5: Factors in Accessible Information Design***



# 4. INFORMATION GUIDELINES

The objective of this report is to research and delineate guidelines for the improvement of information in transportation vehicles and terminals to enhance accessibility for people who are elderly or disabled.

Transportation is particularly sensitive to the need to inform and to be informed. Access to information at all times during the travel process is vital if the service provider and the traveller are to have complete awareness and understanding. People with cognitive, sensory, intellectual or physical disabilities must not be barred from receiving everyday information. Without information, individuals will miss important clues to the situation and their environment.

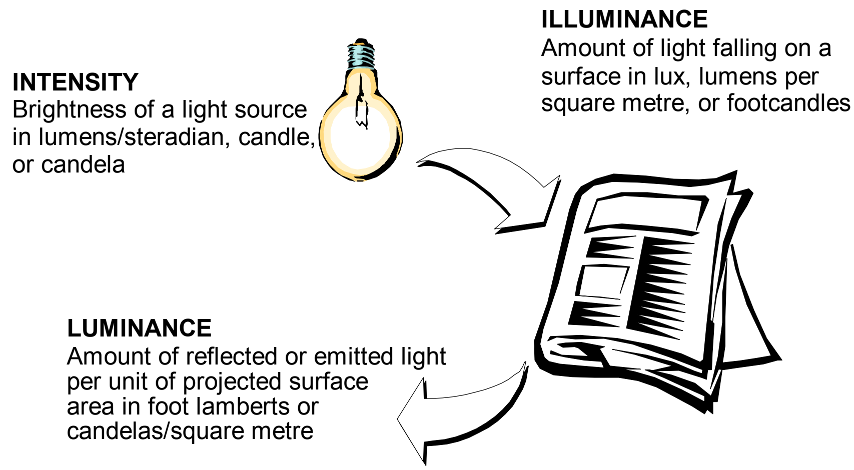
Environmental communications is a term used to describe the information used by individuals to understand where they are and how to reach given destinations in their everyday environment. It covers general information about the setting, directions to destinations and identification of destinations, as well as information about operational procedures. This information can be provided in a variety of forms: visual, auditory or tactile. All forms should be considered. The following offers guidelines for providing this information.

# Visual Information

***Lighting***

Lighting, either natural or artificial, is provided to enable people to see what they need to see in order to perform certain tasks, such as to obtain information from a sign. Commonly used lighting terms are shown in Exhibit 6.

***Exhibit 6: Common Lighting Terminology***




Providing higher and higher illumination levels will not necessarily result in improved seeing conditions. Although the level or intensity of light is obviously important, light can be too bright as well as too dim for the seeing task. In addition, as light levels increase, glare problems also increase *[Woodson, 1981, page 322]*.

***Illuminance***

Illuminance is the amount of light falling onto a surface. It is measured by a light meter at the object's surface. The unit of illuminance measurement is the lux (SI) or foot-candle and 1lux = .093 foot-candles. Illuminance falls off as the square of the distance from the source. The amount of illumination required to light an object adequately depends on the object. An excellent source for illuminance standards is the IES Lighting Handbook published by the Illuminating Engineering Society of North America. The Handbook is updated regularly and has extensive illuminance recommendation lists. Recommended levels can also be found for almost all objects in building codes. Accessible lighting levels (see Exhibit 7) are about 100-300 lux *[Parks Canada, 1994, page 4]:*

***Exhibit 7: Accessible Lighting Levels***

| | |
|---|---|
| Ambient lighting | 50-300 lux |
| Text panels | 100-300 lux |
| Controls | 100 lux |
| Directional signage | 200-300 lux |
| Maps, displays | 100-300 lux |
| Ramps, stairs | 100-300 lux |
| Pathways | 100-300 lux |

***Luminance***

Luminance or light reflectance value is defined as the amount of light emitted by a surface. The unit of luminance measurement is the candela/$m^2$ (SI). A luminance or brightness ratio of between 10:1 and 3:1 between the object and the surrounding area has been found to be comfortable. Excessive luminance causes glare. Insufficient luminance reduces visibility. Concentration is helped if the work area is the brightest part of the visual field. Limiting the brightness ratios or luminance reduces glare *[Woodson, 1981, page 324]*.

***Glare***

Glare occurs when there are areas of brightness in the visual field. There are two main types of glare (both must be avoided): (1) *discomfort glare*, which causes discomfort only; and (2) *disability glare*, which causes discomfort and a drop in visual performance by reducing the ability to see detail. Glare from a single source is measured and expressed as a glare constant. This is then converted to a Glare Index. Where there is more than one glare source, they can be summed to give the Glare Index. In environments where glare must be kept to a minimum the Glare Index limit should be less than or equal to 13 *[Clark and Corlett, 1984, pg. 49].* Signs and light sources should be carefully located to reduce glare. Diffusing light sources are recommended to reduce glare and shadow effects *[Woodson, 1981, page 327]*.

**_Consistent Illumination_**

An environment should present a constant level of adequate illumination to pedestrians as they move from one part of a terminal to another. Illumination levels should be constant from one room to the next. Particular attention should be given to areas such as elevators, stairs and landings which are often inadequately lit in comparison to the rooms opening onto them *[Richesin et al., December 1989, page 53]*.

**_Illumination Highlights_**

Use light to accentuate signage, stairs, handrails, and other decision-making points *[Richesin et al., December 1989, page 53]*. Red lighting should be used where dark adaptation is required; for example, in emergency exits. At low levels of light, the eye finds red symbols very visible. The narrow range of red is near the centre of vision and, for this reason, is often used in military equipment *[Dreyfuss, 1993, page 86].*

**_Finishes/Reflectance_**

Matte finishes should be chosen in preference to highly-reflective, glare-promoting surfaces such as polished floors, metals, glass, mirrors *[Richesin et al., December 1989, page 52]*. A matte white ceiling is preferred for high light reflectance, but floors are best with about 20 to 25% reflectance, and recommended wall reflectance is about 50 to 60% *[Dreyfuss, 1993, page 87].*

**_Decor and Colour_**

Use decor and colour to regulate and enhance the light available in a room. Most of the light that enters our eyes has not come directly from its source but has been reflected off the ceiling and walls and off objects in the room. Light-coloured decors reflect more light while dark-colour decors tend to absorb the light in a room *[Richesin et al., December 1989, page 53]*. Bright environments are best for large dynamic settings, and strong colours are more prevalent in such bright environments. Soft, deep colours are best for places where mental and physical tasks are performed *[Dreyfuss, 1993, page 86].*

***Flicker***

Flicker arises from poor quality fluorescent fittings or rotating parts between a light source and the eye. Flicker should be eliminated since it can trigger epilepsy. If it cannot be eliminated, the flicker should be greater than the Critical Flicker Fusion Frequency (CFF) for the given luminance level. The CFF is the frequency at which flicker becomes imperceptible. This threshold varies greatly between people but can be as high as 85 Hz. Also, the greater the luminance level the greater the human sensitivity to flicker. Flicker can be noticed more easily at the edge of the field of vision. The choice of phosphors in fluorescent lights can eliminate flicker *[Clark and Corlett, 1984, pg. 49]*.

***Colour***

Artificial lighting has colour. Choosing the colour of lighting is important emotionally and with respect to the appearance and colour of objects and signs. Coloured objects look white under light of their own colour and black under light of a complementary colour, e.g., red objects look white in red light and black in green light. The appearance ratings of typical surface colours when viewed under various artificial light sources are provided in Exhibit 8 *[Woodson, 1981, page 327]*.

***Exhibit 8: Appearance of Colour under Different Lighting***

| | | Fluorescent Lamps | | | | |
|---|---|---|---|---|---|---|
| Colour | Daylight | Standard Cool White | Deluxe Cool White | Standard Warm White | Deluxe Warm White | Incan-descent Lamps |
| Red | Fair | Dull | Dull | Fair | Good | Good |
| Brown | Dull | Fair | Good | Good | Fair | Good |
| Yellow | Dull | Fair | Good | Good | Dull | Fair |
| Green | Good | Good | Good | Fair | Dull | Dull |
| Blue | Good | Fair | Dull | Dull | Dull | Dull |
| Purple | Good | Fair | Dull | Dull | Good | Fair |
| Gray | Good | Good | Fair | Soft | Soft | Dull |

*Note:* Good -- colour appears most nearly as it would under an ideal light source. Fair -- colour is less vivid. Dull -- colour is even less vivid. Soft -- surface takes on a pinkish cast because of red light emitted by lamp.

### *Contrast*

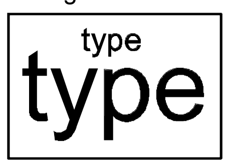
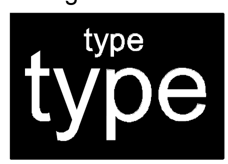
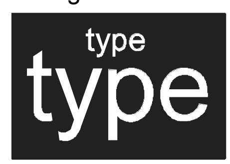
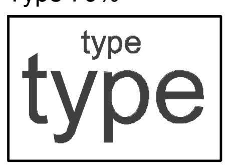
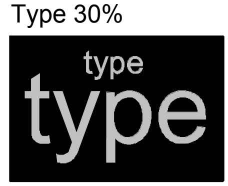
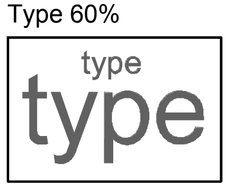
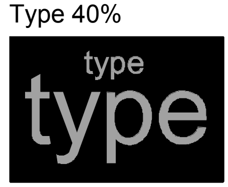
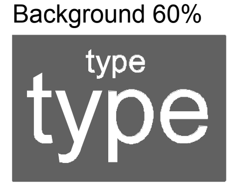
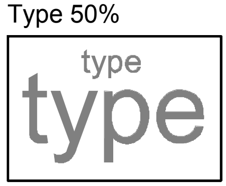
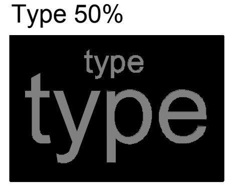
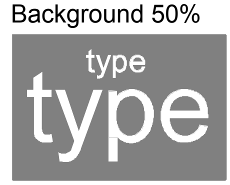
An object can be seen and its shape identified because of its contrast with its background. Contrast can be improved by changing the illumination or changing the reflectivity of certain parts of the sign. Text and graphics should have a contrast of at least 70 percent against their background, using the following equation *[ADA Guidelines, 1991, A4.30.5]*:

$$\text{Contrast} = (B_1 - B_2)/B_1 \times 100\%$$

$B_1$ = light reflectance value (LRV) of brighter colour
$B_2$ = light reflectance value (LRV) of darker colour

Examples of accessible and non-accessible type are provided in Exhibit 9 *[Parks Canada, 1994, page 7]*.

***Exhibit 9: Type and Background Contrast***

| | Halftoned type on white | Halftoned type on black | White type on half-toned background |
|---|---|---|---|
| **Accessible** | Type 0%<br>Background 0%<br> | Type 0%<br>Background 100%<br> | Type 0%<br>Background 80%<br> |
| | Type 70%<br> | Type 30%<br> | Background 70%<br> |
| **Not Accessible** | Type 60%<br> | Type 40%<br> | Background 60%<br> |
| | Type 50%<br> | Type 50%<br> | Background 50%<br> |

### *Colour Contrast*

Colour and contrast are closely associated. Yellow and red should be preferred to indicate colour accents, because green and blue become difficult to distinguish with increasing age. High-contrast images are also preferred. Extra lighting (increased illuminance) can improve the visual ability of aging persons. But, since glare is a problem for many, care must be taken of bright light sources. It is recommended that yellow, orange or white be used on a dark or black background to achieve optimum visibility for the majority of visually impaired persons as well as for the normally sighted population. Percent contrast for various colour combinations have been calculated and are presented in Exhibit 10. It is noted that yellow, beige or white on black provides the greatest colour contrast, although other combinations, such as yellow on green are certainly acceptable *[Arthur and Passini, 1994, pg. 179]*.

***Exhibit 10: Colour Brightness Differentials***

| | beige | white | grey | black | brown | pink | purple | green | orange | blue | yellow | red |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| red | 78 | 84 | 32 | 38 | 7 | 57 | 28 | 24 | 62 | 13 | 82 | 0 |
| yellow | 14 | 16 | 73 | 89 | 80 | 58 | 75 | 76 | 52 | 79 | 0 | |
| blue | 75 | 82 | 21 | 47 | 7 | 50 | 17 | 12 | 56 | 0 | | |
| orange | 44 | 60 | 44 | 76 | 59 | 12 | 47 | 50 | 0 | | | |
| green | 72 | 80 | 11 | 53 | 18 | 43 | 6 | 0 | | | | |
| purple | 70 | 79 | 5 | 56 | 22 | 40 | 0 | | | | | |
| pink | 51 | 65 | 37 | 73 | 53 | 0 | | | | | | |
| brown | 77 | 84 | 26 | 43 | 0 | | | | | | | |
| black | 89 | 91 | 58 | 0 | | | | | | | | |
| grey | 69 | 78 | 0 | | | | | | | | | |
| white | 28 | 0 | | | | | | | | | | |
| beige | 0 | | | | | | | | | | | |

do not use

acceptable

preferable

| Hues | LRV(%) |
|---|---|
| red | 13 |
| yellow | 71 |
| blue | 15 |
| orange | 34 |
| green | 17 |
| purple | 18 |
| pink | 30 |
| brown | 14 |
| black | 8 |
| grey | 19 |
| white | 85 |
| beige | 61 |

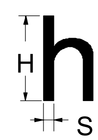
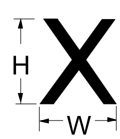
### *Type Proportions*

The proportions of a font refer to its weight, width, and height, and contribute to its legibility, or ease of reading *[Parks Canada, 1994, page 10]*.

- ***Weight*** (percentage of width of the vertical stroke of the lower-case ‘h’ to the height of the upper-case ‘X’) should be 10%-15% for text.
- ***Width*** (percentage of width to height of the upper-case ‘X’) should be 65%-95% for accessibility.
- ***Height*** (percentage of the height of the lower-case ‘x’ to the upper-case ‘X’) should be 65%-75%.

Sometimes these proportions are expressed as ratios rather than percentages; for example, letters and numbers on signs should have a width to height ratio between 3:5 and 1:1 and a stroke width to height ratio between 1:5 and 1:10 *[CAN/CSA-B651-M90, September 1990, page 64]* and the height to cap height ratio should be 3:4 *[Arthur and Passini, 1992, page 155]*. Type proportions that give an accessible and legible font are provided in Exhibit 11.

***Exhibit 11: Type Proportions***

| Attribute | Range for Accessible Information |
|---|---|
|   | WEIGHT (%) = (S x 100) ÷ H = 10 to 15%<br>(i.e. Stroke Width to Height Ratio between 1:5 and 1:10) |
|   | WIDTH (%) = (W x 100) ÷ H = 65 to 95%<br>(i.e. Width to Height Ratio between 3:5 and 1:1) |
|   | HEIGHT (%) = (H2 x 100) ÷ H1 = 65 to 75%<br>(i.e. An X-Height to Cap Ratio of about 3:4) |

***Type Style***

Type style is the letter form of a font, and the basic style choice is critical. Two major style categories are 'serif' and 'sans serif', and both include many highly legible fonts. Any font that fulfills accessibility criteria is acceptable. Cursive italics and outlined and shadowed type styles are very difficult to read and should be avoided for text and labels. Body copy and labels should be upper and lower case. Typography in all caps or small caps is more difficult to read and should be limited to titles *[Parks Canada, 1994, page 9].* Recommended styles include Helvetica Regular, Times Roman, Palatino, and Univers 55 as shown in Exhibit 12.

***Exhibit 12: Type Font Samples***

| **Accessible for text** (weight %, height %, width %) |
| --- |
| Serif |
| Times Roman (11, 69, 105)<br>New Century Schoolbook (13, 71, 103)<br>Palatino (11, 67, 93)<br>**ITC Garamond Condensed Book** (13, 72, 77) |
| Sans Serif |
| Helvetica (12, 72.5, 89)<br>Univers 55 (14, 70, 93)<br>Futura (12, 62, 77) |
| **Not accessible for text** (weight %, height %, width %) |
| Serif |
| **Times Roman Bold** (19, 67, 101)<br>**New Century Schoolbook Bold** (22, 69, 106)<br>**Palatino Bold** (18, 69, 93)<br>ITC Garamond Condensed Light (9.5, 72, 75) |
| Sans Serif |
| Helvetica Light (7, 72.5, 81)<br>Univers 45 (7, 71, 84)<br>Futura Condensed Light (12, 62, 77) |

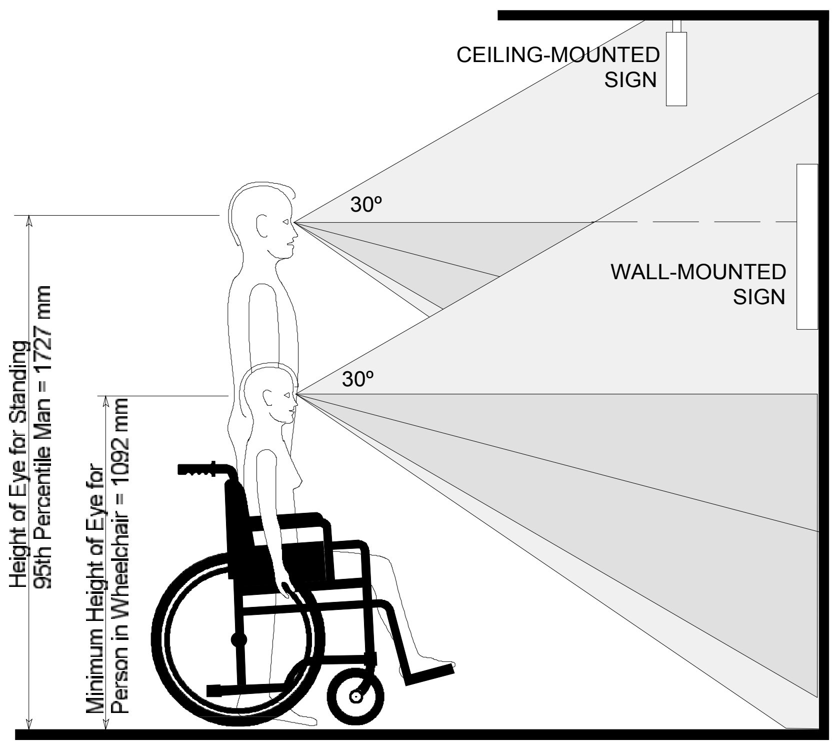
| Decorative |
| --- |
| Gatsby Light (2, 54, 54) |
| Arcadia (5, 84, 21) |
| Linoscript (9, 31, 1307) |

Legibility and readability are different concepts. 'Legibility' refers to how the design of letter forms that make up a particular font influences word recognition. Legibility contributes to 'readability', or the ease of reading, which is determined by the combined impact of type size, kerning, line and word spacing, and line length.

