The University of Calgary

Breaking Down the Barriers:
Making National Hockey League Arenas More Accessible

Linda May Cunningham

Master's Degree Project (MDP)

Submitted to the Faculty of Environmental Design
in partial fulfillment of the requirements for the degree of
Master of Environmental Design (Environmental Design)

Calgary, Alberta

June, 2000

0-612-66981-5

ACKNOWLEDGEMENTS

This Masters Design Project would not have been possible without the unconditional support and encouragement of:
Fredrick A. Grosby, Richard M. Levy, Tang G. Lee, Ann Davis, Ron Wardell, Mary-Ellen E. Tyler, R. Douglas Gillmor, Brian P. Kooyman, Patricia M. Ruby, Edward C. Samson, William N. Porochnuk Jr., Myrna J. Riches, Marino Vardabasso, Aldona Jaworska, Michael J. McMordie, Richard D. Revel, Norman R. Ball, Michael Edwardes, the management and staff of the Grad Lounge, and Malcolm J. Sword.

The author also wishes to thank:
The University of Calgary's Faculty of Environmental Design for a Graduate Research Scholarship to fund the site visits conducted with respect to this work; Almira Chow (General Motors Place, Vancouver), Peter Hanlon (Canadian Airlines Saddledome, Calgary), Craig Tkachuk (Skyreach Centre, Edmonton), Ken Dryden and Karen Petcoff (Air Canada Centre, Toronto), and Cathy Deogrades (Corel Centre, Kanata) for being generous and gracious hosts; and Howard Shubert (Canadian Centre for Architecture, Montréal) for sharing his time, enthusiasm, humour, and work on the history of hockey arenas.

Table of Contents

List of Tables

List of Figures

Breaking Down the Barriers:
Making National Hockey League Arenas More Accessible

Submitted to the Faculty of Environmental Design in partial fulfilment of the requirements for the degree of Master of Environmental Design (Environmental Design)

Supervisor: Tang G. Lee

Abstract

This Masters Design Project examines the specific needs of hearing- and visual-impaired patrons visiting National Hockey League arenas. After a description of the methodology used to conduct the research, as well as an exploration of post-occupancy evaluation and the history of the building form, the National Building Code of Canada is reviewed for its capacity to accommodate such visitors. An exploration of the visual and aural components (both in general, and with a specific set of interests) is described, with emphasis on a defined group of wayfinding tasks. After determining the lack of facilities, which poses hazards to all users, suggestions for improving the facilities, leglislative changes, and futher research projects are identified.

For my parents

1.0 Introduction

1.1 Background

Nearly one of every four persons in Canada and the United States has some form of visual or hearing impairment (Baucom, 1996); with the baby-boom generation quickly approaching retirement, this number will increase at an astronomical rate, because of the sheer physical degeneration of eyes and ears. This Masters Degree Project (MDP) explores, using the principles of post-occupancy evaluation, how the design of public buildings can be improved to facilitate their use by persons with reduced visual and hearing acuity (because of age, injury, or disease) by examining how National Hockey League (NHL) arenas perform in providing positive experiences to patrons with such constraints.

NHL arenas were chosen as the building paradigm to be examined because those in Canada form a sufficiently small sample to be examined (a total of six), and because they are large structures open to the general public, frequently financed by a combination of public and private monies, and used for a wide variety of spectator entertainment purposes (including such diverse events as circuses, tractor-pulls, rodeos, and trade exhibitions) that require an extensive and flexible range of solutions (Jewel, 1978; Petersen, 1996); a brief look at the history of hockey arenas is contained in Chapter 2.

Although there have been studies (Dagdelen Ast, 1977) done and legislative solutions (Jeffers, 1977) imposed regarding mobility constraints, regrettably, there has been little specific research into the needs or most effective solutions for persons with hearing and visual problems in public facilities, despite a growing emphasis on Universal Design[1] concepts (Mace, Hardie, and Place, 1991). Additionally, there is a public perception problem; "accessibility," to most people means "wheelchairs," with other physical incapacities, such as vision and hearing loss, discussed in glowing, but unsupported, generalities (Bednar, 1977).

While Parts 17 and 24 of the Canadian Human Rights Act provide minimal requirements to ensure that buildings offer accommodation to the mobility-impaired, and Section 3.8 of the National Building Code (NBC) and provincial building codes detail requirements for wheelchairs quite extensively, Canada does not have a direct equivalent of the Americans with Disabilities Act in the United States; Chapter 3 provides more detail about such legislative and other measures, including a look at non-binding international standards. Nevertheless, there seems to be a certain degree of "goodwill" on behalf of the six NHL arenas in Canada (Vancouver, Calgary, Edmonton, Toronto, Ottawa, and Montréal) to go beyond the strict national, provincial, and civic regulations and provide services to patrons who have less-than-perfect hearing and vision. That more extensive accommodations are not provided is likely due to a lack of extant research and an understanding of what is both desirable and useful.

Chapter 4 provides in-depth research material on the visual and audio aspects of the buildings that are the basis for the tasks undertaken, details and analyzes the

---

1 Universal Design is the current term that refers to architectural and interior designs that remove barriers that allow people with physical and mental impairments total access to buildings (Null and Cherry, 1996). It replaces "barrier-free design," which was the reference term for the removal of barriers that prevented persons with mobility restrictions specifically from using buildings (Bednar, 1977).

experiences obtained in the site visits (both in specific areas, as well as in tasks designed to test how well a patron can find their way), and draws a number of conclusions, while Chapter 5 provides a series of recommendations.

While this MDP explores the NHL arena as a building typology with respect to the specific issue raised, it does not explore other building-related concerns, including specific access requirements for physical mobility issues of persons who may or may not be confined to wheelchairs (including elevators); air-quality standards that can interfere with perception by reducing sensory acuity and imposing health risks and physical barriers; and a range of other diverse problems, including, but not limited to, the design and safety requirements (for both players and spectators) of safety glass, economic viability of the buildings, and diversity of tenants. Some of these concerns are explored in more detail in Chapter 6, which suggests directions for further study.

In an era when "bigger is better," and the financial reality of building and maintaining such facilities that demands an ever-increasing base of support from patrons, lessons learned from the strengths and weaknesses of the arenas visited can be applied to other large-scale public facilities.

1.2 Procedural Details

After a review of literature on post-occupancy evaluation, the planning and construction of arenas and associated infrastructure components, government legislation regarding the construction of facilities to better accommodate persons with hearing and sight impairments, and scientific research regarding human abilities in visual and aural perception, all six arenas used by Canadian teams were visited by the author, who has limited depth-of-field and other visual performance difficulties.

1.2.1 Post-Occupancy Evaluation

While the visits conducted with respect to this MDP would not meet strict guidelines for scientific research, they are both understandable and allowed in architectural performance reviews known as post-occupancy evaluation (POE).

A concerted effort to label and use POE as a tool began approximately thirty years ago (Marans and Spreckelmeyer, 1981) — although in one respect or another, has been around since building began (Becker, 1989) — and has all but disappeared from architectural literature within the last ten years. Part of the problem in the discontinuance of literature regarding the use of POE to analyze existing construction may have been because of the conflict between the architectural community, represented by Preiser (1989a), White (1991), and others, who feel that effective evaluation can only occur if the evaluation is systematic and rigorous, and the data organized and made available for future use, and the behavioural community, such as Sommer (1983), who are considerably more open-ended in both their questions and responses in forming opinions and recommendations. That POE can be used to effect social changes is discussed in Vischer (1991).

While each approach has its critics and supporters, this MDP draws from both in order to synthesize a more cohesive, interdisciplinary approach, in hopes of reviving both the interest and use of such evaluations both pre- and post-occupancy as a tool to improve the quality of life in buildings. As much as a doctor does not perform self-evaluations of his or her surgical procedures, it seems important to emphasize that the person least capable to evaluate a building is the architect who designed it, which tends to be the approach of the architectural community in their approach to POE, given the recent emphasis on reducing costs since the early 1990s.

Zeisel (1989) makes the case for an integrative approach, arguing that

> *(O)ur competition is not each other. It is the professional groups who believe that creating buildings is an end in itself, that intuitive building evaluation leading to personal insight is sufficient to complete the learning cycle, and that it makes little difference what methods are used to assess buildings because you can't really learn that much, anyway.*

However, as Yogi Berra once said (quoted in Zakia, 1994), "you can observe a lot by just looking around." The next section details how this advice was followed.

1.2.2 Data Collection and Analysis

Part of the attempt to "harmonize" both approaches to POE is evident in the method used to collect and analyze the data obtained during the site visits. The architectural approach is generally to examine the building in detail, using a form or checklist approach to evaluate a range of existing conditions; Gustafsson (1989) provides an excellent example of the creation and scoring of such a form. This example became the basis for the construction of the site evaluation form in Appendix 2, but included more subjective areas, such as "comfort level" of the evaluator, that are generally explored through the behavioural approach to POE.

Gustafsson was also faced having to set up a weighting system to evaluate his various points and discovered that an "'objective' distribution of weights" (such as described in Weaver, 1997) was difficult to achieve, so he let his evaluators agree on the weight distribution on a case-by-case basis, based on the psychophysics work originally developed by Stevens (1975) and refined by Kvålseth (1980). This method of data analysis was also adopted, albeit more simply, in this MDP.

While it could be reasonably argued that there could be some bias in the data collection and analysis work contained in this MDP because there is but one person performing a range of objective and subjective evaluations, this approach is not unique. Wilson (1997) performed his experiment to examine passing on two-lane highways in Canada by driving from Sudbury, ON to Victoria, BC, return, on a selection of highways, resulting in data collection along more than 4000 km of road. Chung and So (1997) used subjective comparison as a basis for research in measuring hearing, and Genaidy et al (2000) measured human expertise in evaluating manual lifting tasks. Moreover, any inherent bias from using one evaluator would be the same across the six arenas visited, if a concerted attempt was made by the evaluator to replicate physical conditions (i.e., wearing the same shoes would allow measuring relative differences in floor texture) for each venue.

In weighing the proper approach to data collection and analysis, cost was also a factor. Despite receiving funding from the faculty, the most cost-effective approach was to have one person visit all six arenas, as opposed to a range of subjects attending only one building, or being able to experience multiple buildings only via a virtual reality simulation.

Wang (2000) explored the benefits and problems of using such virtual reality (VR) simulations to test the perceptions of subjects in Light Rail Transit (LRT) stations by requiring subjects to navigate a situation that is not dissimilar to the wayfinding[2] tasks described herein. One problem he uncovered was that his sample pool was bias based on their previous experience with such computer simulations, and he found that while VR was a useful technique, it also suffered from a number of limitations, particularly in navigation, which forms a crucial part of this MDP. In testing his subjects by asking them to compare the usefulness of elevators, ramps, and signage to navigate a journey from one end of Calgary to the other he concluded that signage was the most effective in helping people find their way.

Additionally, the cost and time constraints also resulted in the evaluation of lighting or sound conditions for this MDP without employing mechanical measuring devices. While the lack of quantitative numbers may be questioned, the evaluator self-tested and standardized observations by utilizing both Dreyfuss' Environmental Tolerance Zone (as discussed in MacDonald, 2000) and Hunt's (2000) definition of "personal knowledge" to ensure as consistent a set of observations and reporting as possible.