***Eye Level***

The average height of a viewer's eye level, measured from the ground when the viewer is standing, is about 1.7 metres; when sitting, it is about 1.3 metres *[Dreyfuss, 1993, pg. 36]*. Sight lines are a very important factor in sign placement.

***Exhibit 13: Eye Level Height and Viewing Angle***



***Normal Field of Vision***

Studies indicate that the normal field or cone of vision suitable for signing covers an angle of about 60°. Areas outside the angle tend to be seen in much less detail. For example, if a sign were supported from a high ceiling so that a sight line between the viewer's eye and the horizontal were more than 30°, it would probably be overlooked (Exhibit 13).

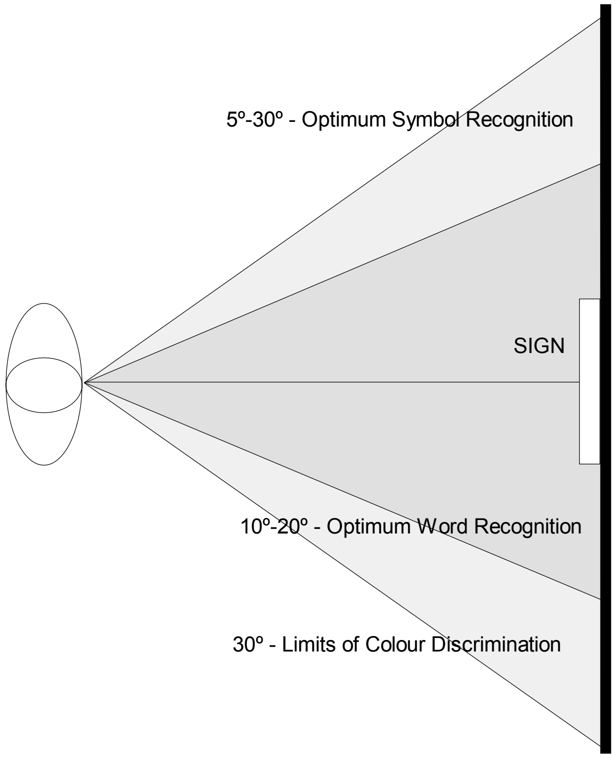
***Viewing Angle***

The viewing angle is the angle formed by the plane of a sign and the observer's central line of vision. Ideally, a sign should be placed at a right angle to the line of vision; that is, the viewing angle should be nearly 90 degrees. The legibility of a sign message deteriorates when the viewing angle is less than 45 degrees.

***Sign Displacement***

The location of a sign should be planned in relation to the observer's normal line of vision. Displacement is the distance between the centre of a sign and an observer's central line of vision (measured at a right angle to the central line of vision). Ideally, the angle of displacement should be between 5 and 15 degrees, e.g., 0.25 m of displacement per 1.00 m of viewing distance provides an angle of approximately 15 degrees at the eye of an observer (see Exhibit 14).

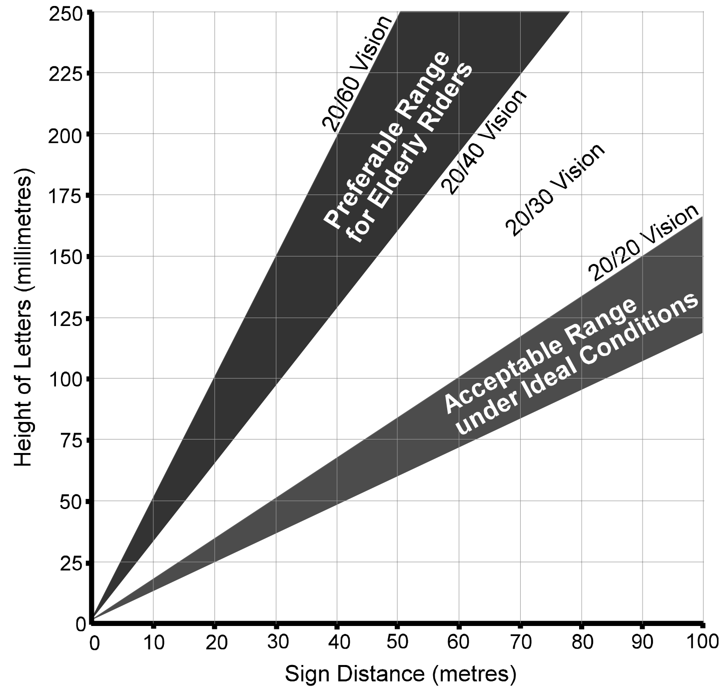
***Exhibit 14: Angle of Displacement of Signs***




***Legibility***

Distance studies indicate that under normal daylight when standing still a person with normal 20/20 vision can read 25 mm high letters on a standard Snellen eye chart used by optometrists at a distance of 15 m. For elderly and disabled persons, and to meet broader public needs, a letter height of 25 mm for 7.5 m of viewing distance is probably a more practical guide *[Atkinson and Geehan, September 1994, page 6]*. Exhibit 15 gives an indication of legibility distances.

***Exhibit 15: Legibility Distances under Different Conditions***




***Character Size***

The selection of the character size is generally based on the normal viewing distance; where applicable, it depends also on the speed of traffic. Viewing distance, message length, character size, and sign dimensions are interdependent factors that must be considered when planning any type of sign. In general, the larger letters and numbers are, the better they are seen and recognized. Exhibit 16 provides one set of guidelines for determining how high a letter or numeral has to be for a given viewing distance *[CAN/CSA-B651-M90, September 1990, page 65]*.

***Exhibit 16: Character Size and Viewing Distance***

| Minimum character height, mm | Maximum viewing distance, mm |
|---|---|
| 200 | 6000 |
| 150 | 4600 |
| 100 | 2500 |
| 75 | 2300 |
| 50 | 1500 |
| 25 | 750 |

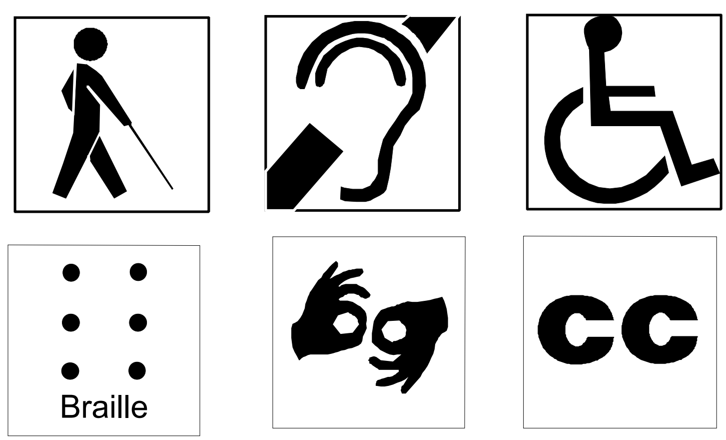
In a vehicle, at a normal reading distance of 700-750 mm, a minimum character height of 3.00-3.25 mm (i.e., about 12 point type) should be used. But since vibration diminishes legibility, character heights above that for minimum legibility should be used *[ICE Ergonomics, 1983, page 54]*.

In vehicles, increased contrast may compensate to a certain extent for a smaller character size for older drivers. Light on dark is most appropriate because bright panels are distracting and can produce reflections *[SAE 576, 1984]*.

***Pictorial Symbols***

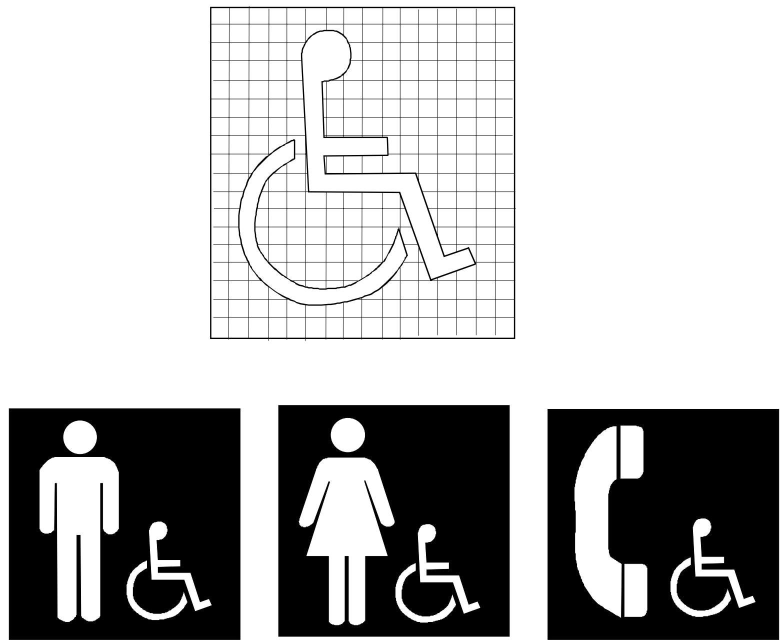
Pictorial symbols make it possible for persons with different language backgrounds to recognize and understand a single symbol *[Woodson, 1981, page 371]*. Some pictorial symbols of accessibility are shown in Exhibit 17.

***Exhibit 17: Some Symbols of Accessibility***



***Symbols of Accessibility:*** The international symbol of accessibility is illustrated in Exhibit 18 along with some sample applications for accessible washrooms and telephones *[CAN/CSA-B651-M90, pg. 66]*.

***Exhibit 18: International Symbol of Accessibility***



***Other Standard Symbols:*** A number of organizations, including the Canadian Standards Association and the International Organization for Standardization have published recommended standards *[CAN CSA-Z321, Signs and Symbols for the Occupational Environment;* and *ISO 7001, Public Information Symbols].* See Exhibit 19.

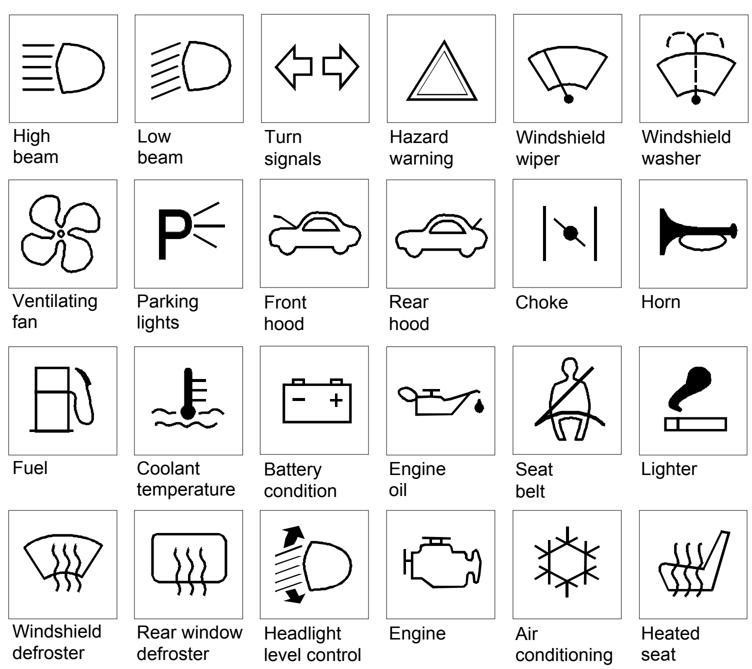
***Exhibit 19: Examples of Other Standard Symbols***

***Control and Display Symbols.*** In vehicles, ISO Standard 2575 is often used for symbols (see Exhibit 20). Generally, symbols are at least twice as legible as text, although demographic and cultural differences are important (elderly people and women have somewhat greater difficulty in identifying symbols). Symbol legibility is affected by image size, resolution, contrast, luminance, orientation and other factors. A study showed a diameter of 20 mm for a symbol in a vehicle will lead to correct identification 95 percent of the time *[Green, Automotive Ergonomics, 1993, pg. 247]*.

***Ambiguity of Symbols***

The majority of people are verbally oriented, absorbing most information through words, while the minority respond more quickly to visual devices, such as symbols. Most sign systems need some verbal messages; but, most international airports use symbols to reinforce the verbal message or to stand alone. But even one of the most simple symbols, the arrow, can be ambiguous; the difficulty comes when the direction 'ahead' is indicated by an arrow. There can be confusion whether this means down or ahead or up or ahead, depending on the direction of the arrow.

***Exhibit 20: In-Vehicle Control and Display Symbols***



***Use of Arrows***

The arrow is one of the most commonly used symbols in a signage system. The arrow should be two times the upper case character height that is used in the message. Arrows pointing to the left or up should always be on the left of the message and vice versus *[KRW Inc., Sept. 1995, page 8]*.

***Symbol Shapes***

The set of symbols illustrated in Exhibit 21 is based on consistent use of geometric shapes and specific colours. These shape and colour codes permit users to distinguish between the six types of symbols. The shape, colour, function and subject area of each type are indicated below:

***Exhibit 21: Classification of Graphic Symbols***

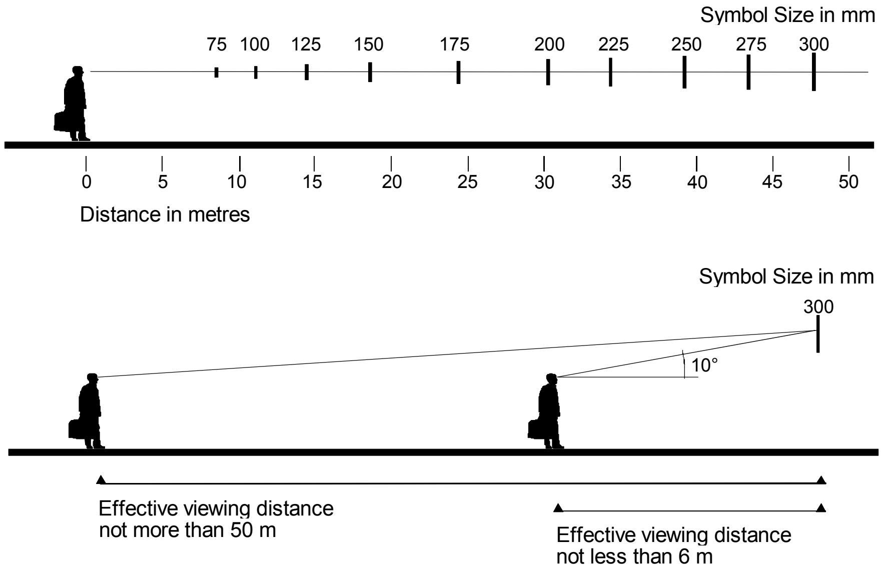
| *Class and shape* | *Type and colour* | *Function of symbols* |
|---|---|---|
| **Regulatory** ● | **Prohibition** Red and black on white | To indicate an order forbidding an action |
| | **Mandatory** White on black | To indicate an order for obligatory action |
| **Warning** ▲ | **Caution** Black on yellow | To indicate a potential hazard |
| | **Danger** White on red | To indicate a definite hazard |
| **Information** ■ | **Emergency** White on green | To provide information required in case of emergency |
| | **Guidance and Information** White on dark gray; or White on blue | To provide general information Concessions Recreation General |

Regulatory signs are generally prohibitory and deal with such subjects as smoking or entry into restricted areas. In addition to regulatory signage, there are warning signs, particularly in relation to hazardous areas. Consideration has to be given to providing warning information that will be equally useful to sighted and sight impaired visitors.

***Symbol Size***

The selection of the symbol size is generally based on the normal viewing distance; where applicable, it depends also on the speed of traffic. Exhibit 22 illustrates the results of pragmatic testing of several symbols and represents a rough guide to size/distance relationships *[Woodson, 1981, page 374]*.

**Exhibit 22: Symbol Size and Viewing Distance**




***Illuminated Signs***

All signs should be well lit at all times, whether by natural or artificial lighting. Internally illuminated translucent signs, as shown in Exhibit 23, may be suitable for areas which are inside buildings, but care should be taken that there is no glare to reduce their effectiveness; the colour and stroke width of lettering may need to be different from externally lit signs to ensure a consistent standard of maximum legibility *[Barham et al., 1994, page 34]*.

**Exhibit 23: Example of an Illuminated Sign**

Lighted signs, when used with a dark background, are a reinforcing device to help separate a sign system from competing signs. For example, airport information signs use internal illumination to stand out against a background of airline and concessionaires' advertising signs, which compete for the viewer's attention.

***Emergency Signs***

Special (battery-operated) lighting may be needed for signs that must be visible during emergency conditions (such as power failure). It is also important to provide proper illumination for signs bearing regulatory, warning or emergency messages, and to ensure effective recognition of safety colours. Certain illuminants, such as low and high pressure sodium lamps and clear mercury vapour lamps, may distort colours under some circumstances. To avoid misinterpretation, supplementary illumination (e.g. by incandescent lamps) may have to be provided.

***Variable Message Signs***

Variable message signs (VMS) as illustrated in Exhibit 24 are increasingly used to provide specific time-related information and many of them can also show variations from scheduled operations, late running, cancellations and other messages. The flexibility of these signs has, however, until recently often been offset by their comparatively poor clarity, especially in bright sunshine. Recent examples using light-emitting diodes (LED), fiber optics and flip-disks are approaching the clarity of conventional signs *[Barham et al., 1994, page 34]*.

***Exhibit 24: Example of Variable Message Signs***


***Display Time***

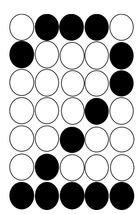
***Reading Rate:*** Among the normal reading public, there is a wide variation in individual reading rates from perhaps 125 words per minute to 500 or 600. Factors like age, intelligence and education influence reading rates; the average is about 250 words per minute.

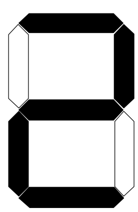
***Display Time:*** Where signs change rapidly or 'scroll' to cover longer messages or complete information, passengers must have enough time to read and comprehend the information before it changes. Existing examples which change every three or four seconds do not meet this criterion, and a fixed time of about 10 seconds before a change is more likely to avoid confusion *[Barham et al., 1994, page 34]*.

***Electronic Characters***

Electronically generated characters can be formed by segments or dots. Exhibit 25 shows an example of each. Generally, dot matrix characters are more readable than segmented characters because of the greater capability to produce apparent curved lines. Increasing the number of dots or segments improves character readability. Exhibit 25 also contains recommendations for character formation *[Woodson, 1981, page 371]*.

***Exhibit 25: Electronic Character Formation***

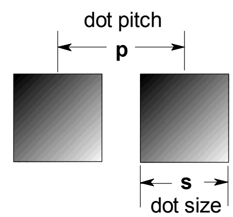



| ***Character Type*** | ***Recommended Use*** |
|---|---|
| Segmented Displays | |
| 7 segments | Numerical information only |
| 14 segments | Preferred for general applications |
| Dot Matrix Displays | |
| 5x7 matrix | Minimally acceptable |
| 7x9 matrix | Preferred for general applications |
| 8x11 matrix | Minimum if symbols rotated |
| 15x21 matrix | Preferred if symbols rotated |

***Dot Pitch and Size.*** The diameter (or width if the dot-matrix display is a matrix of square elements) of one element is referred to as the *dot size* of the display. The *dot pitch* is the distance between dot centres (see Exhibit 26). High resolution video displays use a dot pitch of 0.28 mm. LED (light emitting diode) displays in transit systems use a dot pitch of 6.0 mm and a dot spacing of 5.0 mm *[Hunter-Zaworski and Watts, 1994, page 42]*.

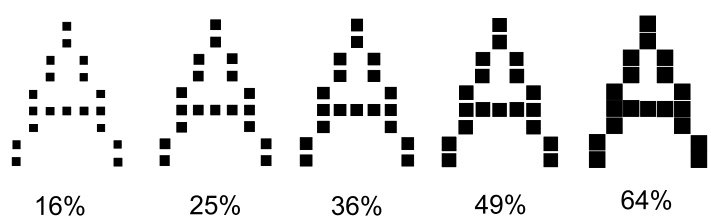
***Exhibit 26: Electronic Character Dot Pitch and Size***




***Active Area.*** The minimum active area percentage (see Exhibit 27) for optimum legibility on flat panel dot-matrix displays is 36 percent based on the following parameters: 7x9 square dot matrix, Helvetica font, unstressed conditions, and constant illumination, time and contrast *[Clayton et al., 1991, page 172-177]*.

$$\text{Active Area} = s^2 / p^2$$

***Exhibit 27: Five Active Area Percentages***




***Letter Size.*** To form a character, a minimum dot matrix of 7 x 9 is preferred. For an electronic display with a dot pitch of 6 mm (as is common in transit systems), the minimum character height would be 53 mm, which should be readable at a distance up to 1500 mm. For a display with a dot pitch of 0.28 mm, the character height would be 2.5 mm, which would only be suitable for close-in reading. Therefore, LCDs (liquid crystal displays) are better suited to in-vehicle displays.

***Colours.*** In producing electronic messages, colour deficiencies must be considered. Avoid using red/green or yellow/blue in pairs. Avoid the blue end of the spectrum for important displays. Highly saturated, bright colours in vehicles are found irritating by young drivers but are preferred by older drivers *[ICE Ergonomics, 1993, page 25]*.

***LED vs LCD.*** LED displays tend to be lower cost than LCDs and can produce a wider variety of characters and symbols (even animation sequences). Reflecting LCDs are not as legible as dot matrix or LED displays and are bad in low light. Transmissive LCDs which are back lighted are very clear in low lighting conditions and suitable for in-vehicle conditions. Transflective LCDs are suitable for both high and low illumination levels. All LCDs, however, are limited in their character generation and colour capabilities and are generally more expensive *[Hunter-Zaworski and Watts, 1994, page 43]*.

***Visual Display Screens***

The use of colours for visual display screens enhances their legibility, and the use of bright yellow letters/numbers on a background of alternate black and blue horizontal bands as illustrated in Exhibit 28 is a great improvement *[Barham et al., 1994, page 34]*.

***Exhibit 28: Visual Display Screen with Horizontal Bands***

***Video Brightness/Colour***

Textual information should be displayed in high contrast black and white images to ensure high legibility. Colour should not be used to code critical information. Colour, however, is effective for dividing a display into separate regions and colour coding is useful for inexperienced users. If colour is used, then the number of colours should be limited to six. The brightest and most saturated colours attract a viewer's attention and should be restricted to critical but low probability information that requires immediate attention *[Kaufmann and McFadden, November 1989, page 21-30].*

***Visual Pagers***

Visual pagers enable people with hearing impairments to see, read, and have access to information that is ordinarily delivered through a public address system. This is done with equipment and programming to operate monitors, as shown in Exhibit 29, that would display paging information. Digital displays (although more expensive than cathode ray tubes) are often used to eliminate flicker and increase readability.

***Exhibit 29: Example of a Visual Paging Monitor***

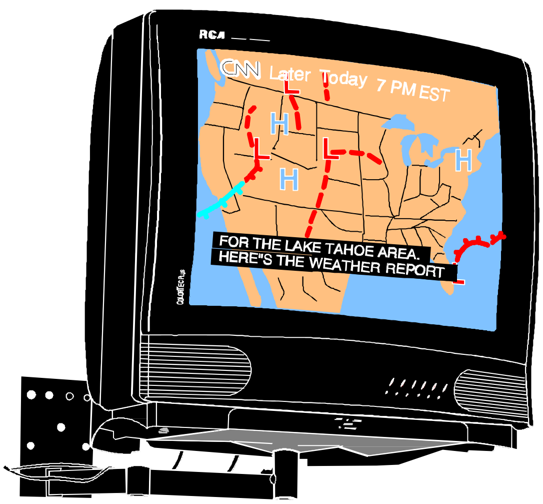

***Video Captioning***

Captioning translates the audio portion of a video or film program into visible subtitles, or 'captions'. Dialogue and narration shall be condensed to a maximum of 120 words per minute, and language adjusted to a Grade VI comprehension level. All video and film programs that are shown regularly or that provide essential interpretive messages should be captioned *[Parks Canada, 1994, page 20]*.

***Captioning standards:*** Standards developed by the National Captioning Institute (USA) should be used. Captions should be white text on black or dark background box. No more than two lines of text at a time should be shown on the screen *[Parks Canada, 1994, page 20]*.

***Closed versus open captioning:*** Closed captioning requires a decoder for display on a standard television receiver and can be switched on or off (receivers are now manufactured with built-in decoders). As illustrated in Exhibit 30, open captioning, which is present on the screen at all times, does not require special equipment but cannot be switched off *[Parks Canada, 1994, page 20]*.

***Exhibit 30: Example of Open-Captioned Television***

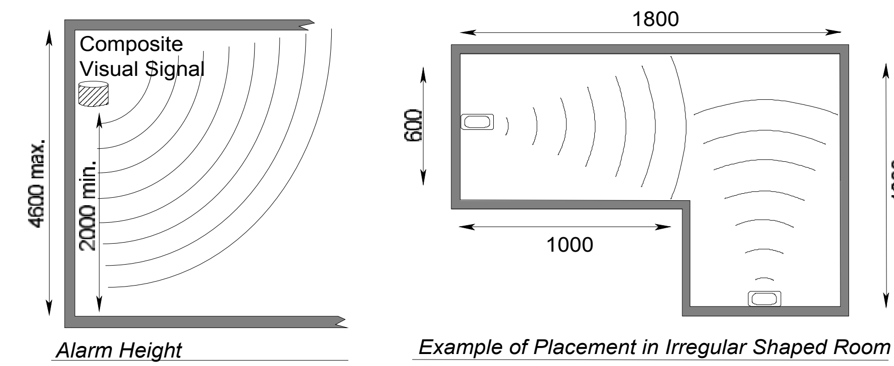



***Visual Alarms***

Visual alarms should be used with audible alarms, especially in main concourses and washrooms. Visual alarms should be lights that flash at 1 Hz in conjunction with audible alarms. Bright white lights, at least 75 cd in intensity, should be used for flashing alarms. Flashing lights should be presented at not less than 5 flashes per second. If the light is combined with an auditory signal, it should be presented at a rate of 1 per second *[Richesin et al., December 1989, page 60]*.

***Visual Alarm Location.*** Visual alarms should be placed 2030 mm above the highest floor level or 152 mm below the ceiling, whichever is lower (see Exhibit 31). In general, no place in any room or space required to have a visual signal appliance should be more than 15 m from the signal. In large rooms and spaces such as auditoriums, devices may be placed around the perimeter, spaced a maximum 30 m apart, in lieu of suspending appliances from the ceiling. No place in common corridors or hallways should be more than 15 m from the signal *[ADA Guidelines, 1991, 4.28.3]*.

***Exhibit 31: Placement of Visual Alarms***




***Sign Language***

Travellers who are deaf or hard of hearing may communicate through speech-reading, sign language, print, and mime and gesture. When sign language interpretation is used for a program of more than 2 hours, two interpreters are required, and they should alternate every 20 minutes. Interpreters may be booked through the Department of the Secretary of State of Canada *[Parks Canada, 1994, page 21]*.

***Speech-Reading***

The hard of hearing rely on speech-reading and hearing devices to communicate, and good speech-readers can understand 30%-40% of what is being said. To assist speech-readers, speakers should make sure their faces are fully visible and should speak clearly, without exaggerated articulation, at a normal speed. They should also use short, simple sentences *[Parks Canada, 1994, page 21]*.

# Audible Information

***Sound Intensity***

Intensity is the sound level or loudness: the pressure of the sound waves. The loudness is measured as the ratio of the sound pressure to that of the pressure for a just-audible sound. The ratio is logarithmic, to enable the enormous range of audibility to be expressed in convenient numbers. The unit of intensity is N $m^{-2}$. The unit of loudness (i.e., the human perception of intensity) is the decibel or dB(A). A quiet office might measure 55 dB(A) and a busy office would measure about 68 dB(A). The limit of noise causing damage to hearing is about 85 dB(A). Very short exposures should not exceed 135 dB(A), except for impulse noise whose instantaneous level should never exceed 150 dB(A). A change of 3 dB means doubling the physical effect of the noise; small changes in level are thus important.

***Ambient Noise***

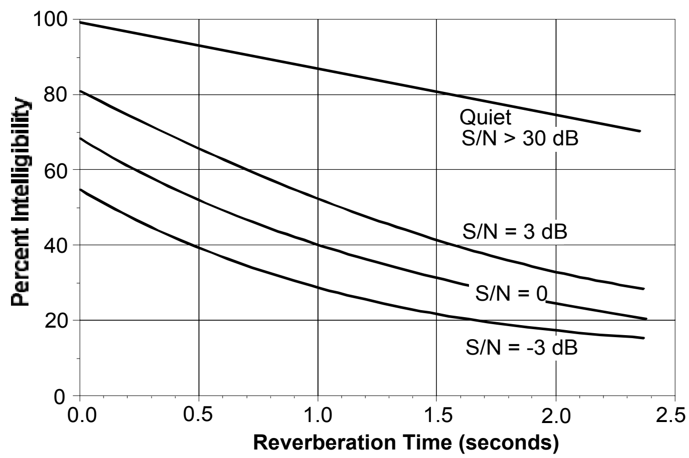
***Peak noise criteria (PNC).*** Measures the ambient noise in a room, giving greater weight to noise within the same range of frequencies used by broadcast media. Ambient noise should be no more than 40 PNC *[Parks Canada, 1994, page 19]*.

***Signal to noise ratio (S/N).*** Signal to noise ratio is the difference in decibels (dB) between the signal (for example, speech) and the background noise (for example, air-conditioning or traffic noise). The higher the S/N ratio, the better for communication. Persons who have hearing losses require at least a +5 dB S/N ratio (the signal being 5 dB louder than the noise). S/N ratios should be a minimum of +10 dB (reference to sound pressure level A weighted) *[Parks Canada, 1994, page 19]*.

***Reverberation***

Reverberation, or reflected sound, is the time a sound needs to become inaudible; the longer the reverberation time, the more difficult to comprehend speech. Speech intelligibility starts to drop at a reverberation time of 2.0 seconds, but for hearing impaired persons, it starts to drop at 0.5 seconds, and shows a remarkable drop under longer reverberation conditions *[Onaga et al., August 1994, page 134-136]*. The reverberation time should be as low as possible, preferably less than 1 second. This will depend largely on whether the room is empty or full of people. A full room absorbs sound reflections, making the reverberation time shorter *[Parks Canada, 1994, page 19]*. Speech intelligibility as a function of reverbation and background noise is shown in Exhibit 32.

***Exhibit 32: Speech Intelligibility and Reverberation Time***

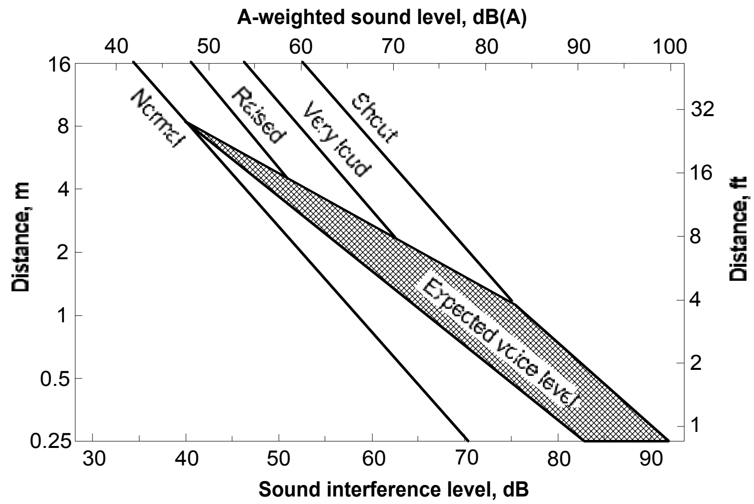



***Speech Interference***

Speech in a raised voice at a distance of 50 cm from the ear creates a sonic pressure of about 75 dB, and at a distance of 25 cm a sonic pressure of over 80 dB. For the speech frequency range, this corresponds to about the same value in dB(A). Since two noises must have a difference in intensity of about 10 dB before they can be separated by the ear, to improve the intelligibility of speech the surrounding noise level should not exceed 70 dB(A), although lower levels are more desirable.

***A-Weighted Sound Level*** can be used to predict maximum permissible talker-to-listener distances for *just-reliable* speech communication in noise. The curves in Exhibit 33 show maximum permissible talker-to-listener distances. The parameter on each curve indicates the relative voice level. Since a talker will raise his or her voice in noise, typically at the rate of 3 to 6 dB for every 10-dB increase in noise level above 50 dB(A), the expected voice level will increase with increasing noise level. The shaded area shows the range of permissible speech distances under these conditions *[Harris, 1962, page 16.12]*.

***Exhibit 33: Speech Intelligibility and Background Noise***




***Speech Interference Levels (SILs)*** will give guidance on the noise levels which interfere with speech communication. The speech interference level is an index designed specifically for assessing the interfering effects of noise on speech. This index is derived from measurements of the background noise level in four contiguous octave bands and takes into account frequency-dependent variations in the noise spectrum. The SIL can be used to predict the maximum permissible talker-to-listener distances for just-reliable communications. Exhibit 33 can be used for this purpose *[Harris, 1962, page 16.12]*.

### *Allowable Consonants*

The quality of delivered sound is measured in percentage of *allowable consonants (All Cons)* -- the number of distinguishable consonants in a broadcast message discernible to average hearing. This Exhibit should be a minimum of 80%-85% and preferably 90% *[Parks Canada, 1994, page 19]*.

### Sound Frequency

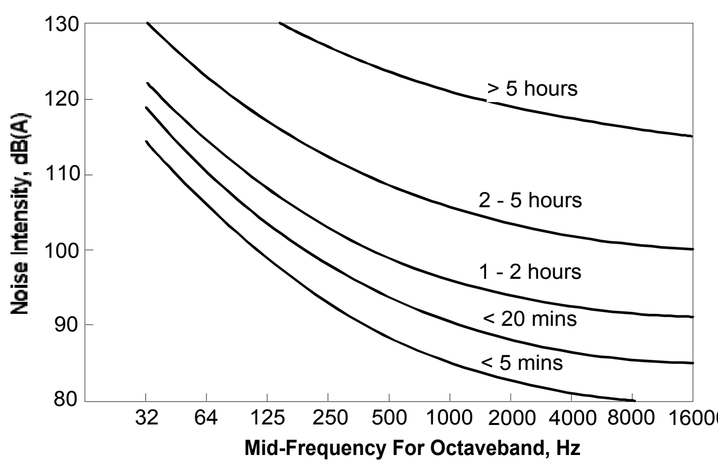
Frequency, or pitch, is the rate of repetition of the cycles. The unit of frequency is the hertz (Hz) or cycles per second. Human perception of frequency varies with loudness. In the normal range of background noise, human hearing is more sensitive to the higher frequencies. Sounds with frequencies between 500 and 3000 Hz are most effective, as the ear is most sensitive in this range. Fluctuating frequency noise is more effective than a steady pitch. People who experience deafness to specific tones, often caused by exposure to loud noises, find complex tones particularly helpful in hearing at least some of the signal. Abruptly rising waveforms, however, should not be used in the first 0.2 seconds of a signal, so as not to startle the recipients (e.g. sudden noise could cause spasticity for persons with cerebral palsy).

***Infrasound*** is very low frequency sound. Research has shown that at the lower end of the sound spectrum, between 16 and 3.5 Hz, persons have complained of the sensations of vertigo, nausea and headaches.

### Exposure Time

Exposure time is the maximum time unprotected ears may be exposed to different intensities and frequencies of noise. An example is provided in Exhibit 34. If high frequency noise is present, then shorter exposure times or lower intensities are required for different exposure effects.

***Exhibit 34: Maximum Exposure Time to Noise***



**_Sound Systems_**

Sound systems with loudspeakers should be designed with professional advice. Rooms with low ceilings (less than 3 m) require distributed systems with many speakers mounted in the ceiling and facing down at the audience. Rooms with higher ceilings require point-source, single-speaker systems. Long, tall rooms require point-source systems, perhaps with second point sources with a digital delay halfway down the room. Wide rooms require point-source, speaker-array systems with wide sound distributions *[Parks Canada, 1994, page 19-20]*. Providing more speakers allows for a reduction in volume, without reducing the penetration of the sound.

**_Assistive Listening Devices_**

Assistive listening devices (ALDs) as shown in Exhibit 35 should be provided in areas that use audio communication. Many persons who are hard of hearing use hearing aids. However, hearing aids amplify background noise in crowded rooms, thus reducing speech comprehension. Sound amplification systems should be compatible with hearing aids that bear direct audio input. Induction loop, AM or FM radio, and infrared radiation systems broadcast audible signals through different means. Visitors who have hearing aids with telephone, or ‘T’, switches can receive signals from low-cost induction loop systems. Other systems require a portable receiver for every user *[Parks Canada, 1994, page 20]*.

***Exhibit 35: Assistive Listening Devices***

***Audio Description***

Audio description (or an auditory map), a fairly new development, is ‘the art of talking pictorially’ to make media and buildings more accessible to persons who have visual impairments. It consists of tape recorded information that guides a person through an environment by providing step-by-step directions. Trained describers provide commentaries or wayfinding information on visual aspects of objects, buildings, procedures or activities. Describers must have good language skills, extensive vocabularies and appropriate voices *[Parks Canada, 1994, page 18]*.

***Help Phones.*** Telephones provide an excellent means of conveying orientation and wayfinding information. Upon lifting the handset of the help phone from its cradle, visitors are provided with a verbal description of the chief building characteristics, where its facilities are in relation to the visitor’s position and so on.