1.2.3 Definition of "Site Visit"

The standard visit (conducted at Edmonton, Calgary, Ottawa, and Toronto) consisted of arriving at the venue several hours before the game, receiving a tour of

2 "Wayfinding" is defined as how people track where they are and how to get where they wish to go. The most comprehensive text on the topic is the classic *Wayfinding: People, Signs, and Architecture*, by Arthur and Passini (1992), and was first used by Kevin Lynch in 1960.

the facility with a member of the staff, asking a series of questions regarding items of specific interest to persons with visual and hearing impairments (Appendix 1).

The author then explored the facility alone, with camera and notebook, completing the site evaluation form, negotiating a series of simple tasks common to any patron attending a game (finding a specific seat, a concession stand, a washroom, a bank machine, a pay telephone, and the exit most appropriate for taking public transportation when leaving) and completed an evaluation form for each venue (a copy of the evaluation form and the raw data derived therefrom are included in Appendix 2) used to compile the results in Tables 1 and 2 (pages 36 and 67).

This review of the standards used to evaluate both visual and aural features, a detailed examination of the tasks, and the experiences at each arena, is located in Chapter 4, with general comments regarding each arena forming Appendix 3.

Vancouver and Montréal did not receive a "standard visit" as defined above. In the case of Vancouver, two separate visits were made; one during the hockey off-season, and one for part of one game. The Montréal Canadiens flatly refused to participate in this project, resulting in a lack of specific comments from the organization on their facilities, however, the author did participate in the English-language public tour, and attended a game as a paying customer, therefore, comments on that facility are drawn from the author's experience, which would not be dissimilar to that of a regular patron.

2.0 The Development of the Indoor Arena

As a building form, the hockey arena is a relatively recent type, but construction of public venues for sporting events has a long and lively history. As Sheard (1998) so eloquently states,

> *(T)hey can be wonderful places, they can host the population of a city for a few hours and can contain all of the good and bad in that part of society who are attracted to physical skill and endurance, and more recently vocal effort. They can be spectacular, uplifting buildings that punctuate our lives with enjoyment and sometimes disappointment. They can be places of worship and inner thought and they can bind us with our fellow man like no other building.*

Perhaps the earliest arena was on Crete, in approximately 2400 B.C., where bull-leaping was performed by trained youths in front of a crowd sitting on elevated seats. The Coliseum and Circus Maximus entertained millions during the height of the Roman Empire (Jewel, 1978). In some respects, hockey today, both the game and the venue, has borrowed extensively from these bloodthirsty models, albeit with a roof added for environmental control.

The Victoria Skating Rink, built in Montréal in 1862 and designed by Lawford & Nelson, Architects, hosted the first hockey game played according to rules that closely resemble today's on March 3, 1875. In fact, because of the proportions of the building, it was the dimensions of that ice surface, which was 200 feet x 85 feet (60.96 x 25.9 m), that set the standard for today's NHL arenas. By the time the Westmount Arena, also in Montréal, was completed in 1898 as the first purpose-built hockey arena, seating for 6,000 was accommodated in a grandstand around the ice surface that was enclosed by boards that were four feet (1.22 m) high.

The first game played indoors on artificial ice was in Vancouver in 1911 in the Vancouver Arena, owned and built by Frank and Lester Patrick, members of one of the founding families of NHL hockey (Strachan, 1999). Not only were games no longer dependant on the vagarities of the weather, but the rules began to change, reflecting the restricted ice surface. The number of players was reduced to six (from nine), and rubber balls were replaced with pucks (Messier, 1987).

Following creation of the NHL in 1917, more, and larger, buildings were constructed, including the original Montréal Forum, designed by John S. Archibald in 1923–24, and Toronto's Maple Leaf Gardens, designed by Ross & Macdonald in 1929–31. It is a testimony to the size (since enlarged), style, and design of Maple Leaf Gardens that it has only recently (1999) been replaced by Air Canada Centre as the home of the Toronto Maple Leafs. Both the Forum and Gardens were built to contain ice-making equipment, which consisted, then as now, of miles of thin, coiled pipes embedded in the concrete arena floor, through which a continuous flow of cold liquid was pumped that caused water spread over the surface to freeze. With the development of ice resurfacers during the Second World War invented by and named for Canadian Frank Zamboni, improved lighting (both for spectators as well as broadcast crews) and electric timing devices — now frequently joined by extensive television displays and sophisticated loudspeaker systems — that patrons have been able to better follow the game while in progress.

Indeed, in the past ten years, there has been a remarkable boom in the construction of hockey arenas. Constructed by a handful of large, corporate architectural firms (primarily Ellerbe Becket and HOK Sports Facilities Group), these behemoths frequently cost in excess of $200 million, bear the names of multinational corporate sponsors, and symbolize the transformation of professional sports into "big business," complete with private boxes, club seating, and other perks for wealthy and indulgent patrons. No longer are the buildings for loyal fans and hockey cognoscenti, but for thrill-seeking consumers who attend any number of events held within, be they concerts, tractor-pulls, or basketball games (Petersen, 1996).

But by their very nature of trying to be as many things possible to as many money-bearing customers, the current NHL arenas have evolved. Hockey, entertainment, and money have always been closely intertwined, with emphasis in the bulk of the twentieth century to the first, but what is noticeable in the last five to ten years is that entertainment and commerce have become more important.

(This chapter owes a great debt to the unpublished work of Howard Shubert of the Canadian Centre for Architecture, who is currently engaged in writing a history of Canadian hockey arenas.)

3.0 Existing Legislation and Standards

3.1 Federal Regulations

As virtually all NHL arenas are designed primarily by architectural firms based in the United States, a brief examination of the standards used by both Canada and the United States is a useful exercise. In the United States, the Americans with Disabilities Act (ADA) is an all-encompassing piece of legislation passed in 1990, that mandates "reasonable accommodation" in all buildings used by the public, whether publicly or privately financed. The need to provide "reasonable accommodation" under ADA falls into one of three categories:

1. Making the workplace or facility accessible.
2. Changing the way a job or service is normally handled or provided.
3. Providing or modifying equipment or assistive devices.

For example, a person with a hearing impairment can reasonably expect to have an assistive device at a public theatre or arena, and s/he should be able to work, live, and relax in a well designed acoustic environment that can be adapted to specifically accommodate the impairment. Persons with visual impairments can reasonably expect to encounter environments that are free of hazards and that offer clear signals for wayfinding (Null and Cherry, 1996).

There are limitations to what ADA can accomplish, however, and the U.S. Department of Justice recognizes that removing physical barriers entirely may not achievable, and that a combination of barriers can be a burden, rather than each barrier independently. Their list of priorities includes providing access to a place of public accommodation from public sidewalks, parking, or public transportation; providing access to restrooms where they are used by the public; providing access to places where goods and services are made available to the public; and taking other measures to provide access to places of public accommodation (Farmer, Mulrooney, and Ammon, 1996).

The Canadian experience is substantially different in implementation. Unlike the United States, which has specific architectural requirements as part of the ADA, the National Building Code does not have any legislative authority and is a model code only, which each province can choose to adopt or modify as required. With interpretation and enforcement of accessibility the responsibility of the Canadian Human Rights Act under Sections 17 and 24, but no nationally legislated standard, some confusion as to what should be required is understandable.[3]

Section 17 (1) states "(A) person who proposes to implement a plan for adapting any services, facilities, premises, equipment or operations to meet the needs of persons arising from a disability may apply to the Canadian Human Rights Commission for approval of the plan." After the Commission approves the plan, under Subsection (2), Subsection (3) requires "(W)here any services, facilities, premises, equipment or operations are adapted in accordance with a plan approved under subsection (2), matters for which the plan provides do not constitute any basis for a complaint under Part III regarding discrimination based on any disability in respect of which the plan was approved."

3 A complete copy of the Americans with Disabilities Act can be located on the World Wide Web at http://www.usdoj.gov/crt/ada/ada-home.html, and the Canadian Human Rights Act at http://www.canada.justice.gc.ca/STABLE/EN/Laws/Chap/H/H-6.html.

Section 24 deals with accessibility standards. It requires that "(T)he Governor in Council may, for the benefit of persons having any disability, make regulations prescribing standards of accessibility to services, facilities or premises." Additionally, "(W)here standards prescribed pursuant to subsection (1) are met in providing access to any services, facilities or premises, a matter of access thereto does not constitute any basis for a complaint under Part III regarding discrimination based on any disability in respect of which the standards are prescribed."

Thus what is fundamental in both the building regulations and the Canadian Human Rights Act is the recognition that buildings must be made accessible to all citizens, regardless of their physical condition. While this is an admirable goal, closer scrutiny reveals that the overwhelming majority of what is considered "accessible" regards persons with physical restraints that require the use of wheelchairs. Indeed, in the NBC, Section 3.8 is labelled "Barrier-Free Design," with a wide range of entries. Yet despite a proclamation in the NBC that states "(P)ersons with visual or hearing disabilities that do not require the use of a wheelchair can be expected to move throughout a building," apart from a requirement for assistive listening devices (Article 3.8.3.7. states "in a building of assembly occupancy, all classrooms, auditoria, meeting rooms and theatres with an area of more than 100 m^2 shall be equipped with an assistive listening system encompassing the entire seating area."), there are no specific requirements in the applicable section to require such access.

There are, however, other aspects of Universal Design dealt with in the regulations that impact accessibility for the visual- and hearing-impaired as discussed in this

MDP. When such items as sound levels for alarms and lighting are dealt with, it is with respect to requirements for emergency situations, such as in NBC Article 3.2.4.19, Sentences 7 and 8 ("Fire alarm audible signal devices shall be supplemented by visual signal devices in any floor area in which the ambient noise level is more than 87 dBA.... Sentence (7) shall also apply in an assembly occupancy in which music and other sounds associated with performances could exceed 100 dBA."), and Article 3.2.7., which requires minimum lighting requirements "at an average level not less than 50 lx at floor or tread level and at angles and intersections at changes of level where there are stairs or ramps." While these requirements are adequate for persons with "normal" vision and hearing, they are not sufficient for the visual- and hearing-impaired; Chapter 4 explores those requirements more thoroughly.

Additional Universal Design concepts are dealt with in Article 9.9.10.6. ("Lettering...shall be made with not less than 19 mm wide strokes and be not less that 150 mm high when the sign is externally lighted, and not less than 114 mm high when the sign is internally lighted.") but deals only with exit signage, although it is not an unreasonable baseline standard for others. Section 3.3 deals specifically with safety within floor areas, and examines ramps and stairways, while Section 3.4, concerning exits, defines the signage and handrails needed.

3.2 International Standards

Despite the lack of federal legislative standards in Canada, the country is a signatory to the International Organization for Standardization (ISO), which, in 1990, passed a second edition of ISO 7001, containing fifty public information symbols. While these cover a diverse range of symbols, from indicating where washrooms are located to ski-lift etiquette, not only are a number of categories, such as bank machines, omitted, but the document takes great pains to point out that "(T)his is not a standard but an example, the use of which is encouraged."