***Public Telephones***

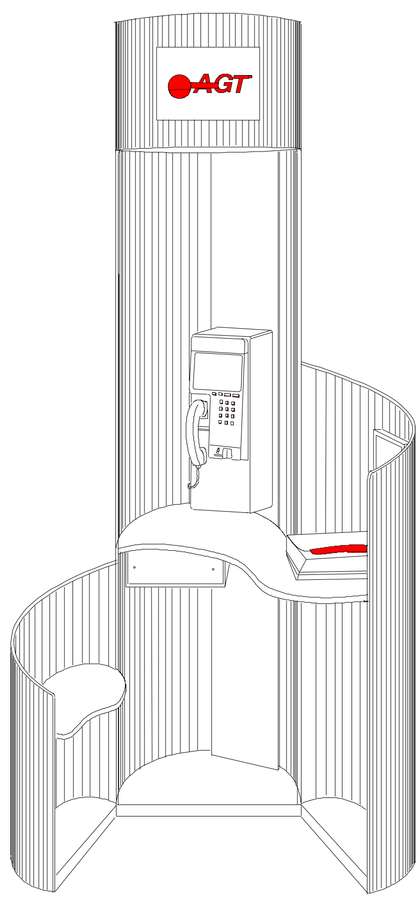
Many deaf and hard of hearing persons use a Telecommunication Device for the Deaf (TDD) with the standard telephone for communicating visually via the telephone system. Persons using TDDs often carry their own units and require shelf space for it beside or beneath the telephone. Telephones for use by deaf and hard of hearing persons should have a volume control; have a flux coil; and comply with CSA Standard CAN3-T515. A shelf at least 250 mm wide x 350 mm deep, with at least a 250 mm clear space above the shelf, should be provided to accommodate the use of a TDD *[CAN/CSA-B651-95, 1995, page 51-52]*.

All accessible telephones must be equipped with controls for adjusting the volume from 12 decibels to 18 decibels above the noise level of the surroundings so that individuals with hearing difficulties can adjust the volume for their use *[ADA Guidelines, 1991, 4.31.5].* Push button volume controls in which the volume increases while the button is pushed are preferred. The volume must go back to normal when the phone is replaced in the cradle.

Accessible telephones must have push-button controls *[ADA Guidelines, 1991, 4.31.6].* The cord of the telephone handset must be at least 75 cm in length *[ADA Guidelines, 1991, 4.31.8].* An electrical outlet must be located in or adjacent to the telephone enclosure. The telephone handset must be able to lie flush on the shelf *[ADA Guidelines, 1991, 4.31.9]* so that the handset can connect the text phone and the telephone receiver if an acoustic coupler is used.

Consideration should also be given to a fold-down seat (as illustrated in Exhibit 36), provided that it does not interfere with access for a person in a wheelchair when it is folded up. The preferred coin slot height is 1200 mm, but this height may not be achievable with some public telephone units.

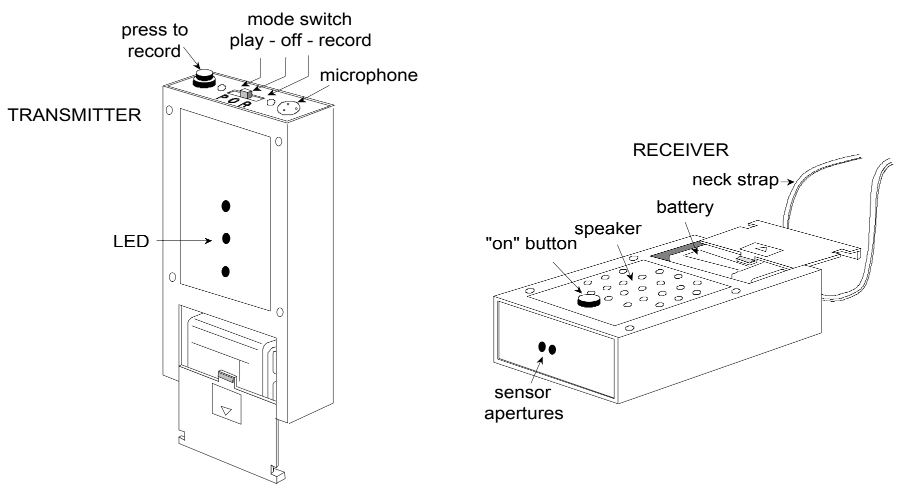
***Exhibit 36: Example of a Telephone and Shelf for TDD***



***Talking Signs***

Talking Signs® provide an audio message. This allows a person who is blind to locate a destination in the same way as a sighted person who looks around for a sign. Talking signs are a form of radio broadcast technology. An infrared transmitter is built into the base of a sign. When a small, handheld receiver is aimed at the sign, it picks up identifying messages (see Exhibit 37). The messages may be programmed in any language and contain any desired information. In its simplest form, the message would identify the destination, such as "women's washroom". This information would be presented via speakers or earphones.

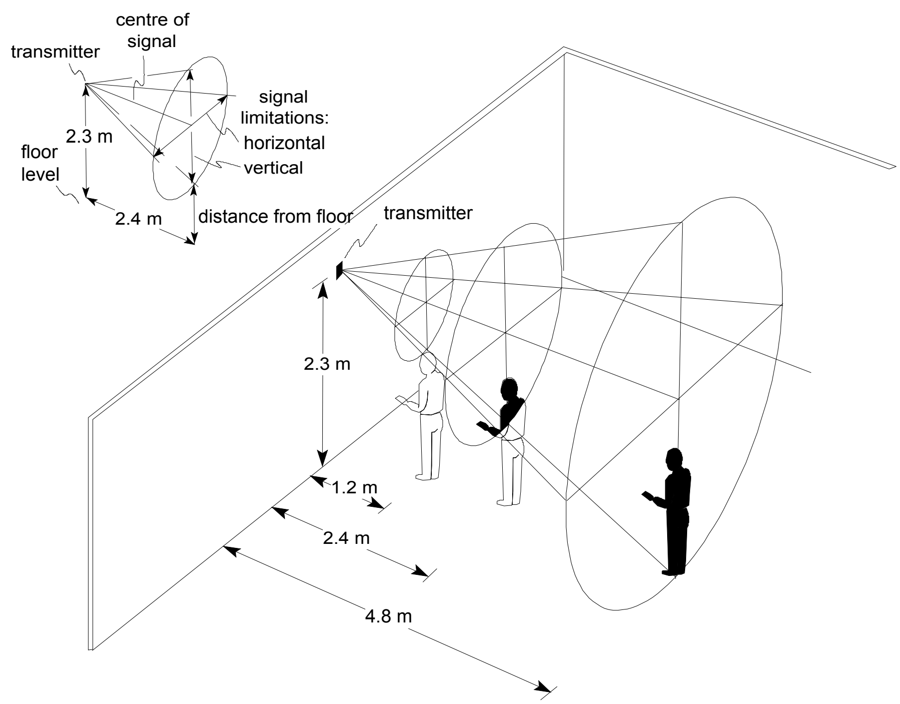
***Exhibit 37: Talking Sign Transmitter and Receiver***




In general, it is appropriate to place talking signs in the vicinity of printed signs, at an elevation of approximately 2.3 m. The transmission range is 2.4 m to 4.8 m, depending upon the function of each sign. The shading in Exhibit 38 indicates how much of the user's body is illuminated by the message at each of three distances from the talking signs transmitter *[Crandall et al., 1995, page 9-11]*.

The transmitter sends out a spoken message on a beam of infrared light. Adjustment of the transmitter and the LED arrays allows control of the maximum distance at which the message is received, the direction in which a message is transmitted, and the area covered by the message.

***Exhibit 38: Placement and Location of Talking Signs***




***Verbal Landmarks***

Verbal Landmark® has an inductive loop system which uses a portable receiver to pick up messages transmitted from an electromagnetic loop. Messages are picked up when the receiver enters the transmission field. The messages are produced by DECTalk® synthesized speech. The technology has the disadvantage of being non-directional and in recent tests was found to be less easy to use and comprehend in both familiar and unfamiliar areas than Talking Signs® *[Crandall et al., 1995, page 8]*.

***Auditory Pathways***

Auditory pathways consist of electronically activated speakers positioned throughout the immediate environment. Instructions from the speaker lead the person to the next location, thereby guiding them to their destination. There are several methods by which a person desiring to use the auditory pathway could signal the loudspeakers along the way: the person could carry a device to activate the loudspeakers; the person could activate the system by depressing a button at the entrance, and then announcements would automatically be activated once the person has entered a certain space; or the person could wear something that would be detected by a device on the speakers.

***Audible Alarms***

Audible alarms should exceed the ambient noise of a setting by 15 decibels, or exceed any maximum sound level with a duration of 30 seconds by 5 decibels, depending on which is louder. Audible alarms should not exceed 120 decibels, and should provide intermittent nose. Where possible, the alarm should be placed immediately above an emergency exit door *[Richesin et al., December 1989, page 68]*.

***Audible Warnings***

Audible warnings should be between 500 and 3000 Hz. Use frequencies below 500 Hz if the sound must bend around obstacles or pass through partitions. Use a modulating signal (1 to 8 beeps per second, or warbling that changes 1 to 3 times per second). Present the signal for at least 0.5 to 1.0 seconds *[Richesin et al., December 1989, page 68]*.

***Annunciators/Bells***

Talking elevators should be at least 20 dB at 1500 Hz *[ADA Guidelines, 1991]*. Recently, an imaginative and helpful use has been given to the bell in elevator lobbies by sounding it twice to indicate that the arriving elevator is going down and once to indicate that it is going up.

# Tactile Information

Tactile communication is best suited to relating qualitative and comparative information such as an object's shape and size relative to those of something familiar to everyone. For example, an airplane model should exclude many smaller details so that the overall shape and major components are easily discerned by touch. The same concept should be applied to tactile maps and signs. Quantitative details and abstract ideas can only be communicated if the traveller can read Braille.

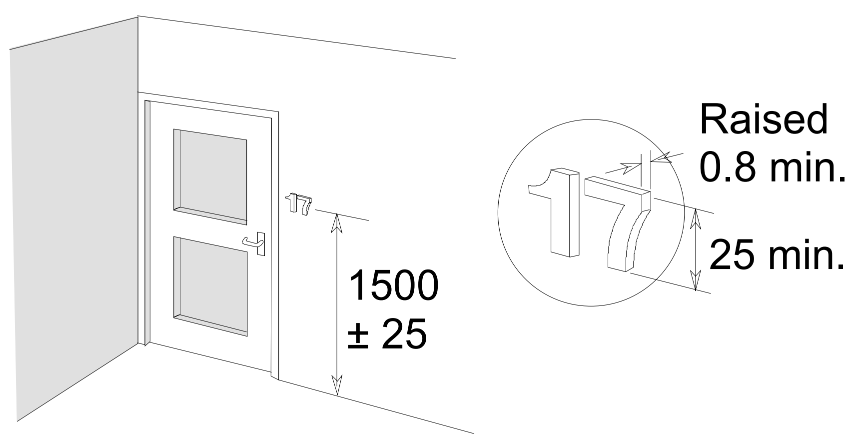
***Tactile Signs***

High visibility and tactile signs should always be used on or adjacent to: washroom doors, elevator call buttons, the top and bottom of flights of stairs, and wherever else is necessary to show the function of a room *[Barker et al., 1995, page 125]*. They should always be placed on the latch side of door openings for safety considerations.

***Sign Position***

A tactile sign must be positioned where it can be easily touched, that means at a height of between 1.4 m and 1.7 m as shown in Exhibit 39 and at a forward distance of approximately a half a metre (i.e. a maximum horizontal stretching distance of 500 mm) *[Barker et al., 1995, page 125]*.

***Exhibit 39: Placement of Tactile Signs***

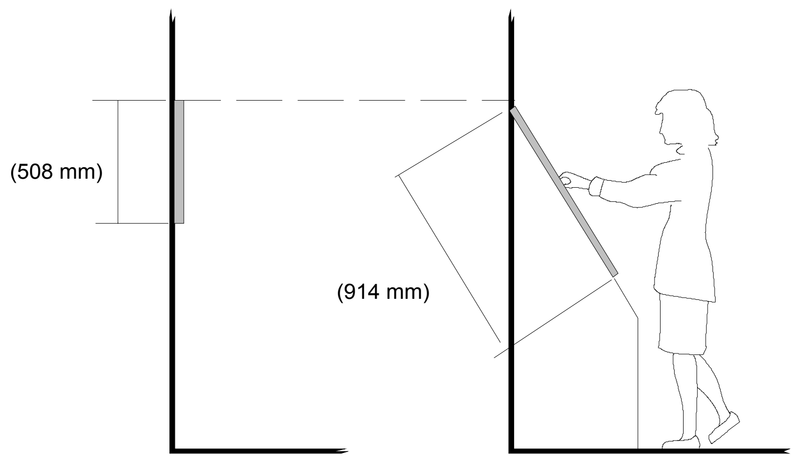


Consistency in mounting height is critically important to the visually impaired. All tactile signs should be mounted so that the top line of tactile characters on the signs are at the same height from the finished floor. The reach of wheelchair users should be taken into consideration when mounting tactile signs. The maximum reach range for a person in a wheelchair using a parallel approach is 1372 mm *[KRW Inc., 1995, page 12]*.

***Mounting Angle***

If the message on a tactile sign is too lengthy to fit within the recommended upper/lower limits, signs can be mounted on an angle, to provide additional message space. The sign should only protrude into the path of travel a maximum of 100 mm. Exhibit 40 illustrates this mounting technique *[KRW Inc., 1995, page 13]*.

***Exhibit 40: Mounting Angle - Tactile Surface***

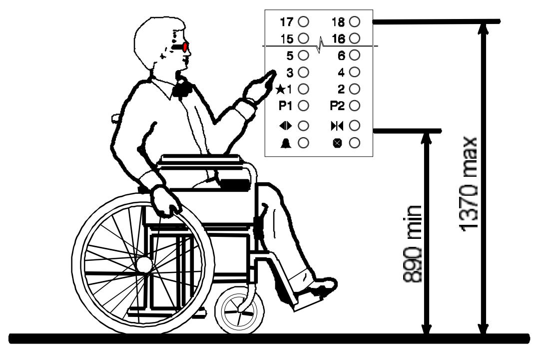



***Embossing Depth***

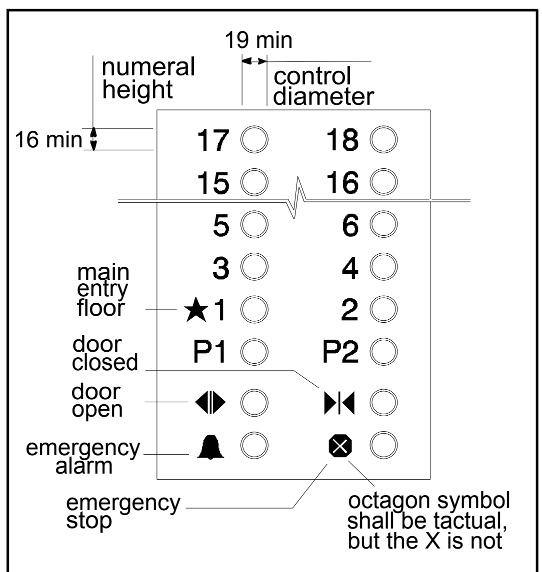
A tactile sign must be embossed, not engraved. The depth of embossing must be 1 mm to 1.5 mm and the stroke width 1.5 mm to 2 mm. The edges should be slightly rounded (a half-round section is not acceptable). The minimum character height should be 15 mm, the maximum 60 mm *[Barker et al., 1995, page 125]*. Tactile signs should be accompanied by Level 2 Braille *[Hunter-Zaworski and Watts, 1994, page 18].*

For elevator control panels (see Exhibit 41), characters should be raised 1 mm (BC Building Code 3.7.3.13(2)); for doors and openings, 3 mm (BC Building Code 3.7.3.19(1)); for stairwell floor numbers, 0.7 mm (BC Building Code 3.7.3.20(2b)) *[Richesin et al., December 1989, page 61]*.

***Exhibit 41: Placement of Elevator Controls***




Control Height




Panel Detail

Hands-free emergency phones should be used in elevators with an operator able to talk to the occupants of the elevator directly upon learning of an malfunction or emergency situation in the elevator.

***Special Characters***

For tactile lettering, use white upper- and lower-case letters on a black background. Special care must be taken with certain letters. Zeros, for instance, have slashes in the middle, to distinguish them from the letter “O”. and the number four is somewhat open at the top, so as not to be confused with the letter “A” *[Rumble, April 1995, page 73]*.

***Special Symbols***

For men’s and women’s restrooms, use the triangle and circle as shown in Exhibit 42, which are state-mandated symbols in California. To indicate a staircase, use a series of stacked lines; for an elevator, a hollow square. Finally, to indicate “you are here” on a tactile map, a hemisphere *[Finke, July/August 1994, page 56]*.

***Exhibit 42: Suggested Symbols for Tactile Maps***


***Tactile Maps***

Tactile maps need to be larger and simpler than visual maps to convey the same information. A minimum of 5 mm shall be left between parallel lines (representing streets, for example) and 3 mm between adjacent symbols. Varying the height of symbols helps users to decipher them, but too many symbols create ‘tactile noise’ *[Parks Canada, 1994, page 18]*.

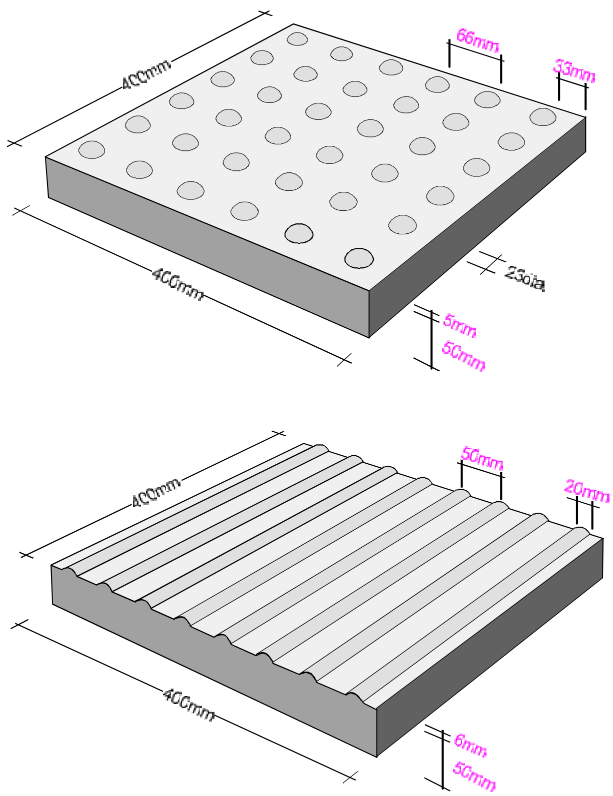
Tactile maps must be carefully designed to give information without clutter and must be easily accessible. Different textures can be used to signify different types of routes, although the number or readily recognizable different textures which can be distinguished is limited to four *[Passini et al., May 1991, page 7].*

***Warning Surfaces***

Tactile cues utilized for warning surfaces must be clearly differentiated from other surfaces in the setting and must be located consistently throughout the setting. Examples of tactile warning surfaces are shown in Exhibit 43. The tactile warning surface must be clearly detectable under both foot and cane *[Richesin et al., December 1989, page 61]*.

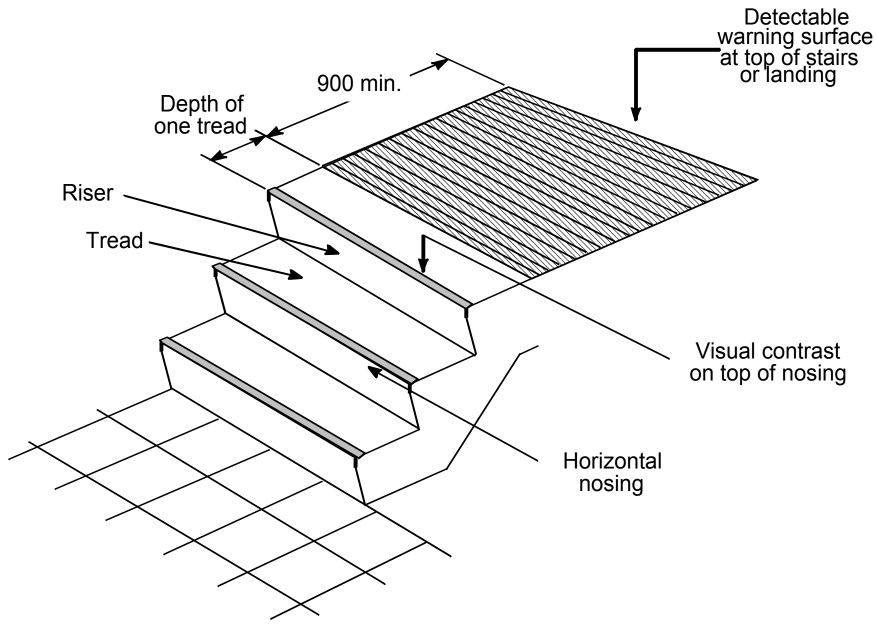
Detectable warnings on walking surfaces shall be at least 900 mm long and of a texture and colour that contrasts with the surrounding surfaces *[CAN/CSA-B651-95, 1995, pg. 57].*

***Exhibit 43: Examples of Tactile Warning Surfaces***




Detectable warnings surfaces should be provided at the top of stairs and at landings as shown in Exhibit 44, extend the full width of the stair for a depth of at least 900 mm commencing one tread depth back from the stair, and consist of flooring material that is contrasting in colour with the surrounding floor material and of a different texture from the surrounding flooring material *[CAN/CSA-B651-95, 1995, page 27].*

***Exhibit 44: Detectable Warning Surfaces on Stairs***



# 5. INFORMATION RELATIONSHIPS

Travellers' perceptions of and responses to information systems are influenced by numerous physical and psychological factors such as quality of eyesight, reading ability, memory, colour sensitivity, and mental attitude. These are referred to as *human factors*.

When a specific environment can be controlled by the responsible authority, the viewer's awareness of the signage system and its effectiveness can be dramatically increased. By using various *environmental factors* such as good lighting and appropriate textures and colours, an appropriate psychological environment can be created to enhance the message.

Some of the important human (physical and psychological) and environmental factors to be considered in implementing new information systems are discussed in this chapter.

While these vary with the individual and are beyond the control of the responsible authority, a general understanding of how these factors affect the traveller's response to information systems is important.

# Physical Factors

***Clarity and Contrast***

Clarity of visual output is important for all users when obtaining information; however, it becomes more crucial for those with a visual impairment. For visual information, the use of colour, upper and lower case, fonts, styles, resolution, contrast between figure and background, and the variability of ambient light must all be taken into account. If auditory output is used, its clarity, understandability, and contrast with ambient noise must be considered. This is especially important for those with mild or moderate hearing impairments who can still cope with auditory messages.

***Size and Intensity***

Is the size or intensity of output large enough for all users to obtain the information? Is the size or intensity of output loud enough for all users to obtain the information?

***Visual Acuity***

Viewers differ considerably in their ability to see clearly. Yet environmental communications is almost entirely based on the assumption that it will be read with normal vision.

***Readability***

Readability is defined as the relative ease or difficulty a reader experiences in attempting to understand the concepts in written text. Readability formulas use two criteria, word difficulty and grammatical/semantic complexity. Two common formulas are the Fry and Flesch readability formulas. Both should show a level of 9.0 to 10.0 for easy readability *[Stahl et al., Winter 1995, pages 105-114]*.

***Reading Rate***

Among the normal reading public, there is a wide variation in individual reading rates from perhaps 125 words per minute to 500 or 600. Factors like age, intelligence and education influence reading rates; the average is about 250 words per minute.

***Legibility***

Distance studies indicate that under normal daylight when standing still a person with normal 20/20 vision can read 25 mm high letters on a standard Snellen eye chart used by optometrists at a distance of 15 m. For elderly and disabled persons, and to meet broader public needs, a letter height of

25 mm for 7.5 m of viewing distance is probably a more practical guide.

***Eye Level***

The average height of a viewer's eye level, measured from the ground when the viewer is standing, is about 1.7 m; when sitting, it is about 1.3 m. Sight lines are a very important factor in sign placement.

# Psychological Factors

***Interpretation of Symbols***

Is the presentation of information easily interpreted, with no room for ambiguity? Has international symbolic language been considered, not just to help the reading impaired and foreign language speakers, but for all travellers? The majority of people are verbally oriented, absorbing most information through words, while the minority respond more quickly to visual devices, such as symbols. Most sign systems need some verbal messages; but, most international airports use symbols to reinforce the verbal message or to stand alone. Symbols can be ambiguous and should be carefully designed and tested to ensure easy interpretation.

***Perception of Colour***

Have basic guidelines on the use of colour been followed? Certain issues need particular investigation with the elderly and disabled, e.g., the use of colour coding for warnings. Although important for all drivers, this is particularly relevant to the visually impaired so that there are no safety risks and no interference with task performance. *ICE Ergonomics, 1993,* notes that colour deficiencies must be considered. Avoid using red/green or yellow/blue in pairs. Avoid using the blue end of the spectrum for important displays. Highly saturated, bright colours are found irritating by young drivers but are preferred by older drivers.

***Implications of Colour***

Individuals seem to vary considerably in their ability to distinguish and remember colours. Probably only six different colours, not including white and black -- red, yellow, blue, green orange, brown -- can be readily distinguished and remembered by normal viewers. Despite these limitations, colour can be used as a secondary identification element or as a coding device in situations where the number of colours is very limited. For example, Revenue Canada Customs and Excise is trying a system using red and green doors at customs areas in airports (red = stop and declare; green = proceed, nothing to declare). This coding application does not require colour memory when reinforced by numbers or letters.

Certain colours can be powerful reinforcing agents in signing; the viewer has been conditioned to associate red, for example, with danger or emergency through experience. Similarly, we respond to yellow as a warning colour.

***Distinguishability of Sounds***

Is it easy to distinguish auditory feedback between devices and between the different types of system output, such as feedback, prompts, questions, warnings, error messages, menus, etc.? *SAE-576, 1984,* says to use sounds having frequencies between 500 and 3000 Hz, as the ear is most sensitive in this range. People who experience deafness to specific tones, often caused by exposure to loud noises, find complex tones particularly helpful in hearing at least some of the signal. Avoid using high frequencies above 2000 Hz for warning signals, and use complex tones to give travellers with hearing loss the ability to hear at least some of the signal. Abruptly rising waveforms could be especially hazardous for certain people, e.g. sudden noise could cause spasticity for persons with cerebral palsy. These guidelines for disabled and elderly users need to be integrated into all guidelines.

***Clarity of Copy***

Because certain phrases tend to be ambiguous or subject to personal interpretation, it is important to make sure the message is consistent, is stated positively, is as short as possible, and means the same thing to all viewers. For example, restrooms may be designated 'Men' and 'Women' or 'Gentlemen' and 'Ladies'. While wording may vary, it is important to maintain consistency within any sign system. The FIP guidelines help to achieve this.

***Consistency of Output***

To what extent is the type and format of information consistent between tasks? Consistency is important both within a terminal or vehicle and between terminals or modes of transport. *Federal Identity Program, 1990,* outlines a corporate identity program for the Government of Canada to ensure consistency in the appearance of signs in Federal buildings. It uses consistent letterform, colours, shapes and symbols. *DRIVE Project V2008* aims to propose recommendations for the consistent presentation of information to drivers.

# *Environmental Factors*

Many aspects influence an observer's ability to perceive a specific sign, to read its message and to act upon it. These factors include the viewer's ability to see the sign clearly (visual acuity), and the viewing conditions at the site, namely:

- the angle from which a sign is normally viewed;
- the quality and intensity of the light falling on the sign;
- any obstructions of the sight lines between viewer and sign; and
- the visual environment behind or around the sign (e.g. other, competing signs or distracting elements).

Whether a sign is placed in a natural or an architectural environment, it modifies its surroundings. Signs not only become part of their surroundings, they also 'reflect' on the organization occupying the space. The purpose of signs is to help. They provide a communication system that enables users to function in that space. However, for a variety of reasons, signs tend to detract visually from the surroundings. This is particularly true of oversigning.

For the most part, environmental factors may be beyond the direct control of the designer, but there are closely related design factors which can be controlled. Artificial lighting can be used to increase perception of signs. Signs can be placed to improve sight lines. Most design elements of a sign can be adjusted to improve legibility of a sign, compensating for a poor visual environment.

***Sight Lines***

The placement of signs within a facility or on a site involves these considerations: where to locate signs; how to install them; and, in the case of directional signs, how many? A basic human factor concerned with the placement of signs is the average eye-level height. It may seem obvious that pedestrian signs should be placed at eye level, but that would be a gross simplification of the problem. The important thing to remember is that signs should be placed to avoid obstructing normal *sight lines*. Some questions to consider are:

- Can the sign be seen over the heads of other people by an average viewer?
- Will the sign face be at an acute angle to the normal line of vision?
- Will the sign be outside the normal field of vision?
- What is the background behind the sign and the environment around it?
- Will other signs or architectural features be in the way of the sight lines?

***Location of Information***

Is visual information presentation close to the intended viewer's normal line of vision without obstructing important areas of the visual field? To what extent is the display adjustable to meet the needs of drivers with visual acuity or visual accommodation difficulties? *CAN/CSA-B651-M90* provides specific information on character proportions and character height for signs, as well as general information on contrast and illumination. More specific user testing is probably required with persons with disabilities before these guidelines can be validated. This guideline for disabled and elderly users would need to be validated in a driving environment. The size of characters acceptable for all drivers needs to be determined, especially for those with a visual impairment, such as those with bifocals.

***Exposure and Timing***

Is the presentation of information well-timed? As many tasks take longer for elderly persons and persons with disabilities to perform, they often require more time to act on the information. Is the display duration long enough to read all the information, without interfering with the safe performance of other tasks (such as the driving task in a private vehicle)?

***Signs: How Many?***

Many factors influence decisions on how many signs will be needed to provide direction on a particular route. They include the nature of the environment (complexity), the distance between starting point and destination, and the number of decision points (e.g. intersections) on a route. Research has shown that signs should be located just before each decision point. Where there are long distances between decision points, a message may need to be repeated confirming the direction towards the destination. Providing information and direction to help users should not lead to a proliferation of signs. Commonly referred to as oversigning, it causes too many reference points, diminishes essential information, confuses people, and clutters the environment.

# 6. INFORMATION APPLICATIONS

The obvious trend towards improved availability of information through the application of new technology can be used to simplify the problem of improving information for travellers and to provide broad categories for analysis. The transference of information processing from trained personnel to technological devices not only reduces personnel costs but allows for greater user accessibility through a broader placement of relatively inexpensive media. At the same time, improved systems of communications allow for the economies inherent in the centralization of information storage and retrieval devices. The complexity of information systems does not therefore defy definition. The trend resulting from the application of new technology illustrates a number of possible categories of systems as perceived by the traveller:

- **planning** where the telephone and computer can provide a large amount of information to travellers;
- **terminal** where visual or audible systems may be used for providing direction, location and/or time information; and
- **onboard** where selective information may be provided through electronic messaging systems.

Much of the information in this chapter was obtained via the internet from the U.S. Federal Transit Administration.

# Planning Information

Planning information can include routes, schedules, fares, and other pertinent information (e.g., parking locations). Often this information can support itinerary planning, which can provide information on a whole trip from one point to another, even if it involves multiple modes.

The convenience of obtaining planning information can be increased by using touch-tone telephones, personal computers, pagers, personal communications devices, kiosks and/or voice synthesizers. Automated data retrieval systems to augment existing human-operator interfaces can provide information to the caller in a timely manner.

***State-of-the-Art***

Planning information systems in the past were primarily directed towards riders who knew the transport system already, and only wanted updates on schedules. New systems provide relatively easy-to-obtain information to the novice as well as the experienced traveller. Typically, these systems can be accessed by a touch-tone telephone. Newer systems include map displays and schedule information that is provided on the Internet through the World Wide Web. These newer systems, whether accessed directly or through a customer service operator can provide detailed directions on transportation between the origin and destination stops, and directions to the final destination.

Transportation agencies have made great strides in reducing the amount of time a customer has to wait to obtain information. Automation has led to a greater amount of information being provided more quickly and with an overall reduced operating cost. This has made it possible to handle a higher volume of calls than before.

In a manner similar to that in airline and train companies, real-time schedule information is beginning to be provided by several transit agencies through a variety of media, including electronic signs and kiosks.

***Applications***

Automated Trip Planning Systems have been installed at many transit agencies by a variety of vendors. For example, a system developed by Tidewater Consultants Inc. is designed to run in a Windows-based environment on a standard PC. The system relates stops, routes, and schedules to a GIS based on a Rapid Routing Module, an algorithm that computes a trip plan for a customer who has called. Travellers call the transit agency's telephone information centre, give their origin and destination, and the system computes a trip plan, generally in under 10 seconds. Looking at a pull-down menu, the telephone centre agent can then describe to the caller the proposed itinerary, or can fax it or send it by mail. These print-outs can be multi-lingual, in Braille and/or in large type.

*Winston-Salem, NC*

The Winston-Salem Transit Authority (WSTA), through the Mobility Manager model project being developed under the FTA's APTS program, will provide users with a menu of transportation services by telephone. By calling a single number, a prospective passenger will immediately be able to schedule a trip, ask about the status of a trip, make arrangements to transfer more readily from one mode of travel to another, or receive a schedule of transportation service available in the regional area. Participating transit services includes both private and not-for-profit providers. In the future, the Mobility Manager project will be expanded to include electronic variable message signs to provide passengers with real-time information about a vehicle en route, such as updates on delays or revised schedules.

*Los Angeles, California*

Caltrans is directing the SMART TRAVELLER program, which is a free automated information service to provide commuters with:

- Up-to-the-minute freeway conditions and traffic speeds;
- Customized transit route planning; and
- Real-time carpool matching.

SMART TRAVELLER, a telephone information service operating 24 hours per day, provides Los Angeles County Metropolitan Transportation Authority (LACMTA) information. The telephone information service also provides an Automated Telephone Rideshare Matching system (Ridestar from Commuter Transportation Services, Inc.), through which registered carpoolers can obtain a list of interested carpoolers, query the system based on specific needs on a specific day, and instantly send a personal voice message.

*Seattle, Washington*

The King County Department of Metropolitan Services is employing several forms of electronic communication technology to access vital transportation information relating to the greater Seattle/Puget Sound region. Riderlink is an on-line information resource available on the Internet via the WWW. It gives instant access to Seattle Metro bus routes, timetables, and maps, as well as information about vanpool and ridematch services, bicycle transportation, freeway congestion, the state's commute trip reduction law, and a variety of other transportation topics. In addition, Seattle Metro's automated Bus-Time system makes schedule information available to anyone with a touch-tone phone.

*Riverside County, California*

Touch screen kiosks, featuring full-motion color video, stereo sound, on-screen maps, personalized public transit itineraries, and carpool matches for commuters, have been installed in the Coachella Valley area of Riverside County, California. The pilot project, called TransAction Network, has four kiosks at shopping centres with high pedestrian traffic. The kiosks provide the public with a one-stop source of a variety of information in English or Spanish. Users are offered five touch screen options: Carpool Service; Route Service; SunBus Maps and Videos; Rideshare Videos; and Kiosk Help. By entering a destination, arrival, or departure time and a transportation option, a user can receive a free printout of a complete itinerary including route, bus stop, fare, and schedule, as well as a carpool match list. Also included with the printout is a free ticket good for one ride.

*Baltimore, Maryland*

The Mass Transit Administration of Maryland's transit information centre has been upgraded to contain all of the latest schedule information. When a customer calls the information centre, the operator will call up the schedule on a computer screen, instead of looking through books. Moreover, the system will keep a running memory of the customer's call based on the number the call came from.

The caller's last question asked, home address, etc. can be brought up on screen by the operator, reducing the time need to process the information request. Five kiosks will also installed in greater Baltimore to provide the same information as the operators.

*Columbus, Ohio*

Beginning in March 1995, the Central Ohio Transit Authority (COTA) implemented a Trip Information System for the door-to-door paratransit services for the disabled citizens of Franklin County, Ohio. It allows those riders using a touch-tone phone to call 24 hours a day, seven days a week, to enter a personal identification number and quickly confirm their scheduled trips. Beginning in early 1996, COTA will implement the next phase, which will allow passengers to schedule their trips using touch-tone phone and numeric codes to enter dates, times, origins, and destinations. The second phase will especially benefit speech-impaired people because it will be much faster for them to push telephone buttons than to communicate verbally.

*Newark, New Jersey*

The New Jersey Transit's automated telephone information system that went into service in November 1993 has dramatically reduced the waiting time for customers calling NJT for bus and train schedules and has allowed the agency to answer more calls than ever before. The system provides callers with train schedule and fare information and supplements live operators, who continue to provide bus and rail schedule information for those customers who choose to speak to an operator or who need special assistance. Although the automated system provides only rail schedule information, it has benefited those calling for bus schedule information by allowing more callers to reach the agency.

*Jamaica, New York*

The Long Island Rail Road's Traveller Information Center provides callers with information, 24 hours a day, that ranges from fares and schedules to up-to-the-minute status of train services to special excursion packages and tours.