ISO is well-known for their work in the standardization in a wide range of issues and items, with "standardization" defined (Arnold and Duce, 1990) as:

> *The activity of establishing, with regard to actual or potential problems, provisions for common and repeated use, aimed at the achievement of the optimum degree of order in a given context.*

The preparation of ISO standards is carried out through technical committees, consisting of interested membership bodies, and international organizations (both governmental and non-governmental). Draft standards are then circulated to member bodies, where at least 75 percent must approve, before it is formally adopted (International Organization for Standardization, 1990).

In the case of ISO 7001, it was adopted because of the increasing use of graphical symbols to present information to the public. Although ISO 9186 specifies procedures for the development and testing of public information symbols, it was recommended that cultural and technological differences between countries might lead to some confusion, and thus it was decided to standardize on the image content of the symbols, not the graphical images themselves (International Organization for Standardization, 1989). However, this may lead to some confusion when educating a population as to the meaning of a specific symbol, especially if it is substantially different from that experienced in another country. A brief look at methods of educating people regarding the meaning of symbols and pictograms is contained in Chapter 4.

The Standards Council of Canada (the Canadian representative to ISO) also works closely with the American National Standards Institute (ANSI), which published ANSI A117.1–1998, with new standards for ADA signage. These standards are nearly identical to those which are being integrated into ADA, and deal with specifying sizes and location of both Braille and raised-character signs, as well as specifics regarding typefaces and styles (Toji, 2000). As mentioned above, further discussion regarding signage is contained in Chapter 4.

When implemented, it is obvious that the requirements for the wheelchair-bound become conveniences for the population-at-large: any casual observation of a street corner will reveal that able-bodied pedestrians prefer curb cuts — anyone maneuvering a baby carriage, grocery cart, or large object is grateful — and that lower water fountains benefit both children and shorter adults. If additional NBC requirements for persons with less-than-perfect vision and hearing were implemented, including improved standards for floors, corridors, staircases, signage, and the projection of sound (both ambient and communicative) as discussed in this MDP, all persons, not just the visual- and hearing-impaired, would see an improvement in their daily quality-of-life.

4.0 Perceptual Concerns and Site Analyses

This chapter addresses the specific perceptual concerns used to analyze NHL arenas to determine how they currently serve the needs of patrons with visual and aural deficiencies, looks at specific areas that primarily relate to these concerns, defines a set of tasks common to patrons, and details how the venues performed in each area and task.

Matrices relating the perceived objective and subjective concerns, as well as wayfaring tasks, by venue are displayed in Tables 1 and 2 on pages 36 and 67, respectively, and are generated from the site evaluation form and raw data contained in Appendix 2. By using the form to collect data, then assigning weights to each question in specific categories, an average score was factored for each (primarily) objective concern was determined. A separate score was recorded for the subjective "comfort level" of the evaluator. The matrices quantify some of the perceptual concerns and abilities to perform the tasks across the range of experiences noted, with higher numbers representing increased difficulty in performance of the task. As discussed in Chapter 1, and as a specific method, such items as contained in the site evaluation form are considered to be sound within literature relating to POE.

These evaluations were based solely on the initial visits and examination by one evaluator; Calgary's arena had been previously visited, although prior to the most recent renovation. The consistency of one evaluator enabled all venues to be assessed on a more-or-less level playing field, as opposed to a rotating set of evaluators; such persons might only available at one venue and already be familiar with it, thereby increasing the possibilities for error, chance, or simply unusable evaluations being performed. By utilizing a group of subjects who would be working with some form of reduced reproduction of all the facilities, either through a series of virtual reconstructions or a series of photographs, any attempt at "reproducing" the total experience of being in the venue would be extremely problematic because of technical and financial constraints (see Arisz, Kanis, and Rooden, 2000, for a discussion on the optimum number of participants for studies).

Wang (2000) discussed some of the problems encountered when attempting to reproduce Calgary train stations using virtual reality techniques, and determined that persons familiar with the technology performed better than those without that knowledge, while also acknowledging the limitations that are imposed technologically. Thus, recreating each individual arena, complete with sound effects, would present insurmountable challenges because of the lack of equipment capable of providing such an experience.

Additional details regarding the collection and analysis of the data are contained in Chapter 1.

4.1 Perceptual Concerns

Edward T. Hall (1966) was an early proponent of analyzing how humans perceive space and to point out the inter-relationship between the senses, especially those of sight and sound. As people grow older, two of the most noticeable (to both themselves and others) growing physical deficiencies with respect to hearing and visual perception (Baucom, 1996).

For the purposes of this research, three separate, and primarily, visual components (colour, contrast/lighting, and texture) were explored, as well as two aural ones (ambient and communication) and how they impact the experience of interacting with the floors, corridors, stairs, and signage. As a way of relating these physical concerns directly to the building form, a series of tasks common to patrons at hockey games are defined and performed to see how the various visual and aural perceptual concerns interact in a "real-life" situation.

What is important to realize is that changes to improve visual systems are not just helpful for the visual-impaired, or that better acoustics make life easier for everyone, not just persons with perceived hearing difficulties. As John and Heard (1981) write,

> *The worse his level of vision is, the more a person becomes dependent upon other characteristics in the physical environment. By increasing the understanding for, and knowledge regarding, these characteristics one should be able to lower the number of, or remove, directly dangerous situations, thereby increasing the possibilities of a normal life for persons with impaired vision.*

By inference, the same can be said for the hearing-impaired; they require additional signage and other visual clues to assist them in improving their quality of life. It is vital to acknowledge the connection and interrelation between both audio and visual cues (Morrissey and Zajicek, 2000), as well as how seeing and hearing reinforce each other (Parret, 1994).

4.1.1 Visual

As this Masters Design Project examines, in part, how visitors orient themselves visually ("wayfinding") within NHL arenas, it is important to explore the perceptual components of colour, contrast, and texture that work together to enhance or detract from the experience. After examining these components, specific elements, such as floors, corridors, stairs, and signage, are detailed at the various venues. (A complete discussion of how the human eye works can be found in Zakia, 1997, and an accessible discussion of vision is perceived in the brain is contained in Hubel and Wiesel, 1979, while Michel, 1996, provides an excellent perspective on visual perception in architecture.)

That "perfect" vision exists for a substantial portion of the North American population is a common misconception: a person is considered legally blind if his/her vision is at or below 20/200 (Olin, 1983). Approximately 20 percent of the North American population requires eyeglasses or some sort of visual aid by age twelve; this group increases to nearly 60 percent of people in their mid-twenties to mid-sixties, and after the age of sixty-five, nearly everyone requires some sort of mechanical visual improvement (Baucom, 1996).

Also, as people age, visual clarity — the ability to change focus quickly and adapt to varying light conditions — also decreases. It would seem logical that planners and architects who design interior spaces used by large numbers of people would strive to maximize the visual experience for those with less-than-perfect vision, and that building codes, even though they currently mandate minimum lighting levels, would reflect this reality. As more research is being directed in this area

(Stabler and van den Heuvel, 2000), perhaps this will encourage architects to improve buildings by raising their consciousness, rather than necessitate legislation.

4.1.1.1 Colour

The ability to see colour (taken here to mean general colour perception, and not specifically referencing or examining the additional problems of colour-blind individuals) and the capacity to discriminate detail in interior spaces are two elemental aspects of the vision process and should be afforded the highest consideration when designing interior spaces (Baucom, 1996).

Colours in our environment can enhance visual orientation by making a space easier for a person with reduced vision to understand, since people tend to see colour before they see form, even for the colour-blind. This fact is especially important because people generally make a subconscious assessment of what they see within the first 60 to 90 seconds of encountering a visual image (Baucom, 1996). At the same time, when visiting a hockey arena, they must also acquire (or reacquire) an understanding of the building layout, and be able to navigate through it easily (Arthur and Passini, 1992).

Longer-light spectrum wavelength colours, such as red, are more easily seen, which is why red is used for stop lights, while those colours with shorter wavelengths, such as blue, should be intensified to enhance visual clarity. Contrast between objects and backgrounds or between objects and adjacent environments will also factor heavily in deciding which colours to include in the palette (Baucom, 1996).

Signage colour combinations shown in Chart 1 are shown in descending order, starting with the most visible combination (Baucom, 1996).

Chart 1

Signage Colour Combinations for Visibility

Figure	Ground	
Yellow	Black	Most Visible
White	Blue	
Black	Orange	
Black	Yellow	
Orange	Black	
Black	White	
White	Red	
Red	Yellow	
Green	White	
Orange	White	
Red	Green	Least Visible

While the effects experienced by people when exposed to a combination of illumination, brightness, and colour are a wide-ranging field of inquiry (Birren, 1992), only a few additional brief comments will be made in this MDP. Red hues generally tend to be the least affected by vision differences, but most affected by a lack of illumination (one reason why fire trucks are frequently painted light yellow-green), while red and orange can heighten the senses of taste, smell, and hearing, as well as improve body movement.

4.1.1.2 *Contrast and Lighting*

As people grow older, they require more definition of the visual images to establish where they are in a space. One of the easiest way to do this is to utilize colour in conjunction with lighting to articulate objects visually — that is, to provide contrast. Successful use of contrast in design helps facilitate orientation to a new environment. Adequate contrast heightens depth perception by providing important cues to indicate the proximity of an object, the very basis of effective depth perception. Clear levels of contrast then become a means to improve orientation and to reinforce safety for people moving through unfamiliar spaces.

The ability to navigate can frequently be impeded by low lighting levels. But how much is "enough"? The NBC only mandates a minimum of 50 lx in corridor areas (1 lx is the illuminance at a point on a surface which is one meter from, and perpendicular to, a uniform point source of one candela), for example, but given that even basic textbooks for architectural and lighting design consider 200 lx to be the barest minimum (Ching, 1975) for casual tasks in small, familiar areas, such a low standard published in the NBC seems incongruous.

Williams (1999) emphasizes not only that "the more light available, the easier it is to perform a specific task," but also that "there is generally little value in underlighting a task where human performance is concerned." Illuminance levels are influenced by:

- detail of the task,
- reflectance and contrast between the task and the background,

- the age and condition of the eyes, and
- the importance of speed and accuracy in performing the task.

Additionally, Williams (1999) provides the most current Illuminating Engineering Society (IES) charts for determining the illumination required. The 50 lx requirement of the NBC is the minimum demanded under Category B (defined as "simple orientation for short temporary visits"). To obtain such a rating under the IES method, the sum of the two room and occupant characteristics in Chart 2 below needs to be -2; if it is -1 or 0, then the IES recommended level is 75 lx, and if the sum is +1 or +2, then the recommended level is 100 lx.

Chart 2

IES Procedure for Determining Illuminance over a Large Area

Room and Occupant Characteristics	Weighting Factor -1	0	+1
Occupant ages	under 40	40–55	over 55
Average room surface reflectances	more than 70%	30–70%	less than 30%

However, if a large space (such as the corridor of a hockey arena) is classified as Category C (defined as "working spaces where visual tasks are only occasionally performed," which is a reasonable assumption of the wayfinding tasks that need to be performed at a venue), then the lighting requirements are doubled: with the sum of factors of -2, the minimum suggested requirement is 100 lx; if it is -1 or 0, then the recommended level is 150 lx, and if the sum is +1 or +2, then the recommended level is 200 lx.

The alternative calculation method, known as the "Rae" method, is also presented by Williams, who indicates that "results generally seem to agree with the IES method of calculation." While it is somewhat simpler in that it uses five categories instead of the nine of IES, it requires an evaluation of task, background, and reflectance across a wider range of ages. Williams also notes that for "applications involving merchandising, advertising, decorative, artistic applications, or matters related to safety,...it may be necessary to provide higher than recommended lighting levels."

That there has been no previous discussion regarding the use of daylighting is because no arena uses daylight as either a primary or secondary lighting source. While it plays a limited role in the public corridor areas of two arenas (Toronto and Ottawa), the fact remains that the overwhelming majority of games take place when it is dark outside (either in the evenings, or late afternoons during the winter). Figure 4.1 (page 37), illustrating the sunlit main entrance lobby in Ottawa, works equally well as an artificially lit space; it would appear that great thought about the lighting of this area was considered at an early stage by the architects.

4.1.1.3 Texture

The final component assessed with respect to visual perception is texture. Changes in texture, alone or in conjunction with different colours and lighting, especially on floors or walls near flights of stairs and other areas of different, and often conflicting, uses can be of great assistance in providing the contrast necessary to discern visual clues. What is most important to remember, however, that excessive use of the perceptual elements detailed in this MDP — whether they be texture or contrast in lighting or colours — rapidly becomes counterproductive (Olin, 1983).

Other textural changes that assist persons with visual difficulties include having elevator controls raised, not flush, with respect to the mounting panel, the use of different materials, and embossing larger digits to aid in identification. Most persons with visual difficulties, and even those who are entirely blind, do not read Braille, thus it has been suggested (Thomson, 1984) that the addition of Braille numbers and letters is not particularly useful.

As previous mentioned, ANSI A117.1–1998 standards (Toji, 2000) address this specific issue, but there is nothing in the NBC that does so for Canada.

After examining these visual qualities, and in conjunction with the aural values explored in the next section, lines of inquiry were formulated to examine the objective elements to be evaluated at each venue, as well as their impact on the performance of the wayfinding tasks.

4.1.2 Aural

"Design for the deaf and hard of hearing is not normally a matter of making special provision, but simply of considering their needs at an early stage in the design, and incorporating them as part of good design practice generally" (Thomson, 1984). Frequently, this requires addressing both ambient sound levels, as well as those required to communicate information. Whether that information consists of a goal, a penalty call, or emergency evacuation instructions, it is necessary to put forth the information in a way that allows all patrons to react quickly and appropriately. While the requirements to escape a freestanding building, such as the hockey arenas examined in this MDP, are less rigorous than for other such facilities, such as the largest cavern in the world converted into an arena for the 1994 Winter Olympic Games in Gjøvik, Norway (Meland and Lindtorp, 1994), the NBC does not require visual signal devices unless the building is used "primarily by persons with hearing impairment," as stated in Sentence 3.2.4.18 (4).

Humans can hear frequency wavelengths as short as 15 cm to as long as 150 m in length. The average younger person can hear sounds that range from 20 to 20,000 Hz (hertz, the standard unit of measurement for sound frequency) even though the human voice ranges only from about 100 to 7,500 Hz. The optimum sensitivity of the ear occurs between 500 and 6,000 Hz, while the critical range of speech communication is 300 to 4,000 Hz. Most intelligible speech information is carried in the higher frequencies, which are the shorter wavelengths. Since it is the designer's responsibility to enhance the ability to understand speech in public spaces, s/he should remember that the average male voice centres around 500 Hz, while the average female voice is about 900 Hz (Baucom, 1996).

To enhance speech in public spaces, acoustic design criteria should strive to enhance the high-frequency sound transmission of speech (communication) while attempting to minimize low-frequency background noise (ambient) without sacrificing the perceived direction of the sound source (Baucom, 1996).

Some fundamentals concerning hearing that should be considered in the planning of such facilities include:

- Noise interferes with communication more noticeably for people with reduced hearing abilities.

- Tests show that the degree of annoyance a listener experiences as a result of noise is proportional to the loudness of the noise. The annoyance level tends to be greater for high-frequency noise, and studies also indicate that intermittent noise will cause greater annoyance than continuous noise; this is especially noticeable in hockey arenas when goals are scored.

- Visual space has a different character than auditory space; visual information tends to be more focused than auditory information, although this focus can be diffused because of visual clutter (Wilson, 1984).

- Enhancing hearing ability through the use of architectural acoustics becomes more important if spatial information from visual cues is confusing. Effective acoustic control can lessen visual disorientation (Baucom, 1996).

Achieving improvements in NHL arenas can be a challenge because of their size and construction. "Traditional" methods for reducing the transmission of excess ambient sound, such as using room contents, wall coverings, and floor coverings for sound absorption are virtually impossible in a large space such as the bowl area of an arena, especially when confronted with enthusiastic patrons encouraged to "make noise" to distract the opposing team. Perhaps the best method is to use acoustic ceiling panels, which is done in Calgary, although this is also problematic, as the optimum treatment for such panes is to install them 3 m above the finished floor (McGuinness, Stein, and Reynolds, 1980), which is physically impossible in arenas, because of the design restraints when sheltering large numbers of patrons.

However, with careful planning, an array of surface planes and angles (horizontal and vertical) in the main bowl, and sound-absorbent surface textures where appropriate in corridors, such buildings can be more acoustically effective for people with hearing problems. Aesthetic design decisions should be considered opportunities to improve the acoustical quality of the space (Baucom, 1996).

Sound control involves a combination of reducing noise at the source, controlling noise transmission paths, and protecting receivers (Wilson, 1989). In the first case, there is much that can be done at the venues examined; in the second, a limited amount above that which has been already implemented can be retrofitted at some cost; while with regard to protecting the receivers, there seems to be little incentive. The ambient levels, while approaching the threshold of pain for the evaluator (the pain threshold is generally acknowledge to be rated at 140 dBA), are not sustained, and thus do not require protection for either those employed by the facility or the teams under Occupational Health and Safety regulations, or the patrons who purchase tickets.

Indeed, examining tickets for the venues frequently results in discovering small print that absolves the venue from any liability therefrom. However, research (Vos and Smoorenburg, 1985) shows that sharp peaks of sound results in a greater risk of hearing damage than would be predicted on the basis of equivalent sound level alone. Other detrimental effects of noise include increases in blood pressure, heart, and perspiration rates, the tensing of muscles, and a release of hormones into the bloodstream (EPA, 1978).

As has been previously noted, no mechanical measuring systems were employed in the evaluation of sound levels in the facilities. While the simple reasons are "cost and time," these are deserving of further expansion. Sound level meters, which are relatively portable, are useful in measuring "steady-state" noise levels (i.e., where sound level and frequency are relatively constant during time intervals), however, the sound levels in arenas are not relatively constant.

To accurately measure the varying levels in the facilities, integrating sound level meters and/or personal dosimeters would be required, along with using real-time analyzers and Fast Fourier Transform analyzers, which determine levels within frequency bands (Wilson, 1989). As the evaluator had neither training nor access, or the funds and time available to acquire both, a choice between making personal evaluations or eliminating the concern was necessary. Because of the symbiosis between hearing and seeing, the latter was deemed acceptable for this purpose, with caveats as noted.

But it is not only acoustical improvements in the adequate transmission of communication and the reduction of ambient noise that can assist persons with hearing difficulties. People with extreme hearing loss can benefit from illumination levels that allow them to see facial expressions and read lips, and from simple solutions to ensuring the carpeting be of antistatic materials or treated to be static-free, as static electricity interferes with hearing aid operation (Olin, 1983).

The qualities of ambient and communication sounds evaluated at each venue were determined by assigning values to a number of perceived issues. These data are contained in the evaluation matrix on page 36.

4.1.2.1 Ambient Sound

In assessing the quantity and quality of ambient sound within the arena (both in the public corridors and in the bowl area), it was important to note what the overall sound levels were in a variety of locations before and during the games. Instances of excessively high levels are produced at various times, particularly when the home team scores, which necessitates exploring possible alternatives for such ear-shattering experiences. A third factor in evaluating the ambient sound levels was to determine whether or not they were so high as to interfere with interpersonal communication.

The use of textured floors in Vancouver and premium seating areas in all venues does much to reduce ambient noise in public corridors. Montréal was the only venue where noise levels in the main corridor were approaching painful for the evaluator, and were exacerbated by crowding and poor air quality. Despite having some restricted corridors in Edmonton and Calgary, however, ambient sound levels were within personal tolerance. In Ottawa, the ceilings are very high in the main corridor, while Toronto has a wide variety of wall and floor finishes, both of which help to reduce reverberation.

During the game, ambient levels within the bowl areas of all facilities are generally not intrusive, with the exception of Edmonton; while somewhat intrusive, it could be argued that this contributes to the "sense of place" of the facility — a hockey intimacy lacking in the newer buildings.

4.1.2.2 Communication

There are also new sound systems being developed, such as the "Smartsound" noise-adaptive public address control system, which, although designed for the outdoor platforms of the Docklands Light Railway system in the Docklands regeneration zone in London, England, has major implications for improving the quality of sound in arenas (Fitzgerald and Trim, 1998).

First, Smartsound works by installing many small speakers, enabling the volume of each to be reduced. Second, it has the capability to adapt the volume of the speakers automatically, dependent on the level of concurrent ambient sound. Third, it uses passive infrared detectors to activate only those speakers in the vicinity of passengers; within an arena, this could be adapted to enable hearing-impaired patrons to turn on selected speakers near them.

In some respects, assessing the communications aspect of sound proved to be easier and somewhat more quantifiable than evaluating the ambient aspect. It was necessary to ascertain that announcements could be heard easily from a variety of locations in the venue, both in the corridor access areas and the bowl, and to determine how hearing-impaired visitors would be notified if an emergency occurred. The availability of an assisted-listening device, mandatory in the NBC under Article 3.8.3.7., and generally installed as low-wattage FM transmissions, accessible by special headphones, certainly improves the situation for the newer structures, but it appears that there is little promotion of its availability where it has been installed.

Corridor announcements were easily understood in all buildings, with the exception of the corridor that accesses the private boxes and the press area in Ottawa, where there were few speakers. Given that the corridor is entirely closed off to the bowl area below, an eerie quiet permeated any walk through this hallway.

In the bowl areas, the volume of announcements was generally excellent. However, in the upper level or "nosebleed" seats, additional speakers are required. This is somewhat mitigated by the fact that, in Calgary, there are also television monitors in the area that flash the information at the same time, but it is still problematic. In Edmonton, announcements are easily understood, although because of high ambient levels of sound, seem to be often drowned out.