*Honolulu, Hawaii*

Pre-recorded phone messages that provide transit route information to more than 10 000 visitors to the island who call each week was initiated in Honolulu for their transit service called TheBUS. The message is recorded in both English and Japanese. The objective is to provide more efficient "places of interest" route information 24 hours daily without using TheBUS information agents.

*Atlanta, Georgia*

The Metropolitan Atlanta Rapid Transit Authority is implementing a trip planning system to support MARTA's customer information centre and kiosks that will be available for the Olympics. The Passenger Routing and Information System (PARIS) requires an origin and destination to produce a nearest bus stop-to-nearest bus stop itinerary. Origin and destination can be input in the form of a street address, an intersection or a landmark. Although the itinerary does not provide instructions to reach a bus stop, it does take into account walking time and impossible walks (e.g., crossing a river without a bridge). All the options for a trip are ranked by PARIS, and the highest ranked option will be provided. MARTA will decide how to rank the options and whether or not to provide multiple options prior to full implementation. In addition, a limited amount of highway-related information can be obtained from PARIS.

*Houston, Texas*

Houston Smart Commuter, an operational test sponsored by FTA, FHWA, and Texas DOT and Metro, is assessing "the potential for encouraging greater utilization of high-occupancy commute modes (e.g., buses, carpools and vanpools) by applying innovative approaches using advanced technologies to provide information". The technologies to provide the real-time traffic and transit information under consideration include: touch-tone and cellular telephones, cable television, videotex (both 'smart' and 'dumb' terminals), and pocket systems.

*Minneapolis/St. Paul, Minn.*

In the Minneapolis/St. Paul, Minnesota area, transportation officials are looking to advanced technology to make transit operations more efficient and attractive to commuters. Called Travlink, this $6.5 million demonstration project is part of Minnesota Guidestar, Minnesota DOT's program for ITS, which is actively testing and deploying new technologies that improve the movement of people, goods and services. Travlink represents the integration of a computer-aided dispatch and AVL system based on the global positioning system, an advanced traveller information system (ATIS) and an automatic vehicle identification system in the I-394 corridor in the Minneapolis/St. Paul metropolitan area. Travlink is using “a variety of devices and systems to distribute both real-time and static transit and traffic information to travellers. A primary objective is to determine the extent to which improved information can assist travellers with trip-making decisions and influence travel behavior. Travlink is designed to encourage commuters to consider alternatives to single-occupant travel, especially public transit”.

Metropolitan Council Transit Operations is the transit operator in the Minneapolis/St. Paul metropolitan area, and currently has a fleet of approximately 800 buses. The Travlink project selected 80 buses on nine routes to be equipped with GPS CAD/AVL. Real-time information from these buses is used together with traffic information collected from the Traffic Management Center to provide Travlink users with real-time, route-specific information on the operating conditions of the highway and transit systems, and with other personal-use types of information.

Planning information provided through Travlink includes trip planning information in the I-394 corridor. “How Do I Get There” includes planning from Downtown Minneapolis to the Western Suburbs, from the Western Suburbs to Downtown, Downtown to/from points of interest, and Downtown to/from the University of Minnesota/Minneapolis Campus.

Videotext terminals that operate the Travlink software have been distributed to a group of people made up of carpoolers, transit users and people who drive alone. As of November 1995, there are 315 videotext terminal users and 10 businesses using the terminals.

# Terminal Information

In-terminal and wayside information systems provide schedule updates and transfer information for passengers already en route. This information includes arrival and departure times, information on transfers and connections, information on other regional transportation services and information on related services, such as parking availability. This information can be provided via electronic signs, kiosks or television monitors.

***State-of-the-Art***

Traditionally, except for airport terminals, in-terminal and wayside information has been disseminated manually in the form of paper schedules or static signs. Further, real-time information, such as actual bus arrival or departure time, has not been traditionally available to give to the customer. With the advent of advanced public transportation systems such as AVL, real-time, en-route transit information can be made available to the customer in a variety of forms.

However, automated terminal information systems are in their infancy in North America, primarily because technologies needed to support these systems are just beginning to be fully implemented. Currently, only a few of these systems are in operation, but many are being planned. A few transit agencies are providing smart kiosks which convey schedule information, trip planning information, and static files such as the location of popular restaurants. Visually and hearing disabled travellers are enjoying the benefits of kiosks that convey transit information in a form that they can acquire with a minimum of effort.

***Applications***

Some recent applications of terminal information systems are described in the following paragraphs. Most of these systems are similar to the smart kiosk, which is becoming quite common in shopping centres and other commercial establishments for providing information on facilities, services, restaurants, shopping, points of interest, and sightseeing facilities to visitors.

*Halifax, Nova Scotia*

Metro Transit has 14 video display kiosks, 14 speaker phones and four auto-dial phones (with direct connections to their information centre) located throughout greater Halifax, all providing bus location information in real time. To access information from the phones, the traveller enters a four-digit code signifying his or her nearest bus stop. The system responds with information on the next two buses that will arrive at that location.

*Tucson, Arizona*

The City of Tucson's transit agency, Sun Tran, is currently planning an AVL system. As part of the overall package, there is a component for installing four touch-screen kiosks at their three transit transfer centres, including two kiosks at the downtown centre and one in a transfer centre that is about to be constructed. The initial plan is for the kiosks to provide basic schedule, route, and time information. As the AVL system is completed and implemented, the kiosks will provide real-time information. Eventually three to six more kiosks will be installed in other locations in the city, with the University of Arizona campus most likely to receive at least one kiosk. Also included in the AVL system will be the automation of the telephone information centre for some routes to provide real-time bus arrival information, and the implementation of annunciators on buses to comply with the Americans with Disabilities Act.

*Minneapolis/St. Paul, Minn.*

As previously mentioned, Travlink is part of Minnesota Guidestar, and represents the integration of a computer-aided dispatch and AVL system based on the global positioning system, an advanced traveller information system and an automatic vehicle identification system in the I-394 corridor of the Minneapolis/St. Paul metropolitan area. There are currently three interactive Travlink kiosks in downtown Minneapolis locations: two at business centres and one at a transit office. The kiosks provide information on: transit routes/schedules between selected destinations, bus fares, park-and-ride locations, commuter services, elderly and disabled services, traffic incidents and delays, and highway construction and maintenance. There are also video monitors at two transfer centres.

*Cincinnati, Ohio*

Metro bus operations of the Southwest Ohio Regional Transit Authority recently released an RFP for a Bus Service Management System. The RFP calls for a new state-of-the-art communications system, computer-aided dispatch/AVL, schedule adherence, next-stop annunciation, vehicle condition monitoring and bus stop information kiosks. These advanced technologies will be deployed initially on a number of selected routes and analyzed for full fleet deployment.

*New York City, New York*

The Baruch College Computer Center for Visually Impaired People, together with the New York City Metropolitan Transportation Authority (MTA), is in the first phase of an 18-month project to develop a pilot Talking Directory Display System [TDDS] to be used in intermodal stations. The system will provide three forms of accessible information:

- A schematic overview of the station displayed on a tactile/large print map;
- Spoken or displayed information in large print on a computer-assisted system connected to the map, which is activated by touching points on the map; and
- Information coordinated with large print and Braille signs installed on platform levels of the station at the demonstration site.

The information system is being designed to provide route information to let users easily, efficiently, and safely access major parts of the station.

*Ann Arbor, Michigan*

The Ann Arbor Transportation Authority (AATA) recently initiated an 18-month, $1.9 million program designed to provide some aspects of an Intelligent Transportation System (ITS). Several technologies will be used, including:

- Automatic annunciation and displays in the vehicle;
- A limited demonstration of wayside signs that indicate the status of the next bus;
- Optional messages to cable television regarding real-time system and vehicle status; and
- On-board processors that interface with all on-board components, including passenger counters, annunciation systems, interior and exterior destination signs, public address systems and radios.

*Corpus Christi, Texas*

The Corpus Christi Regional Transportation Authority (CCRTA) is considering the development of a demonstration program at their Staples Street Station to provide real-time next bus passenger information. The initial demonstration consists of installing a display kiosk, or “Intelligent Public Information Display,” at their Staples Street Station. Customers will be able to find out the real-time status of their route and expected arrival time. If the initial demonstration is successful, CCRTA will test additional units at several stops.

*Spokane, Washington*

The Spokane Transit Authority is installing a new Electronic Passenger Information System designed to improve transit service and customer information at Spokane's new downtown transit facility called the Plaza. An automated computer system will be used to control and monitor bus traffic and to provide passengers with scheduled arrival and departure times for buses using any one of the 10 bus bays located around the Plaza. Bus Bay Availability Indicators, similar to traffic lights, will be located near the bus holding areas and will show the bus operators when their assigned bay is vacant. Banks of video monitors, similar to those in airport terminals, will be located inside the Plaza and will display current bus schedule information. In addition, each bus bay will have a large display sign which will indicate route name, number and scheduled departure time for the bus currently parked in the bay.

*New York City, New York*

New York City Transit awarded a contract in November 1994 to Telecite, a Montreal-based electronic services company, to supply electronic display boards for installation on subway platforms. Telecite will supply 409 multi-coloured, animated display boards that will be installed in selected NYCT subway stations. The displays will provide timely messages, such as train service interruptions, next-train arrival time, or temporary service halts due to construction, as well as promotional messages. The displays will also include audio for the benefit of the visually impaired. The project was developed in collaboration with Transport Canada, Industry Canada, and the National Research Council of Canada.

*San Francisco, California*

A joint effort by the San Francisco Municipal Railway and the Bay Area Rapid Transit agency is evaluating new "Talking Signs" for the visually impaired at San Francisco's Powell Street Station. This is the first use ever of remote audible signs in a transit facility. "Talking Signs" provide to blind and low-vision persons the same directional and usage clues that traditional visual signs provide to sighted persons. They work by sending information from installed infrared transmitters to a hand-held receiver. The visually impaired person holding the receiver hears the sign's spoken message, which tells them where they are, and what must be done at that location to reach and board the train or to find other services within the station complex. "Talking Signs" were developed by Smith-Kettlewell of the California-Pacific Medical Center, Love Electronics and Talking Signs of Baton Rouge, Louisiana, as part of a demonstration project being managed by Project ACTION under a contract with the FTA.

*Houston, Texas*

Metro will be involved in a public security project, in which closed-circuit television (CCTV) cameras and call boxes with two-way communication will be installed at park-and-ride lots and transit centres. These cameras and call boxes would be monitored from TranStar, Houston's transportation management centre. Each bus stop on one major route downtown (that runs along Main Street) will also have a CCTV camera and a call box for security. These call boxes will allow travellers to obtain bus schedule information initially and dynamic information at a later time.

*Los Angeles, California*

Caltrans is directing the SMART TRAVELLER program, which is an automated information service for commuters. Interactive (touch-screen) kiosks are provided, which allowed the traveller to access bus, train, and shuttle schedules, routes, and fares. The kiosks also provided the Traveller with the capability to build transit itineraries, which could be printed at the kiosk, and to access the current list of carpoolers registered in the area. Also, the freeway conditions map that was displayed from kiosks is available through the Internet. In the future, services may be available through cable television.

# Onboard Information

In-vehicle information systems include technical innovations which support the transit user en-route. Travellers are aided by on-board displays and communication devices which provide information on routes, schedules, and connecting services. Transit agencies are including these devices in their vehicles for two key reasons: 1) to facilitate the transit trip and make necessary information more user friendly, and 2) to comply with the requirements of the ADA. The ADA requires that all fixed-route transit vehicles provide both visual and audible information "at transfer points with other fixed routes, other major intersections, and destination points, and intervals along a route sufficient to permit individuals with visual impairments or other disabilities to be oriented to their location." Further, any stop must be announced/displayed on request of an individual with disabilities. Automated annunciation devices also remove the responsibility for announcing stops from the drivers, leaving them free to concentrate on driving, which should result in greater safety for passengers.

Although not strictly an in-vehicle information system for passengers, several transit agencies are experimenting with surveillance cameras on selected routes and equipment. It is intended to be a deterrent to crime and to curtail false injury claims made when vehicles are involved in accidents.

***State-of-the-Art Summary***

Rail systems typically have provided audio announcements for stops because they operate on exclusive rights-of-way. Bus systems are in the process of providing information through automated annunciator technology. This technology, based on AVL systems, automatically announces/displays stops, major intersections, and major transfer points. As transit agencies implement AVL systems, more accurate and real-time information will become available. Both rail and bus are beginning to implement in-vehicle information systems that provide not only transit-related information, but also news, weather, and advertising information.

**_Applications_**

The following paragraphs provide some information on recent onboard information systems.

*New York City, New York*

The New York City Metropolitan Transportation Authority is implementing several pilot programs to test in-vehicle message systems. Two new-technology subway cars being tested include real-time in-vehicle announcements. An RFP has just been released for the bus program AVL, which will include in-vehicle announcements. As part of this RFP, there will be a one-year pilot program based on the 126th Street Bus Depot and Bus Command Center locations. As part of the goal for service improve-ments, it is anticipated that accurate customer information will be transmitted in-vehicle and at kiosks at remote bus stops to provide real-time schedule information.

*Corpus Christi, Texas*

The Corpus Christi Regional Transportation Authority is considering upgrading their paratransit and fixed-route passenger information systems. Specifically, CCRTA is looking to upgrade their communications equipment in the fixed-route buses to provide next-stop audible annunciator, visual display, and onboard loudspeaker equipment.

*Scranton, Pennsylvania*

The County of Lackawanna Transit System in Scranton, Pennsylvania, recently implemented one of the first AVL systems for public transit in which the Vehicle Tracking Unit can initiate the "next stop" announcement system. Designed by Auto-Trac, Inc., the Fleetservice system includes: differential GPS; GPS-triggered next-stop announcements; on-time schedule monitoring; multiple mapping stations controlled by an area network; and a replay feature to play back the movement of any bus for any given time and date.

*Newark, New Jersey*

New Jersey Transit is testing two Automated Voice Annunciator Systems (AVAS) to enhance bus service and comply with the ADA. One of the systems, called Automatic Passenger Information System, is developed and marketed by Clever Devices Ltd. and Siemens Transportation Systems, Inc. The other, called the Talking Bus System, was developed and marketing by Digital Recorders Inc.

The Automatic Passenger Information System device uses the bus odometer to automatically read a pre-programmed announcement to customers on the bus at major stops being approached by the bus. Beside this audio announcement, the locations are displayed inside the bus just above the operator, for passengers with hearing disabilities. After the operator has stopped the bus and opened the door, visually impaired passengers outside the bus hear another automated announcement that identifies the bus route and its destination. Hearing impaired customers can identify the bus route by the destination sign on the front of the bus.

The Talking Bus System uses GPS to determine vehicle location, which is then compared to stored route data. Once the vehicle location matches the route data, the message associated with that location is triggered.

***TCRP Study***

A Transit Cooperative Research Program (TCRP) on *Electronic On-Vehicle Passenger Information Displays* is underway to identify and summarize (1) those electronic communication technologies presently in transit use and (2) non-transit applications of such technologies that have potential for transfer to transit. This study will summarize passenger information needs, operator concerns, and the ability of current and emerging technologies to meet those needs. It will identify (1) any disparities between the needs of passengers and operators and (2) the capabilities of electronic display systems. The study will also identify disparities between technology and needs, and provide guidelines to assist in deciding whether or not to purchase an on-vehicle electronic passenger information display system.

# 7. CONCLUSIONS

The issue of accessibility by disabled persons to various modes of transportation has received increasing attention in recent years. Considerable energy, funding and research have been directed toward environmental access needs. Much of this attention has been directed toward removing architectural barriers for the individual who uses a wheelchair, or who is otherwise mobility impaired. However, similar efforts for Canadians with perceptual or cognitive impairments have been lacking.

There is a need to identify the environmental access needs of perceptually and cognitively impaired travellers so that they may use transportation terminals with the efficiency, convenience, and dignity experienced by the general public. Specifically, efforts must be made to assist perceptually and cognitively impaired persons to travel independently, taking into consideration the effects of the environment on safe and efficient movement. Building designers are only beginning to recognize and acknowledge the needs of these persons. Persons with perceptual and cognitive impairments need to know where they are and how to reach a desired destination quickly and safely; and how to obtain needed information.

The guidelines in this report are an attempt to present solutions to information problems and to make travel more accessible. Solutions to information problems are possible through: appropriate visual, auditory, tactile, and kinesthetic cues; speech, large print or Braille technologies; visual backup of auditory messages, assistive listening and telecommunications devices; simplification and standardization; and trained human resources.

Clear, simple designs and direct, universally accessible information systems are required to create an environment that meets the orientation and mobility needs of all travellers.

***Planning Guidelines***

The following are some suggestions on how to use these guidelines when planning and developing information systems *[adapted from Parks Canada, 1994, page 2]*:

1. Get advice and feedback from consumer organizations representing persons who have disabilities. Request input on the form and content of information system design. Consider establishing advisory committees, or review groups for specific tasks. Clarify expectations -- conflict and compromise will likely be part of the process.

2. Try to improve and adapt existing systems before considering the creation of separate systems. Persons who have disabilities don't want to be segregated, nor do they want unnecessary attention brought to their disabilities.

3. If a new information system is being created, try to make it effective for all travellers, not only for those who have disabilities. Look for the most effective method to reach the greatest number of travellers, and make the best use of available resources. For example, visual paging monitors are appreciated not only by persons with hearing impairments but also by other travellers.

4. Continual evaluation is a necessity. It should begin when an information system is being planned, and it should

continue when the system is being operated to determine its impact and effectiveness.

5. Once the information system is accessible, promote it through the media and presentations to key interest groups, as well as in all brochures and advertisements.

***Recommendations***

The following recommendations have resulted from the work done for this project:

- The guidelines should be used as a basis for the development of standards for accessible information systems.
- The guidelines should be disseminated with the express purpose of obtaining as much feedback and input as possible. This feedback should be applied to the development of future standards.

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# APPENDICES

# A. Annotated Bibliography

**Federal Identity Program (FIP)**
Treasury Board

This is the corporate identity program of the Government of Canada. The program's policy is issued by the Treasury Board (Chapter 470 of the Administrative Policy Manual). The applications of the Federal Identity Program (FIP) signage system are set out in the FIP Manual. The Treasury Board has published a Design Guide which is quite specific about the appearance of signs.

*Generally* all signs use helvetica medium letters, upper and lower case in white; dark grey (charcoal) backgrounds; and colour-coded shapes for symbol signs.

*Exterior signs* all have dark grey modular faces and supports. Various formats are used for combinations of message elements. They generally have the Federal symbol at the top left corner and multi-occupancy signs have the "Government of Canada" signature with building name or, the major federal tenants in the building are named. Other sign types feature organizational and branch titles with or without facility names. The lower band of each charcoal sign is a light grey module displaying the Canada wordmark.