The public-address system in Montréal seemed somewhat lacking in volume, although announcements were made in both English and French. Although the building is new and would likely have a low-wattage FM transmitter system installed (as per the NBC), questioning the tour guide, an usher, and a clerk in the souvenir shop proved inconclusive. Ottawa indicated that they did have a low-wattage FM transmission facility, but it is neither promoted nor widely used, likely a case of the former influencing the latter.

The most problematic situation regarding the communication sound level in the bowl deals with the way scoring by the home team is handled. Calgary uses a gas flare which does not create much in the way of sound, but which does sully the air quality. All the other venues resort to an ear-splitting sound, with Vancouver, Edmonton, and Ottawa being the most egregious offenders in this regard. These three left a ringing in the evaluator's ears, and given that repeated exposure to such sounds can contribute to a decline in hearing acuity as noted previously, it would be commendable if the venue staff could be persuaded of the virtues of finding another way to signal a goal.

4.1.3 Evaluated Elements

4.1.3.1 Floors/Corridors

In determining the numerical quantification contained in the matrix on the following page for each venue, a number of possible concerns were drawn from the research presented above and assessed. Most importantly of these concerns was how well the space perceived visually, which combined a set of specific elements, including whether or not there was sufficient light to discern visual clues, what visual or textural cues other than signage were presented and how they eased travel through the public spaces, whether there was sufficient clearance to enable patrons to feel comfortable in the space (i.e., no unmarked projections overhead, no obstacles, no sharp corners or edges, etc.), as well as the sound levels. The decision to evaluate clearance overhead is based on the evaluator's lack of ability to accurately judge such distances and is reinforced by work done by Horberry, Purdy, and Gale (1987).

Figure 4.1 illustrates the main entrance lobby in Ottawa, which is the best example of this area in the venues visited. With its framing staircases and excellent lighting during the day and evening, this is a well-designed, welcoming space; even though it is contained with extensive glass windows on the east (right side of photograph) and polished concrete floors, ambient sound levels are not obtrusive because of the high ceiling and lack of parallel surfaces, and communication is easily discernable, even though the main floor is a popular gathering place before and after the game, as well as during intermissions.

Table 1: Rating of Evaluated Concerns by Venue

Evaluated Concern \ Venue	Vancouver	Calgary	Edmonton	Toronto	Ottawa	Montreal
Floors/Corridors	2	3	3	2	4	4
Comfort Level	3	3	2	2	5	5
Stairs	3	5	4	3	2	2
Comfort Level	3	5	5	3	2	2
Signage	3	1	2	3	3	5
Comfort Level	3	1	2	2	3	5

Key: First line portrays "objective" data, while "Comfort Level" represents subjective evaluation.

Higher numbers indicate more problematic situations.

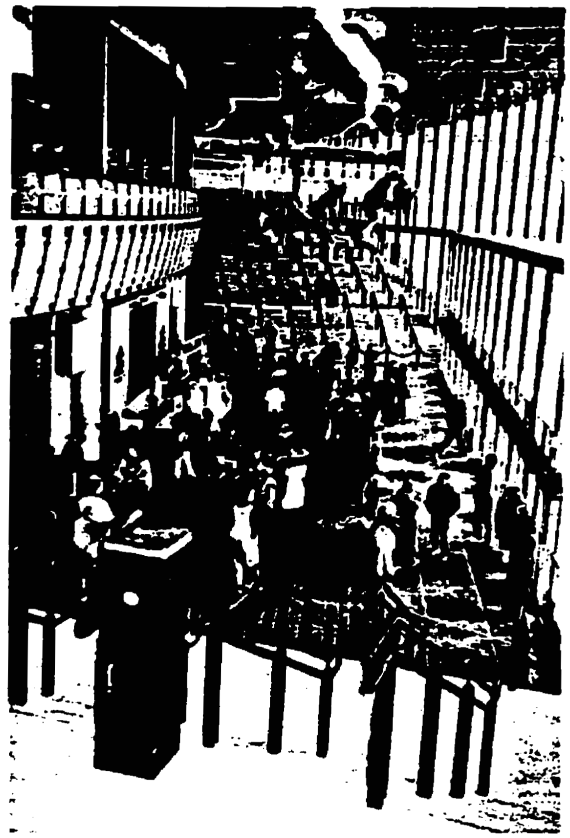

Figure 4.1 Main entrance lobby, Ottawa.

To the left of Figure 4.1 is the area of the main public corridor that overlooks the lobby and is illustrated in Figure 4.2 below. This is the standard corridor width throughout this level, and even widens out at the food court/concession area just beyond the curve of the corridor to the right. The polished concrete surface is easily visible, although during the site visit, it proved somewhat hazardous to a young child who slipped when his foot caught a small puddle. Such accidents require that floors receive conscientious maintenance to avoid potentially hazardous situations.

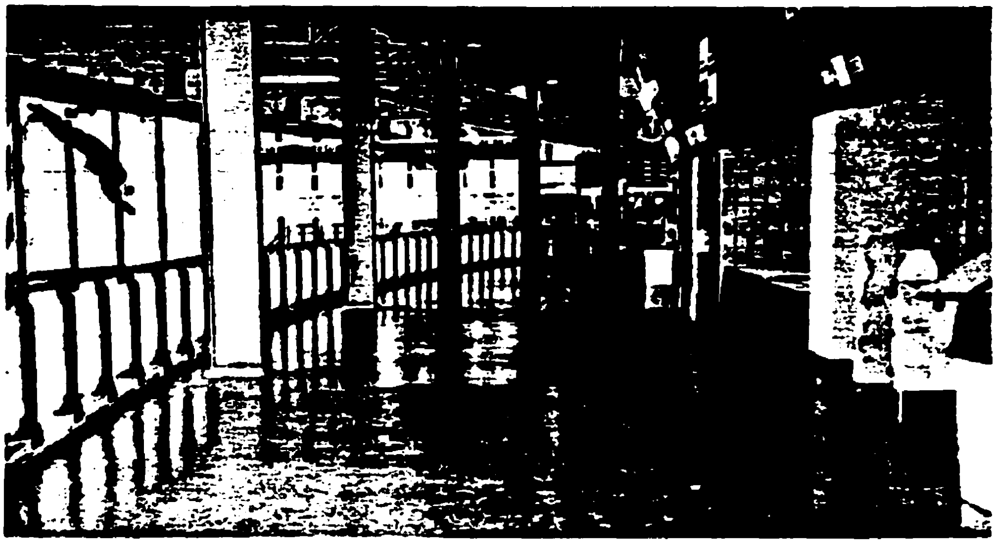

Figure 4.2 Main concourse, Ottawa.

Polished concrete was installed in Ottawa as a cost-saving measure that was specifically mentioned during the site tour; it is also the primary flooring material in Calgary, Edmonton, Toronto, and Montréal. In Vancouver, the floors in the main public areas have been both textured and painted; given the climate and the frequency of rain, as well as the likelihood of the occurrence of similar problematic situations as detailed in the previous discussion regarding Ottawa, the texturing is of great assistance in preventing accidents that can occur on wet, polished concrete, and in aiding people in finding their way around the building.

To differentiate between the standard and premium seating areas, all arenas have noticeable changes in texture and floor coverings. In Ottawa, this is accomplished by replacing the polished concrete with linoleum tile (Figure 4.3), which improves colour recognition of specific areas but does little to solve traction problems.

Figure 4.3 Premium seating area, upper concourse, Ottawa.

Toronto and Vancouver have chosen to use more highly textured floor surfaces. The floor in Toronto (Figure 4.4) consists of a series of coloured, textured ceramic tiles, with subtle indicators as to access points to the bowl seating area. Such textural cues, however, should be used with discretion because overuse will diminish their effectiveness (Olin, 1983). In addition, the small sign to the left contains the Braille numbers corresponding to the sign above the door and to the right at the bottom of the short flight of stairs, ostensibly enabling all patrons to easily assess where they are in relation to where they want to go. Regrettably, only approximately 10 percent of persons with visual impairments read Braille (Olin, 1983), and additionally, the sign is too small and too low to be effectively utilized in a crowded situation.

Figure 4.4 Premium seating corridor, Toronto.

The approach in Vancouver (Figure 4.5) is somewhat less coherent than Toronto's, but as effective. Here, a winding ceramic tile mosaic embedded in the painted cement floor entices patrons into the entrance of the main floor premium seating section; curiously, Vancouver gives the patrons of the higher-priced seats the less appropriate flooring surface, unlike the other arenas visited. Although some glare results from both the painted floor and the ceramic tiles, it did not appear to be problematic in the wayfinding exercises, although for patrons of limited visions, the mosaic might well prove distracting, especially if it was rigidly followed. A more pronounced texture difference would be of great assistance in this regard.

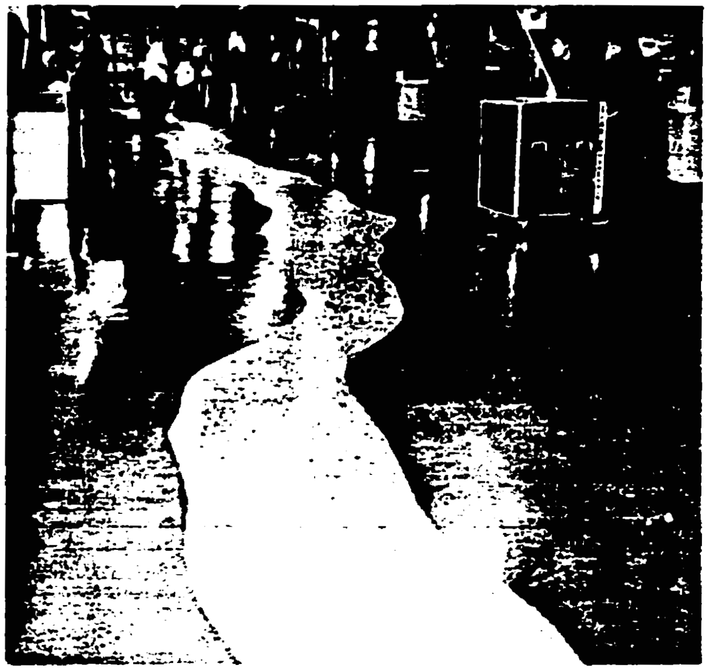

Figure 4.5 Flooring in Air Canada Club, Vancouver.

The premium seating areas in Calgary and Edmonton were both carpeted in neutral colours, providing little assistance in wayfaring, but allowing for a nonslip surface for patrons.

Of some concern were several instances of restricted headroom areas in the facilities, primarily caused by intruding staircases. While this might be expected in an older venue such as Edmonton (Figure 4.6), it is also an issue at Toronto (Figure 4.7) in some isolated places, and throughout the main corridor in Montréal (Figure 4.8). Article 3.4.3.6 of the NBC mandates headroom clearance for stairways to be not less that 2.05 m, but for persons with visual perception difficulties, this minimum may not be sufficient for them to feel "comfortable" within the space (Horberry, Purdy, and Gale, 1997), and may actually be less the closer one gets to the wall; in Figure 4.7, there is sufficient headroom at the right-hand side of the table, but not at the left, where it meets the concrete support. Providing warnings, contrast strips, and padding on particularly problematic areas should be made mandatory to reduce the possibility of accidents.

Figure 4.6 Stairway intruding in main concourse, Edmonton.

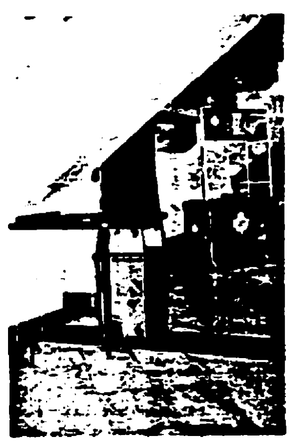

Figure 4.7 Stairway intruding in main concourse, Toronto.

Figure 4.8 Main public corridor, Montréal.

4.1.3.2 Stairs

In assessing the appropriateness and functionality of the stairs as quantified in the matrix, it was important to examine what they were constructed of, whether all the stairs in a run were of equal tread and riser sizes, and whether there was a landing of sufficient dimensions; the size, shape, height, and placement of handrails; how well the stairwell locations were marked; and whether the width was sufficient to accommodate use at busy times like intermissions or at the end of the game.

The standards published in the NBC dealing with exit facilities from Group A, Division 3 occupancy buildings (the category under which arenas are classified) were used as the norm to assess the stairs found in the facilities visited are contained in the following articles:

3.4.6.1. Slip Resistance of Ramps and Stairs

1) The surfaces of ramps, and landings and treads

a) shall have a finish that is slip resistant, and

b) if accessible to the public, shall have either a colour contrast or a distinctive pattern to demarcate the leading edge of the tread and the leading edge of the landing, as well as the beginning and end of a ramp.

2) Treads and landings of exterior exit stairs more than 10 m high shall be designed to be free of ice and snow accumulations.

3.4.6.2. Minimum Number of Risers

1) Except as permitted by Sentence 3.3.2.13.(1), every flight of interior stairs shall have not less than 3 risers.

3.4.6.3. Landings and Maximum Vertical Rise of Stair Flights

1) No flight of stairs shall have a vertical rise of more than 3.7 m between floors or landings, except that a flight of stairs serving as an exit in a Group B, Division 2 occupancy shall have a vertical rise of not more than 2.4 m between floors or landings.

2) The length and width of a landing shall be at least the width of the stairway in which it occurs, except that in a straight run the length of the landing need not be more than 1100 mm.

3) Where a doorway or stairway empties onto a ramp through a side wall, there shall be a level area extending across the full width of the ramp, and for a distance of 300 mm on either side of the wall opening, except one side if it abuts on an end wall.

4) Where a doorway or stairway empties onto a ramp through an end wall, there shall be a level area extending across the full width of the ramp and along its length for not less than 900 mm.

5) A landing shall be provided at the top and bottom of every flight of stairs.

3.4.6.4. Handrails

1) An exit ramp or stairway shall have a handrail on at least one side, and if 1100 mm or more in width, shall have handrails on both sides.

2) If the required width of a ramp or flight of stairs is more than 2200 mm, one or more intermediate handrails continuous between landings shall be provided, and located so that there will be not more than 1650 mm between handrails

3) Handrails shall be continuously graspable along their entire length and shall have

a) a circular cross-section with an outside diameter not less than 30 mm and not more than 50 mm, or

b) any non-circular shape with a graspable portion that has a perimeter not less than 100 mm and not more than 155 mm and whose largest cross-sectional dimension is not more than 57 mm.

4) Handrails on stairs and ramps shall be not less than 865 mm and not more than 965 mm high, measured vertically from a line drawn through the outside edges of the stair nosing or from the surface of the ramp, except that handrails not meeting these requirements are permitted provided they are installed in addition to the required handrails.

5) At least one handrail shall be continuous throughout the length of the stairway, including landings, except where interrupted by doorways or newels at changes in direction.

6) Handrails shall be terminated in a manner which will not obstruct pedestrian travel or create a hazard.

7) At least one handrail at the side of a stairway or ramp shall extend horizontally not less than 300 mm beyond the top and bottom of the stairway or ramp.

8) A clearance of not less than 40 mm shall be provided between a handrail and any wall to which it is fastened.

9) Handrails and their supports shall be designed and constructed to withstand the loading values obtained from the nonconcurrent application of

a) a concentrated load not less than 0.9 kN applied at any point and in any direction for all handrails, and

b) a uniform load not less than 0.7 kN/m applied in any direction to handrails not located within dwelling units.

3.4.6.5. Guards

1) Every exit shall have a wall or a well-secured guard on each side.

2) Except as required by Sentence (4), the height of guards for exit stairs shall be not less than 920 mm measured vertically to the top of the guard from a line drawn through the outside edges of the stair nosings and 1070 mm around landings.

3) The height of guards for exit ramps and their landings shall be not less than 1070 mm measured vertically to the top of the guard from the ramp surface.

4) The height of guards for exterior stairs and landings more than 10 m above adjacent ground level shall be not less than 150 mm measured vertically to the top of the guard from a line drawn through the outside edges of the stair nosings.

5) Unless it can be shown that the size of openings that exceed this limit does not present a hazard, there shall be no opening that permits the passage of a sphere whose diameter is more than 100 mm through a guard for an exit.

6) In a stairway, a window for which the distance measured vertically between the bottom of the window and a line drawn through the outside edges of the stair nosings is less than 900 mm, or a window that extends to less than 1070 mm above the landing, shall

a) be protected by a guard that is

i) located approximately 900 mm above a line drawn through the outside edges of the stair nosings, or

ii) be fixed in position and designed to resist the lateral design loads specified for guards and walls in Articles 4.1.10.1. and 4.1.10.3.

7) Unless it can be shown that the location and size of openings do not present a hazard, a guard shall be designed so that no member, attachment or opening located between 140 mm and 900 mm above the level being protected by the guard will facilitate climbing.

3.4.6.7. Treads and Risers

1) Except as permitted for dwelling units and by Sentence 3.4.7.5.(1) for fire escapes, steps for stairs shall have a run of not less than 280 mm between successive steps.

2) Steps for stairs referred to in Sentence (1) shall have a rise between successive treads not less than 125 mm and not more than 180 mm.

3) Treads and risers in every exit stair, except a fire escape stair, shall have uniform run and rise in any one flight, and shall not alter significantly in run and rise in successive flights in any stair system.

4) The leading edge of a stair tread shall have either a radius or a bevel between 8 mm and 13 mm in horizontal dimension.

5) The front edge of stair treads in exits and public access to exits shall be at right angles to the direction of exit travel.

There are, of course, other considerations not specifically mentioned in the NBC. Of these, the ergonomics of the angle of attack of the stairway is an important determinant of the comfort patrons will have ascending the stairway. Ching (1975) recommends a preferred angle of between 30° to 36°, with a minimum of 15° and maximum of 50°.

Of the venues examined, Montréal was the only one found to have handrails throughout the entire lower bowl area (Figure 4.9). While they are not continuous, and do not have a second, lower handrail for smaller adults and children, they are still of great assistance to patrons.

Figure 4.9 Handrail in lower bowl area, Montréal.

Studies done by the National Research Council at the 1978 Commonwealth Games in Edmonton dramatically illustrated the reduction in accidents and ability to direct the flow of patrons more efficiently into the stands when such handrails are provided. Unfortunately, one problem of such installations is that the stairway must be made wider accommodate the handrail, and this can reduce the number of revenue-generating seats in the area. Furthermore, handrails may block views of the arena for people sitting on the aisle. More investigation as to the optimum angle of seating to eliminate these problems needs to be done.

Of the remaining facilities, Toronto and Ottawa (Figure 4.10) had handrails at the upper edges of the lower bowl area, while all arenas had handrails in the upper level seats, where the angle of the seating area was greater 50°. An excellent example of such stairs is displayed in Calgary (Figure 4.11), where reflective and textured strips, the handrail, and prominent row and seat markings are integral, well-designed (including curved ends to reduce the hazard of sharp edges), and thoughtfully executed.

Figure 4.10 Handrail in upper main bowl area, Ottawa.

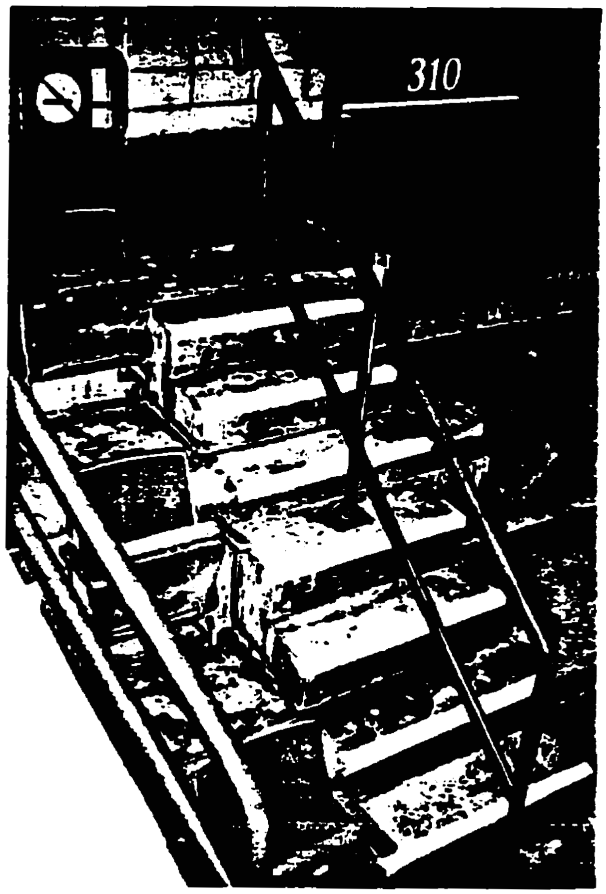

Figure 4.11 Staircase in upper bowl, Calgary.

Where handrails are not provided in the lower bowl area, other methods of assisting patrons are employed. At a long flight of stairs in one corner of Edmonton (Figure 4.12), a series of reflective strips and contrasting-coloured textured strips mark the treads on the metal steps. With all the ushers equipped with flashlights, such strips are effective in guiding patrons, although this system becomes less effective in crowded conditions.

Figure 4.12 Reflective strips on stairway in lower bowl, Edmonton.

In the newer venues, more attention has been paid to the marking of stairs. Figure 4.13 illustrates the marking and texture of the stairs in the main bowl in Ottawa; notice the prominent row markings and coloured texture strip. While not reflective, the texture is of sufficient width and roughness as to be most effective in signalling the edge of the tread without disrupting users' strides.