*Interior Signs* use the same basic colours for operational signs as the exterior signs. 'Common-use' signs have white or black coloured letters and coloured backgrounds: red on white for messages prohibiting an action, white on black for those requiring obligatory action, black on yellow for those indicating caution, white on red for those indicating danger, and white on green for emergency-related messages. Symbol signs, when used, are a combination of colours and shapes (circles, triangles and squares, depending upon what the sign is saying).

**Reference:** Treasury Board of Canada. *Federal Identity Program (FIP) Manual*. Various volumes. Treasury Board of Canada Secretariat, Ottawa, Ontario. September 1987 to March 1990.

**Barrier-Free Design Standard (BFDS)**
Canadian Standards Association

This document (CAN/CSA-B651-M90) developed by Public Works Canada is an important reference work covering the whole subject of access to and use of buildings by physically disabled people.

It is primarily a technical standard for application to new and existing buildings. Departments having control and authority for real property should be consulted for application to specific buildings. The standard describes a level of access for a broad range of users including: people who use wheelchairs for mobility; persons with reduced hearing or seeing ability; persons with reduced stamina, strength, dexterity and speed, such as elderly people; ambulance attendants carrying stretchers; and able-bodied people. Access is provided so that public services and employee areas are accessible and safely usable to ensure equal access to employment opportunities. Design requirements and operational procedures related to life safety and building exits are also included.

This document is organized into three sections. The first part deals briefly with guidelines for the application of the standard. These are followed by technical design requirements outlining how areas and components are to be designed if they are provided in a facility. Appendices are included to provide additional information. Keywords: Barrier-Free Design, Buildings, Disabled, Handicapped, Offices, Accessibility.

**Reference:** Canadian Standards Association. *Barrier-Free Design: A National Standard for Canada*. CAN/ CSA-B651-M90. Canadian Standards Association, Toronto, Ontario. 1990.

**Signs and Symbols for the Occupational Environment**
Canadian Standards Association

CSA Standard CAN3-Z321, Signs and Symbols for the Occupational Environment, was prepared in response to a request made by the Canada Safety Council and supported by the Canadian Society of Safety Engineering. The Canada Safety Council, after a comprehensive study of signage systems used in Canada, concluded that standardization was required because of the proliferation of signs.

The Standard covers a classification of signs, general requirements, and graphic requirements of symbols, legends and the use of arrows.

During the development of this Standard, the Technical Committee took cognizance of existing Standards and practice in Canada and other countries. Principles established by TC 80 and TC 145 of the International Organization for Standardization (ISO) were adopted where possible.

This Standard was prepared by the CSA Technical Committee on Signs and Symbols for the Occupational Environment, under the jurisdiction of the CSA Standards Steering Committee on Occupational Protective Equipment and Products, and was formally approved by these Committees. It has been approved as a National Standard of Canada by the Standards Council of Canada.

**Reference:** Canadian Standards Association. *Signs and Symbols for the Occupational Environment*. CAN3-Z321-77. Canadian Standards Association (CSA), Toronto, Ontario. September 1977.

**1-2-3 Evaluation and Design Guide to Wayfinding**
Public Works Canada

This document, published by Public Works Canada, is a guideline to complement FIP specifications with respect to wayfinding problems in built settings. The *Guide* is divided into three sections:

*Part 1* introduces some of the more important principles of building evaluation, and defines what useful visitor information actually is. The information in Part 1 is general, and prepares the reader for the specifics contained in Part 2.

*Part 2* guides the reader through data gathering activities, noting that signs are just one aspect of the way that the building environment communicates with its visitors.

*Part 3* comprises two approaches to solving problems once they have been identified. There is a temporary, inexpensive solution and a longer-term, permanent and more costly solution. In environmental communications, however, permanency is a relative term because of the dynamics of the environment.

The Appendices contain definitions of terms used in the *Guide* and design intent drawings, diagrams that illustrate text, and other useful information.

**Reference:** Public Works Canada. *1-2-3 Evaluation and Design Guide to Wayfinding*. AES/SAG 1-4: 86-15. Architectural and Engineering Services, Public Works Canada, Ottawa, Ontario. January 1990.

**Airport Building Signs Manual**
Transport Canada

This manual, prepared by the Transport Canada Airports Authority Group, is designed to provide assistance to managers, planners, designers and consultants for the planning of new sign systems or the updating of existing systems. It prescribes standards, guidelines and accepted practices for the provision of an efficient airport sign system. The present technical standards presented in this manual are to be replaced by the barrier-free design standards CAN/CSA-B651-M90.

The manual states that standardization will reduce the cost in contrast to specially designed systems. Standardization will also ensure the familiarization that the use of the pictographs requires.

The manual relates to those airport signs inside or attached to buildings, and site identification signs. For road and traffic signs, the reader is referred to *Manual of Uniform Traffic Control Devices*. For runway and taxiway signs, reference is made to *Airport Operational Guidance Signs*.

This document covers all aspects of: implementing sign systems, sign standards and construction, interior building signs, exterior signs, and signs for airlines and concessions, security check-in and advertising. Examples and specifications are provided for all pictographs.

**Reference:** Transport Canada. *Airport Building Signs Manual*. TP130. Airport Authority Group, Transport Canada, Ottawa, Ontario. November 1986.

**Graphics Standards Manual**
Marine Atlantic

This manual developed by Marine Atlantic is a revised and condensed version of the former *Graphic Standards Manual*. It provides the basic rules on all aspects of the visual identity program of the company. It is noted that only through scrupulous and consistent application of those rules that the organization can establish a strong visual image. The manual is divided into four sections:

*Basic Elements* deals with the basic elements of the visual identity program. They are: the symbol, the signature, typography and corporate colours.

*Stationery and Forms* are the elementary vehicle of Marine Atlantic's corporate identity. This section provides the general norms established to project a uniform and consistent visual image through all corporate printed material.

*Vessels and Vehicles* have distinctive corporate graphics applied to make them easily identifiable. This section deals with the application of the logo and corporate colours to the vessels.

*Signage and Buildings* is recognized as a significant component of Marine Atlantic's corporate identity program and it is noted that signs are the primary means used to inform and direct the people using the transportation services.

**Reference:** Marine Atlantic. *Marine Atlantic Graphic Standards Manual*. Marine Atlantic, Moncton, New Brunswick. 1991.

**International Signs to Provide Guidance**
International Civil Aviation Organization

In 1970 the Council of ICAO published a set of standard signs to facilitate the efficient use of airport terminals by travellers and other users. The Council's decision to promote the uniform adoption of certain graphic symbols for easy location of the more commonly used facilities and services in terminal buildings was taken to provide guidance to the many airport authorities faced with increasing congestion in terminal buildings and having to modify or extend their facilities.

After more than ten years of use and experience the signs were reviewed by ICAO and, as a result, certain modifications, deletions and additions were made. The new or revised signs provided in this 1984 guide, *International Signs to Provide Guidance to Persons at Airports*, are intended for introduction at airport passenger terminals.

The report outlines the general principles concerning the use of signs and gives examples of international signs designed to provide guidance to persons at airports.

**Reference:** International Civil Aviation Organization. *International Signs to Provide Guidance to Persons at Airports (Doc 9430-C/1080)*. Published by the International Civil Aviation Organization, Montreal, Quebec. 1984.

**Specification for Public Information Symbols**
International Organization for Standardization

This International Standard (ISO 7001: 1990) specifies the image content of graphical symbols used for the information of the public. The fields of application specified for each graphical symbol are indicative of the way it is intended that the symbols should be used; their application may be extended into other fields where this is considered appropriate.

The reason for the publication of this International Standard is the increasing use of non-verbal presentation of information in places, buildings and printed materials used by the public. Graphical symbols should be used where verbal messages might be a barrier to understanding.

ISO 9816 specifies procedures for the development and testing of public information symbols. Owing to cultural and technological differences between countries, it has been decided to standardize only the image content of the graphical symbols, not the graphical images themselves. For each of the image contents included in this International Standard, the details are specified on a single sheet. Each single sheet also contains a guideline example which conforms to the standard image content. The guideline examples are not binding, but their use is encouraged.

ISO/TR 7239 specifies a number of definitions and principles concerning the development and application of public information symbols, and should be used as a guide to the application of this International Standard.

**Reference:** International Organization for Standardization. *Specification for Public Information Symbols (ISO 7001:1990)*. Published by the British Standards Institution as BS 6034:1990 (which is identical to ISO 7001:1990), London, U.K. July 1990.

**Design Guidelines for Visually Impaired Travellers**
Canadian National Institute for the Blind

This report presents design recommendations and guidelines for meeting the access needs of blind and visually impaired travellers in transportation terminals. It describes how blind and visually impaired persons orient themselves and move through an environment. The report reveals various problems faced by visually impaired persons in travelling unassisted from place to place.

Orientation and mobility are defined vis-a-vis how blind and visually impaired persons travel. The use of mobility aids (guide dog, white cane, electronic devices, etc.) and of sensory information (visual, tactual and auditory) to effect safe and graceful travel through an environment is described and discussed.

Specific design recommendations for many architectural elements of transportation terminals are presented, including recommendations with respect to signage and symbols.

**Reference:** Canadian National Institute for the Blind. *Design Guidelines for Meeting the Access Needs of Blind and Visually Impaired Travellers in Transportation Terminals*. TP 10067E. Prepared by the Canadian National Institute for the Blind for the Transportation Development Centre, Transport Canada, Montreal, Quebec. December 1989.

**Real-Time Passenger Information**
London Underground Limited

This report details the customer information needs for a specific transit system. Real-time information systems for terminals and in vehicles are discussed in depth. As part of the discussion, the seven audiences which must be served are identified as people on the train, platform, station, line, system, or feeder, and at home. Many different information categories were proposed. The emphasis is what information to display, where to display it, and when to display it.

**Reference:** Anderson, T.N.D., *Real-Time Passenger Information for Transit Systems, Proposals for the Jubilee Extension Line.* London Underground Limited, London, England. September 1993.

**Evaluating the User Interface**
Ergo Systems Canada Inc.

This report is very well focused on the needs of people with disabilities when travelling. Test subjects were observed while using transit systems in simulated conditions. From this testing and research, specific recommendations were developed pertaining to the presentation and content of transit information systems.

**Reference:** Arnold, A.K., U. Wallersteiner, P. Ingelman, T. Geehan, R. Dewar. *Evaluating the User Interface of Information and Communication Systems for Travellers with Sensory and Cognitive Disabilities On-Board Transportation Vehicles*. TP 11582E. Prepared by Ergo Systems Canada Inc. for the Transportation Development Centre, Policy and Coordination, Transport Canada, Montreal, Quebec, Canada. March 1993.

**Smart Traveller System**
U.S. Department of Transportation

This report describes how audiotex and videotex systems can be used to develop more interest in public transportation. The report also discusses how the new system can be integrated with conventional transit, paratransit and ridesharing modes. The outcome will be the reduction of traffic congestion, gasoline consumption, air pollution and mobility problems at a low cost to taxpayers. The report also describes how telephone-based information services can be used to develop low-cost, user-friendly Advanced Traveller Information Systems that will tell drivers and riders the "best" ways to travel between any two points in an area via private vehicle or public transportation. The proposed California Smart Traveller System will enable travellers to obtain more timely and accurate information on which to base their local or regional travel decisions.

**Reference:** Behnke, Robert W. *California Smart Traveller System*. DOT-92-16. Technology Sharing Program, U.S. Department of Transportation, Washington, D.C. February 1991.

**Map and Timetable Design**
Kennedy Center

For this report, a group of cognitively impaired people were surveyed regarding the ease of readability and understanding of transit system maps and timetables. From observations made during the testing, recommendations were developed to aid designers of customer information materials. Recommendations include the use of print type, colour, symbols and language. These recommendations are also applicable for electronic information systems.

**Reference:** Bloch, W., R. Hoyt. *Modifications Menu for System-Wide Map and Timetable Design.* Kennedy Center, Inc., Bridgeport, Connecticut. February 1992.

**Guidelines for Transit Accessibility**
Batelle Institute

This report examines barriers facing persons with sensory and cognitive impairments, and persons who are semi-ambulatory, in public transit. A large matrix lists the transit skills necessary to use the bus system, and suggests techniques to improve transit accessibility generally, as well as for persons with visual, hearing and cognitive impairments. For persons with cognitive impairments, most of the recommendations were for simple, standard signage and training. Other techniques suggested included cooperative training of transit personnel with advocacy groups and community agencies serving people with cognitive impairments; transit information in accessible formats (computer electronic bulletin boards, automated telephone information systems and fax machines); and standardization (bus stop signs, architectural design, lighting, emergency alarm systems, electronic signs, icons and colour coding and priority seating identification).

**Reference:** Coburn, N., C. Martin, R. Thompson, D. Norstrom. *Guidelines for Improvements to Transit Accessibility for Persons with Disabilities.* DOT-T-93-04. Prepared by Batelle for the Federal Transit Administration, Washington, D.C. September 1992.

**Handbook for Transit Accessibility**
Crain-Revis Associates Inc.

This report discusses information dissemination concepts for persons with visual impairments, including auditory mapping, talking signs, audible street crossing devices, tactile mapping, textured surfaces, Braille schedule information, and tape recorded transit information. Teletype or TTY systems and a Bart's Handbook for Communicating with hearing impaired persons are also discussed. The names of companies that manufacture the products and some of the agencies that have used them are listed.

**Reference:** Crain-Revis Associates Inc. and the Washington Consulting Group. *A Handbook Describing Low Cost Concepts and Techniques to Make Public Transportation More Accessible for Visually & Hearing Impaired Persons.* U.S. Department of Transportation, Urban Mass Transportation Administration, Washington, D.C. April 1982.

**Assessment of Advanced Technologies**
Castle Rock Consultants

This report describes advanced traveller information systems currently in use or being developed. Included is mention of systems in use in Japan, including the "RACS" system for in-terminal information, and the "MARIA" (Mitsubishi Advanced Real-time Information Autosystem) system for in-vehicle information. Technologies in the areas of traveller information systems, traffic management systems, fleet management and control systems and automatic vehicle control systems are reviewed. Within these areas, developments in the United States, Europe and Japan are considered. Qualitative and quantitative assessments of the technologies are provided. Assessment frameworks are established to provide comparisons of system benefits and costs.

**Reference:** Davies, P., C. Hill, N. Emmott, J. Siviter. *Assessment of Advanced Technologies for Transit and Rideshare Applications.* NRC Project 60-1A. Prepared by Castle Rock Consultants for the National Cooperative Transit Research and Development Program, Transportation Research Board, Washington, D.C. July 1991.

**Intercity Travel and the Deaf**
Behavioural Team

This report presents an analysis of Canadian intercity transportation facilities and their accessibility to travellers with deaf and hearing impairments. It places particular emphasis on both physical design of facilities and availability of assistive devices. Data was collected through: 1) personal visits to and observations of airports, train stations and bus and ferry terminals across Canada, and 2) a mail-out survey to deaf and hearing impaired individuals across the country. The primary goal of this survey was the identification of specific problems encountered in travel, as well as a general overview of accessibility. Recommendations are made for improvements to transportation facilities as well as for further research and development to benefit persons with hearing impairments.

**Reference:** Fitzpatrick, M.E., B. Barkow, J. Beattie. *Intercity Travel and the Deaf and Hard of Hearing Traveller: An Analysis of the Current State of Accessibility.* TP 9839E. Prepared by Behavioural Team for the Transportation Development Centre, Transport Canada. September 1989.

**Improving Displays for Blind Passengers**
Royal National Institute for the Blind

These proceedings discuss transport accessibility for people with disabilities. The importance of clear signage and visual displays is stressed. Practices which lead to clear visual information are discussed as they pertain to new types of visual displays. A transit user who is visually impaired comments on the readability of various displays currently in use in London.

**Reference:** Harris, D., G. Whitney. *Proceedings of the First Conference on: Improving Signs and Displays for Blind and Partially Sighted Passengers.* Held at the Royal National Institute for the Blind, London, England. December 9, 1993.

**Guide to Assisting Travellers with Disabilities**
Hickling Partners Inc.

The transportation industry is recognizing a need to ensure that employees meeting the public are prepared to provide sensitive and effective service to passengers with special needs. This resource handbook summarizes the information that should be understood by individuals providing service to travellers with special needs. The reader is taught how to recognize, understand and assist travellers who fall within five functional disability groups. Trainers in the transportation industry can use this document in training programs on how to assist disabled travellers. This excellent resource should be used when training persons who work with the general public.

**Reference:** Hickling Partners Inc. *A Guide to Recognizing and Assisting Travellers with Disabilities.* TP 3461. Prepared by Hickling Partners Inc. for Transport Canada, Ottawa, Ontario. March 1983.

**Improving Bus Accessibility**
Federal Transit Administration

Discusses the needs of impaired travellers and points out measures which would help them use transit systems. Describes what constitutes a sensory or cognitive impairment. The conclusions drawn include the need for personal interaction and training for people with cognitive impairments rather than trying to help them with technical devices. Regarding signage, both fixed and electronic, the need for standardization is stressed. This report points out that technologies and policies to help travellers with visual or hearing impairments are currently available, but relatively little attention has been given to people who are cognitively impaired. It provides good background information on the needs of impaired travellers.

**Reference:** Hunter-Zaworski, Hron. *Improving Bus Accessibility Systems for Persons with Sensory and Cognitive Impairments.* NTIS FTA-OR-11-0007-93-1. Prepared for the Federal Transit Administration, Washington, D.C. August 1993.

**Signage for the Blind**
Smith-Kettlewell Eye Research Institute

Talking signs do for print-disabled persons what printed signs do for those able to read them. They are small, inexpensive voice-modulated infrared transmitters whose message is heard by means of a receiver which speaks the sign messages and indicates the direction of their source. The receiver uses a sensitive light detector-demodulator with a speaker to say the message. It is small enough to be carried in a pocket, loud enough to be understood, rugged, dependable (with occasional battery changes) and inexpensive.

**Reference:** Love, Bill. *Signage for the Blind.* Prepared by InfoGrip Inc. for the Smith-Kettlewell Eye Research Institute, San Francisco, California. 1989.

**Travellers with Cognitive or Emotional Disabilities**
Behavioural Team

This report presents an analysis of difficulties created by cognitive or emotional disabilities in the use of Canadian public transportation. Included in this study is the purpose and use of the appropriate terminology, classification of mental disability, and an analysis of Canadian legal issues. Recommendations are provided for personnel training, user training, improvements in procedures operation and information design, technology and facilities for terminals and further exploratory research.

**Reference:** McInerney, P., S. Stein, B. Barkow, S. Wiseman. *Flight 201 Has Been Changed to Gate 102: Challenges Experienced by Travellers with Cognitive or Emotional Disabilities.* TP 10450E. Prepared by the Behavioural Team for the Transportation Development Centre, Transport Canada, Montreal, Quebec. June 1990.