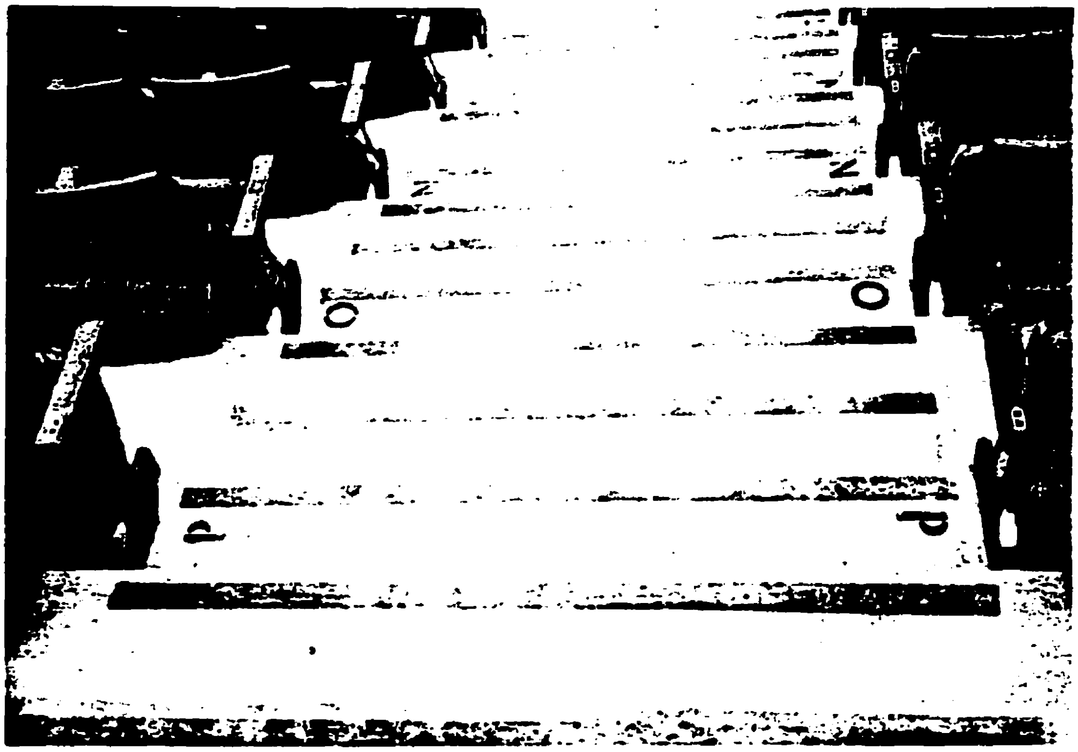

Figure 4.13 Stairway in main bowl, Ottawa.

Toronto takes a somewhat different approach to marking, by placing a small number in the centre of the tread. While the angle of attack of the stair is somewhat less than Ottawa's, the marking can be somewhat confusing; depending on which way one is going, Figure 4.14 could be indicating Row 19 or Row 61, although it is obvious if the rows are in sequence. Nevertheless, the number could be underlined to avoid ambiguity, as well as made larger. Additionally, the plastic is clear and somewhat slippery, becoming a potential hazard.

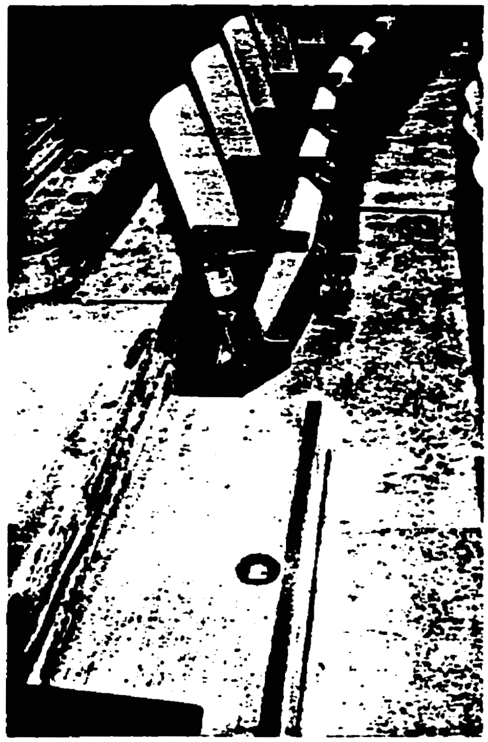

Figure 4.14 Stairs in lower bowl, Toronto.

Outside of the bowl area, stairs generally conform to the NBC, although they are frequently not as useful to persons with visual impairments as they might be. For example, to reach the box office in Montréal, one must descend a series of stairs that are painted a flat light grey (Figure 4.15). With the handrails, treads, and landings all the same colour and texture, it is very difficult to discern where one ends and the other begins. This is a prime example of a situation that could be substantially improved at minimum cost with a revised paint and/or colour scheme; for example, there are specially-formulated nonslip paints that contain grit particles that could be used to impart texture.

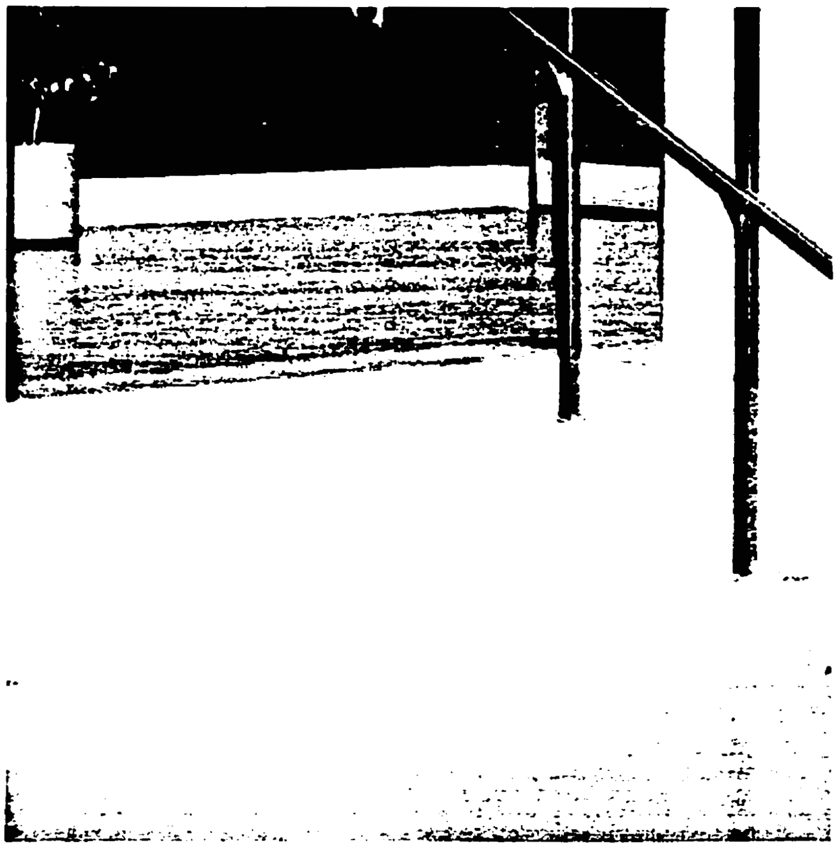

Figure 4.15 Stairs to box office, Montréal.

Not dissimilar is the treatment of the staircases outside of the bowl area in Toronto. Because banks of elevators, staffed with operators, are the prime movers of people between floors, the staircases are primarily used only for emergencies and at the end of the game, when patrons no longer wish to wait for an elevator. Even though they are primarily utilitarian in this regard, and have only one handrail, they are well-textured and lit, with frequent windows to provide outside views (Figure 4.16).

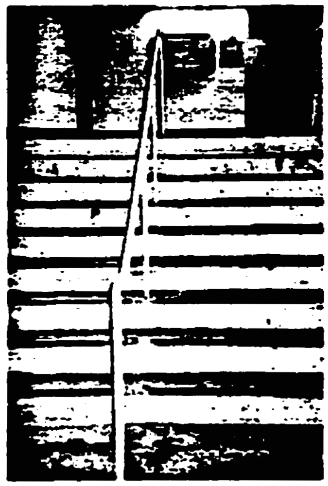

Figure 4.16 Main staircase in interior corridor, Toronto.

In this regard, Vancouver is perhaps the venue that has done the most in providing information via reflective treads as to the position of top and bottom stair treads (Figure 4.17) to assist in patrons finding their way. Edges of the floor and stair areas are painted a different colour, and have additional texture added to them to alert patrons when they are near the wall.

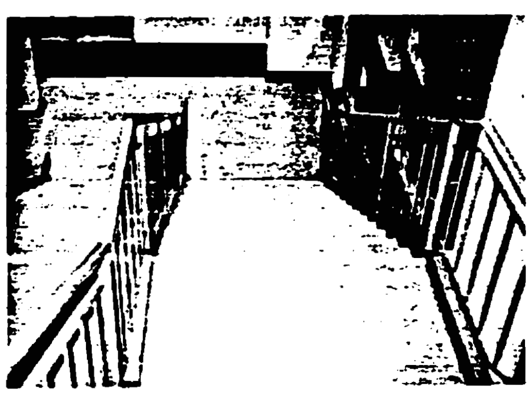

Figure 4.17 Staircase and painted/textured floor, Vancouver.

Regrettably, there are far more problematic situations regarding stair safety than appropriate ones, and several of the more egregious incidents will now be discussed. Not surprisingly, perhaps, they occur in the two oldest facilities (Calgary and Edmonton), which may reflect expansion of the requirements to the NBC after their original construction.

For instance, despite the shining example of a staircase in the seating area noted above in Figure 4.11, Calgary's staircases tend to be primarily within the bowl area, leading to problems with patrons wishing to exit but not being allowed to do so because of a perceived problem with such movement interfering with the progress of the game. While the stairs are adequate in size, this inability to move freely throughout the building is often frustrating for patrons. Additionally, major staircases in the corners of the upper reaches of the public seating are neither well-lit during games, nor have reflective strips or other markings, especially when the width of the staircase changes and becomes narrower as one ascends past the landing and changes direction.

Calgary also features prominently in two other extremely problematic stair situations. First, there is the transition area in the lower bowl between the concrete and metal stairs (Figure 4.18); while well-marked with reflective strips, there is not only a textural change, but also a marked difference in tread and riser dimensions in contravention of Sentence 3.4.6.7. (3) discussed previously.

Even for persons with excellent vision, this is a most disconcerting experience, and several patrons noted that despite having season tickets in the area, they still had difficulty with descending, especially when loaded down with concession items.

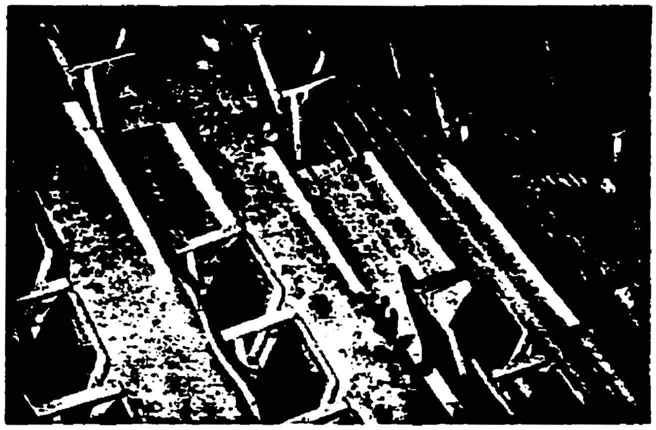

Figure 4.18 Transition area, Calgary.

The final problematic condition extant in Calgary is the matter of the metal stairs that descend from the transition area noted above. While they have minimal texturing, there is no colour or reflective strip marking the edge of the tread. They are also extremely slippery, and caution is needed, especially when descending (Figure 4.19).