**Variable Message Signs**
Transportation Research Board

The objective of this study was to evaluate three different technologies for variable message signs in terms of target value (distance at which the sign is first noticed), legibility and viewing comfort. The three technologies evaluated were flip disk, light emitting diode (LED) and fiber optic. Two groups of observers (young and old) were tested by having them ride in an automobile while observing the signs placed overhead along the freeway. Their ability to see and read the signs in varying light conditions was observed and recorded. The fiber optic signs were the most readable, followed by the LED and then the flip disk signs.

**Reference:** Upchurch, J., H. Baaj, J. Armstrong, G. Thomas. *Evaluation of Variable Message Signs: Target Value, Legibility and Viewing Comfort.* Presentation at the 1992 Transportation Research Board Meeting. January 1992.

**Blind and Visually Impaired Travellers**
American Foundation for the Blind

Light rail and bus travel issues and concerns are discussed, with an overview of how mass transit affects persons with blind and visual impairments and of technological innovation that assists with light rail and bus travel. Approaches and techniques that have been recently developed for orientation and mobility training are also included.

**Reference:** Uslan, M.M., A.F. Peck, W.R. Wiener and A. Stern. *Access to Mass Transit for Blind and Visually Impaired Travellers.* American Foundation for the Blind, New York, New York. 1990.

# B. Glossary of Terminology

**Ambient light** -- spill from existing light sources.

**Audible Information** -- information that is perceived through one's sense of hearing.

**Auditory Map** -- Oral description of a building layout or complex space provided in the interests of orientation. Also referred to as a *verbal* or *spoken* map.

**Application** -- The act of applying the design standards or general rules of the FIP to an object (e.g. a sign or a vehicle).

**Applied Title** -- The approved name used in the signature to identify an organization, program or activity.

**Blade** -- Modular component of a signface.

**Border** -- The white area at the perimeter of a symbol.

**Braille** -- A method of writing words by means of dots, for the use of blind persons. Dots are arranged in *cells* and are raised. Each cell is an arrangement of dots within a six-dot matrix and represents a word or a sound. They are read by touch.

**Brightness differential** -- means whereby the suitability of the two colours used in a sign (one for the background, the other for the message) may be determined.

**Building Directory** -- Information, usually typographic in nature, providing the names of the tenants in a building.

**Cap-Height** -- vertical distance occupied by a capital or upper-case letter.

**Capital Letters** -- upper-case letters (as distinct from lower-case).

**Character** -- a symbol or mark used in a writing system, such as a letter of the alphabet.

**Cognition** -- understanding; a generic term that includes retaining, structuring and manipulating information.

**Cognitive Map** -- an overall mental representation of a setting that cannot be grasped from a single viewpoint but must be integrated from different vistas.

**Colours** -- The distinctive hues associated with each type of symbol.

**Colour Coding** -- the use of a limited number of nameable colours for the purposes of visual orientation or direction.

**Colour Deficiency** -- Inability to distinguish between certain colours.

**Common-Use Sign** -- Any sign with a message related to the facility itself. This type of sign remains valid regardless of changes in the facility's occupants (e.g. a directory board or a sign relating to fire safety, or signs identifying rooms).

**Decision diagram** -- a diagram of a decision plan, used for design or research purposes.

**Design Standard** -- The approved rules on the use of design elements (as outlined in the FIP policy for most government departments). They prescribe elements such as shape, size, layout, colour, typography, and use of symbols.

**Direction** -- one of the basic information types in environmental communications.

**Disability** -- In the context of health experience, a disability is any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being.

**Dynamic Signage System** -- Interactive signage system, as distinct from a passive signage system.

**Environmental Communication(s)** -- Transfer of orientation, wayfinding, and other information within the built environment, by means of signs and other communications devices or architectural features to enable people to reach destinations.

**Federal Identity Program (FIP)** -- The means whereby the Government of Canada visually identifies its facilities and its presence.

**Field of Application** -- The gamut of items that bear the identifying elements of FIP, e.g. stationery, vehicles, signs.

**FIP Signage** -- Primary identification signs; common-use signs; operational signs; and project signs. (Excluded are signs that are subject to a regulation which specifies their design.)

**Floor Directory** -- Information, usually typographic in nature, providing the names of departments or services on that floor and directions thereto.

**Flush (left or right)** -- The lateral position of a word or message, left or right, within the viewing area; as distinct from centred.

**Glare** -- Undesirable degree of sheen reflected off the surface of a sign causing deterioration of legibility.

**Glyph** -- An abstract conceptual or object-related (i.e. pictorial) representation.

**Guidelines** -- Instructions which, while not mandatory, should be followed unless there is good reason not to do so. While valid reasons for non-compliance must be documented, prior Treasury Board approval is not required.

**Halation** -- irradiation; the visual effect resulting when a light image (or letter) is set in a darker field, causing an apparent increase in its size.

**Haptic** -- pertaining to the sense of touch.

**Helvetica Medium** -- Currently the most popular letterform with application to signage and the one selected by FIP for use in federal government buildings.

**Image** -- a physical or mental representation; as a mental representation it can refer to a particular view or an object or an overall view of a large setting (cognitive map).

**Inductive Loop** -- specialized sound system in which insulated wire placed in a room transmits an electrical current, setting up a magnetic field that is in turn reconverted into sound by a receiver; the receiver can consist of a hearing aid with a "T" switch.

**Infobands** -- horizontal zones cut through a setting and reserved for the display of wayfinding information.

**Infrared system** -- specialized sound system that converts sound into infrared light; the light is reconverted into sound by a portable receiver.

**Interactive** -- Capable of being interrogated; a device used in environmental communications that can, on demand, produce information specific to a user's needs, generally through presentation on a video screen and/or through a telecommunications connection.

**Legend** -- A written verbal message that is used in combination with a symbol to reinforce its meaning, or to communicate a message that cannot be expressed by a symbol; specifically relates also to die-cut vinyl letters or images.

**Legibility** -- Qualities of a sign that determine how easily the viewer can 'read' or discern the message.

**Lower Case** -- Letters that are not CAPITALS.

**Mobility** -- Ability to move about or travel safely, comfortably and independently.

**Non-Verbal Communication** -- One which relies upon symbols or pictographs for its meaning.

**Official Languages Act** -- Makes provision for the use of English and French (the 'official' languages of Canada) and determines the form to be used in their display.

**Operational Sign** -- Any sign with a message related solely to the operational needs of, and hence the responsibility of, the occupant organization. This type of sign is normally located within the space the organization occupies.

**Pictographs** -- Glyphs or symbols incorporated into a sign; hence pictographic to denote a non-verbal sign.

**Primary Identification Sign** -- The first sign bearing the federal signature and the wordmark and identifying a federal facility.

**Project Sign** -- A sign that provides information about federal programs or projects, e.g. public works, employment programs, or housing.

**Readability** -- Qualities of a sign that allow the viewer to comprehend or understand the message displayed; compare to legibility.

**Referent** -- The functional concept that the symbol stands for.

**Sanserif** -- Letterforms without serifs (or *feet*).

**Serif** -- *Feet* of a letter: short cross-lines at terminals of letters classified in this way (as distinct from *sanserif*).

**Shape** -- The outer geometrical configuration of a symbol.

**Sign** -- An entire visual communication device. *Information sign* means a sign denoting the location of (or direction to) an object or facility, or a sign denoting a permissive action. *Regulatory sign* means a sign denoting an order. *Warning sign* means a sign denoting the presence of a hazard.

**Signature** -- A combination of a symbol and a title.

**Signface** -- Reading area of a sign on which are displayed its legends and symbols.

**Special Symbol** -- A graphic device, other than the Coat of Arms, the flag symbol, the "Canada" wordmark and the federal emblem, intended to identify systematically a project, program, service, activity or product of the government. Some examples of special symbols are logotypes, marks or badges.

**Symbol** -- Glyphs or pictographs are pictorial representations used in signs to constitute a non-verbal means of conveying information. Such signs are called symbol signs and they consist of a border, colours, a glyph, and a shape.

**Symbol of Access** -- Sign that represents to a person in a wheelchair that the area next to which it is displayed is accessible, and generally that the building's facilities are similarly accessible.

**Tactile or Tactual** -- What can be physically felt, generally with fingers.

**Tactile Signs** -- Signs with raised letters that are interpreted or read by tracing with fingers over the surfaces. Letters are raised 1 mm.

**Telecommunications Device for the Hearing- and Speech-Impaired (TDD)** -- Device which enables visual typographical messages to be transmitted and received over telephone lines between one user and another.

**Texture** -- extent to which essential differences in the constituent parts of a material, object or background can be discerned visually, audibly or tactually.

**"T" Switch** -- Switch in a hearing aid that enhances a hearing impaired person's ability to use a telephone.

**Understandability** -- The extent to which the contents of a sign message are understood by the viewer.

**Verbal Message** -- One which relies upon words (spoken or typographic) for its meaning.

**Visibility** -- The quality of a sign that makes it separately visible from its background (conspicuity, detectability).

**Visual Communication** -- information that is perceived through the sense of sight.

**Wayfinding** -- Ability of a traveller to arrive with ease at his or her destination.

# C. Information Checklist

The key to making information accessible is to be sensitive to everyone's needs.

It is also important to ask the right questions. The information checklist provided on the following pages will help the user to ask the right questions and to rate information for ease of access.

The greatest value of the checklist is to heighten awareness of the issues so that ease of access becomes part of everyone's thinking.

Remember that it's not just a case of how easy the information is to use for people who use wheelchairs or people who are deaf or blind -- but how easy is it for everyone.

## *Outside the Terminal*

| Checklist Yes | No | | References CAN/CSA B651-95 | ADA Regulations |
|---|---|---|---|---|
| ❑ | ❑ | An accessible route from the parking lot, street, sidewalk and passenger loading zone to the terminal. | 4.1 | 4.3.2 |
| ❑ | ❑ | Accessible walks with a minimum width of 920 mm and a maximum slope of 1:20. | 4.1.1 | 4.3.2 |
| ❑ | ❑ | Accessible paths with a stable, firm and slip-resistant surface. Transitions or level changes flush whenever possible and no greater than 125 mm in height. | 3.3.2 | 4.5.2 |
| ❑ | ❑ | Entrance site and routes to major entrances and parking clearly indicated with directional signs. | 7.4.3 | |
| ❑ | ❑ | A canopy, porte-cochere or overhang at passenger loading zones at major entrances with a minimum height of 2.9 m. | RECOMMENDATION | 4.6.5 |
| ❑ | ❑ | External graphics and signing -- embossed/tactile, good colour definition, large lettering. | 6.4.1 | 4.30.5 |
| ❑ | ❑ | Sufficient, well positioned lighting. Minimum 10 lux on walks is recommended for safety and security. Lighting controlled and aimed to reduce glare. | RECOMMENDATION | |
| ❑ | ❑ | Easy to understand car park entry equipment, help button, easy ticket pull, intercom. | 3.2.3 | |
| ❑ | ❑ | Controls and operating mechanisms illuminated to at least a level of 100 lux. | 3.2.4 | |
| ❑ | ❑ | Appropriately signed disabled parking spaces close to terminal/payment areas, at ground and access levels. | 7.4.1 | 4.6.2 |
| ❑ | ❑ | Marked pavement crossings with dropped curbs or raised crossings (with colour differentiation). | 4.4.1 | 4.7.1 |
| ❑ | ❑ | Contrasting colours and changes in the texture of paving materials to define edges of walks and highlight interfaces with vehicular traffic. Tactile pavements at pedestrian crossings. | RECOMMENDATION | |

## *Outside the Terminal (cont'd)*

| Checklist Yes | No | | References CAN/CSA B651-95 | ADA Regulations |
|---|---|---|---|---|
| ❑ | ❑ | Detectable warning surfaces with raised truncated domes with a diameter of 23 mm, a height of 5 mm, and centre-to-centre spacing of 66 mm. | 6.5 | 4.29.2 |
| ❑ | ❑ | Pavement obstacles protected or colour contrasted. | 3.4.3 | |
| ❑ | ❑ | Visible and colour contrasted handrails on both sides of ramps or staircases. | 4.5.4 | 4.8.5 |
| ❑ | ❑ | No gaps beneath balustrades in stairwells. | 4.5.1 | |
| ❑ | ❑ | Minimum clearance of 1980 mm above ground and/or protection of overhead features. | 3.4.5 | 4.4 |

## *Inside the Terminal*

| Checklist Yes | No | | References CAN/CSA B651-95 | ADA Regulations |
|---|---|---|---|---|
| ❑ | ❑ | At least one door at each accessible entrance meeting the minimum requirements for width, operating force and maneouvring clearances. | 4.2.3 | 4.13.6 |
| ❑ | ❑ | Accessible automatic doors at major entrances that require at least 3 seconds to open and a maximum force of 66 N to stop. | 4.2.8 | 4.13.12 |
| ❑ | ❑ | Glass doors and glazing marked at 0.8 m and 1.6 m above the floor level. | RECOMMENDATION | |
| ❑ | ❑ | Sufficient, well positioned lighting. | 3.2.4 | |
| ❑ | ❑ | Information in as many languages as possible (language barriers present a serious obstacle to accessibility). | RECOMMENDATION | |
| ❑ | ❑ | Sufficient and adequate signage (static and active) for information (instructions, location, direction, procedures, etc.). | 6.4.1 | 4.30.5 |

## *Inside the Terminal (cont'd)*

| Checklist Yes | No | | References CAN/CSA B651-95 | ADA Regulations |
|---|---|---|---|---|
| ❑ | ❑ | Real time status information and communciations (especially with respect to delays, difficulties, etc.) | RECOMMENDATION | |
| ❑ | ❑ | If an audio-amplification systems is provided, a listening system (induction loop, FM radio, or infrared system) should be provided. | 6.3 | 4.33 |
| ❑ | ❑ | Visual paging systems with large screen or television monitors to supplement public address system. | RECOMMENDATION | |
| ❑ | ❑ | Simple, reliable, back-up communication devices (e.g. message cards, paper and pencil, etc.). | RECOMMENDATION | |
| ❑ | ❑ | Letter size, background, etc., responsive to human requirements. | 6.4.1 | 4.30.3 |
| ❑ | ❑ | Tactile signs on latch-side of doorways. | 6.4.4 | 4.30.3 |
| ❑ | ❑ | Tonal contrast on flight information systems with alternating bands of black and blue colour. | RECOMMENDATION | |
| ❑ | ❑ | No slippery or highly reflective floors. | 3.3.1 | |
| ❑ | ❑ | Carpet and all edges firmly attached to floor with trim on all edges and bevelled to a slope less than 1:2. | 3.3.3 | 4.5.3 |
| ❑ | ❑ | Use of colour and contrast to define pedestrian routes/building structure (handrails, carpets, columns, level changes). | RECOMMENDATION | |
| ❑ | ❑ | Colour contrast between doors and surrounds. | RECOMMENDATION | |
| ❑ | ❑ | Contrasting nosings on stair treads, straight flights of stairs. Stair lighting to minimize glare and shadows. | 4.5.1 | |
| ❑ | ❑ | Handrails that meet the requirements on all stairs. | 4.6.1 | 4.9.4 |
| ❑ | ❑ | 'Halo' light when elevator call button activated with an indication of the direction. | E14.2 | 4.10.3 |
| ❑ | ❑ | Indicator lights with both a visual and an audible signal (with standard tones -- two for down, one for up) that the call is being answered. | E9.1 | 4.10.4 |

## *Inside the Terminal (cont'd)*

| Checklist Yes | No | | References CAN/CSA B651-95 | ADA Regulations |
|---|---|---|---|---|
| ❑ | ❑ | Elevator control buttons below 1.4 m. with floor designations provided in Braille and tactile letters immediately left of the button. | E8.3 | 4.10.5 |
| ❑ | ❑ | Embossed (not engraved) lettering for elevator control buttons. | E8.4 | 4.10.12 |
| ❑ | ❑ | Separate and aligned emergency buttons grouped at the bottom of the control panel. Emergency intercom/phone in elevators. | E8.2 | 4.10.12 |
| ❑ | ❑ | An audible elevator position signal sounding at least 20 decibels, with a frequency no higher than 1500 Hz, or an automatic verbal announcment. | C2.1 | 4.10.13 |
| ❑ | ❑ | Emergency intercom/phone in elevators. | RECOMMENDATION | 4.10.14 |
| ❑ | ❑ | Appropriate handrails in passenger elevators with rounded or smoothly returned ends. | E12.1 | 4.8.5 |
| ❑ | ❑ | Low level check-in/information desks. | RECOMMENDATION | 7.2 |
| ❑ | ❑ | Baggage cart storage clear of main routes. | RECOMMENDATION | |
| ❑ | ❑ | Colour contrast between furniture and flooring. | RECOMMENDATION | |
| ❑ | ❑ | Telephones and information kiosks not near or under sources of noise (especially public address system). | RECOMMENDATION | |
| ❑ | ❑ | Properly signed low level telephones, with inductive couplers and push-button volume controls. | 6.2.7 | 4.31.5 |
| ❑ | ❑ | Text payphones in public areas. | 6.2.6 | 4.1.3 |
| ❑ | ❑ | Tactile (embossed) signs on toilet doors, etc. | 6.4.4 | |
| ❑ | ❑ | Audible emergency warning alarms with a sound that is louder than the surrounding sound level by at least 15 dbA, for a duration of 60 seconds. | RECOMMENDATION | 4.28.2 |
| ❑ | ❑ | In areas of common use, visual alarm indicators with a pulse duration of 0.2 seconds, a light intensity of 75 candela and a flash rate of 3 hz. | 10.1.4 | 4.28.2 |

## *Onboard the Vehicle*

| Checklist Yes | No | | References CAN/CSA B651-95 | ADA Regulations |
|---|---|---|---|---|
| ❑ | ❑ | Sufficient, well-positioned lighting. | RECOMMENDATION | |
| ❑ | ❑ | Information in as many languages as possible (language barriers present a serious obstacle to accessibility). | RECOMMENDATION | |
| ❑ | ❑ | Sufficient and adequate signage (static and active) for information (instructions, location, direction, procedures, etc.). | RECOMMENDATION | |
| ❑ | ❑ | Real time status information and communciations (especially with respect to delays, difficulties, etc.). | RECOMMENDATION | |
| ❑ | ❑ | Simple, reliable back-up communication devices (e.g. message cards, paper and pencil, etc.). | RECOMMENDATION | |
| ❑ | ❑ | Letter size, background, etc., responsive to human requirements. | RECOMMENDATION | |
| ❑ | ❑ | Tonal contrast on flight information systems. | RECOMMENDATION | |
| ❑ | ❑ | Colour contrast between doors and surrounds. | RECOMMENDATION | |
| ❑ | ❑ | Tactile (embossed) signs on toilet doors, etc. | RECOMMENDATION | |