Figure 4.19 Metal stairs in lower bowl, Calgary.

There are two problematic situations in Edmonton. The first is at the entry to the lower bowl from the main public corridors and is illustrated in Figure 4.20. Here, the extant condition requires patrons to negotiate several small steps, a series of awkward turns, locate the main stair, and descend, looking for their row number. In the case below, there is also a dearth of handrails and textured treads, although the area is well-signalled with reflective strips. Ushers interviewed in this area indicated that patrons frequently misstep in the area, with two or three injuries requiring medical assistance occurring almost every game.

Figure 4.20 Stairs in lower bowl, Edmonton.

Edmonton's other code violation occurs in the exterior staircases. As is visible in Figure 4.21, there is no guard on the outside of the railing to the right, in contravention of Article 3.4.6.5 as discussed previously. While no injuries or problems were experienced during the site visit, this is certainly one area where management needs to address improvements to the facility.

Figure 4.21 Exterior staircase, Edmonton.

4.1.3.3 Signage

Signage was one of the more difficult areas to assess, and one of the most important in impacting the abilities of patrons in wayfinding (Wang, 2000). There was also a great deal of design variation between arenas, indicating that this is likely an area where proscribing standards might be a frustrating exercise at best, and an impossible one at worse. Notwithstanding that statement, visitors are greatly influenced in there perceptions of buildings in general by the readability and appropriateness of the signage (Marans and Spreckelmeyer, 1981).

The main characteristics used in evaluating the venues, and adopted as standards for legibility were set as viewing distance, typeface and proportion, and colour contrast (Olin, 1983; Arthur and Passini, 1992); these have also been emphasized in the recent ANSI A117.1-1998, as discussed in Chapter 3 (Toji, 2000). Bringhurst

(1996) discusses rationales for selecting specific typefaces, but does not emphasize one as being "better" than another. In fact, examining the signage in Calgary, which was ranked as superior, both serif and sans serif faces are used together.

In utilizing signage optimally, a determination needs to be made as to what information needs to be portrayed, as well as the most appropriate method to display it. There is a distinct move towards using pictograms (such as those in ISO 7001, and the extensive collection published by Dreyfuss in 1972) where ones exist, but unless the pictograms are easily understood, confusion can be quickly encountered (Hochberg, 1994; Bruyas, LeBreton, and Pauzié, 1998). (A prime example of this appears below, in locating the bank machine in Ottawa.)

Pictures have existed for thousands of years, and their perception studied extensively (Kennedy, 1994). And although "Western culture has taught us to be wary and even distrustful of images as reliable sources of information and knowledge" (Beck, 1994), their continued, and expanding, use can be problematic if the users do not understand what they mean.

There can be many forms of literacy: "each one consists of a set of interdependent social practices that link people, media objects, and strategies for meaning making" (Lemke, 1998). It is important that if the use of pictograms as signage is continued, that the population-at-large know the meanings of the signs used, and with the growing role of computers and hypertext to expand and contextualize meanings in education (Askov and Bixler, 1998; Fawcett and Snyder, 1998), transforming the visual literacy of people regarding pictograms could be made easier if the symbols or pictograms are accompanied by appropriate (from visual and content perspectives) texts. The use of both pictogram with text is most definitively shown in Figure 4.23.

In analyzing and evaluating the signs presented in the six venues, it was important to notice if signs were indeed present, and if so, were they easy to locate. When signs existed, it was necessary to determine whether they communicated sufficient information in an understandable form, either in English or French, or by the use of pictograms. Persons with visual impairments may be able to see appropriately sized pictograms easier, but it is important that they be easy to interpret, which is not necessarily true in all venues.

A relatively proficient job of indicating the two adjacent classes of seating is demonstrated in Toronto (Figure 4.22); the premium club seats are to the left, and are differentiated by the larger sign, the title "Air Canada Club" over the aisleway, and the row notations with an "M."

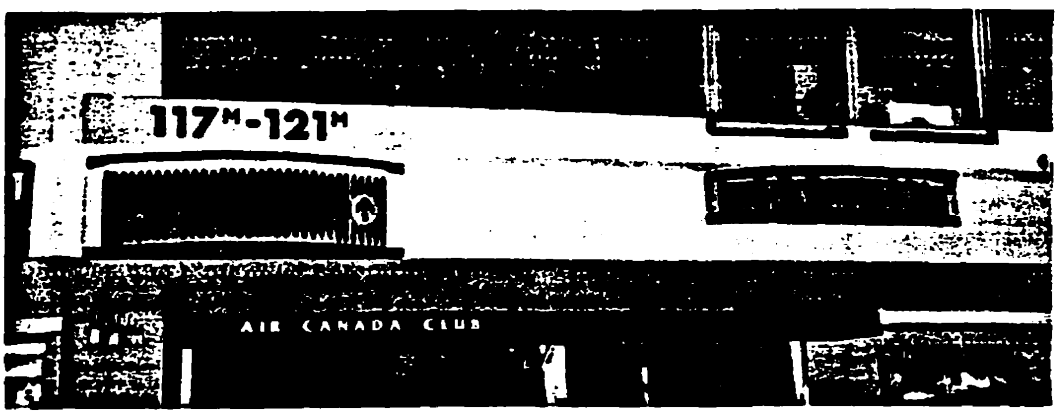

Figure 4.22 Seat signage, Toronto.

As noted above, some signs use a combination of internationally recognized pictograms and text. In this example from Edmonton (Figure 4.25), the pictogram not only depicts the gender, but also that the washroom is wheelchair-accessible. This sign is somewhat problematic, however, in that it is only clearly visible if one is a few metres away from the wall it is painted on, and the wheelchair logo is too small to be identified at a distance.

Figure 4.23 Bathroom signage, Edmonton.

One of the major challenges in Ottawa is the posting of signs in both English and French. While Figure 4.24 depicts a typical directional sign on the main concourse level, its major flaw is readability; the actual size is approximately 30 x 45 cm, and it is not easily visible at a distance of more than 2 m.

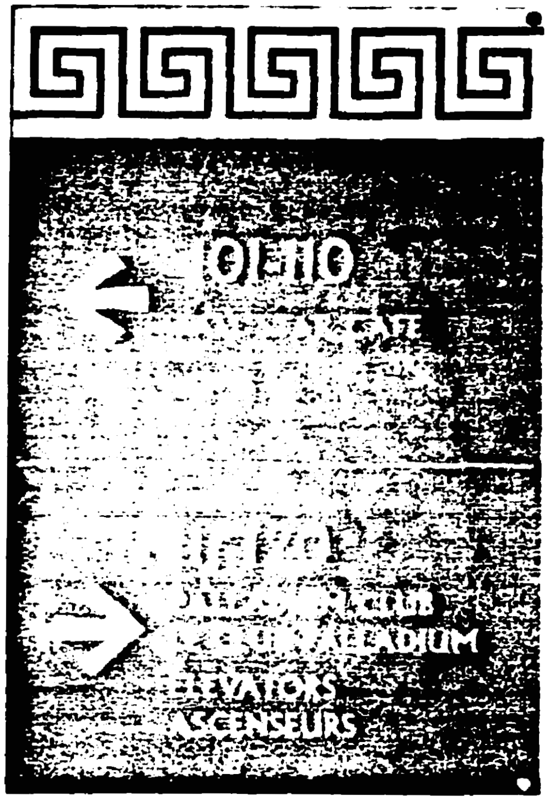

Figure 4.24 Typical sign on main concourse level, Ottawa.

As noted in Edmonton, the placement of signage can be problematic, even if the sign itself is otherwise "useful." Figures 4.25 and 4.26 highlight this problem in Ottawa, where the placement of both is awkward, and the signs themselves are too small to be comprehended at any distance more than 2-3 m, especially in the case of the interior sign (Figure 4.26) which is almost lost in the visual clutter of the tile wall. In such instances, the most readily accessible way to determine that this door leads to a women's bathroom is by looking at the queue that forms during intermission.

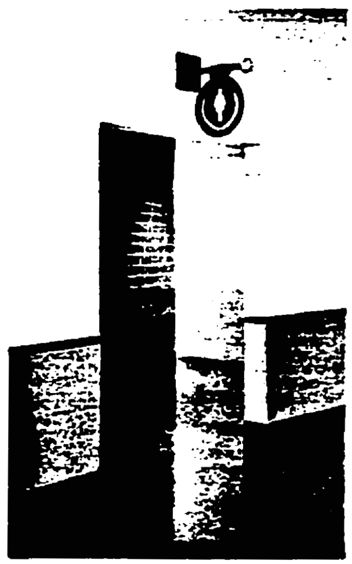

Figure 4.25 Corridor sign, Ottawa

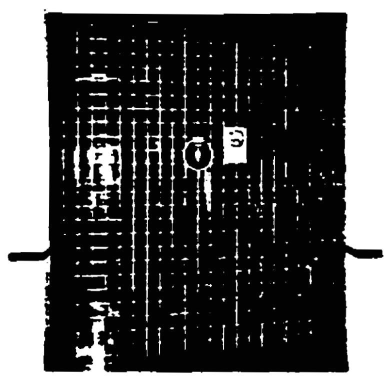

Figure 4.26 Interior sign, Ottawa.

In Vancouver, the situation is a little more confusing. Figure 4.27 illustrates an excellent example of the right descriptor for the sign and excellent placement, but with a deceiving directional indicator. The washroom entrance is directly below and to the left of the sign, not to the right, as a cursory inspection might indicate.

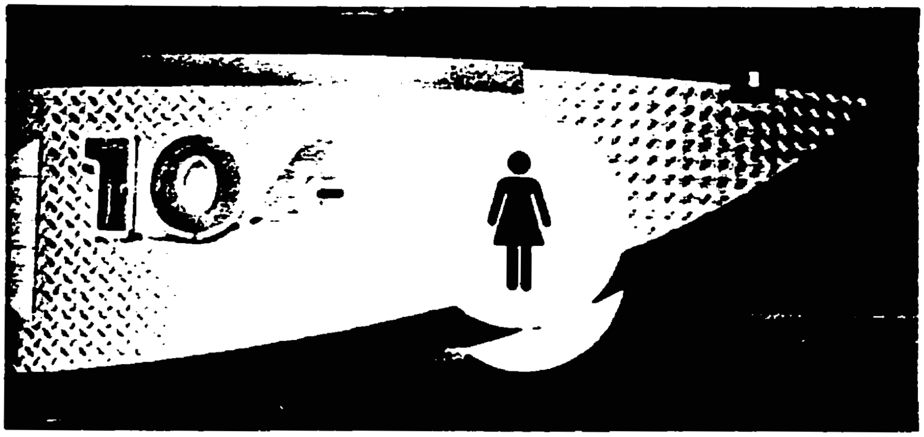

Figure 4.27 Women's washroom, Vancouver.

While Ottawa makes the attempt at communicating in both official languages, Montréal has obviated the problem by either not posting signage (there is but one to be seen in Figure 4.8, although what little there is in the public corridors consists of easy-to-read black figures on a yellow ground) or by not keeping signage maintained. For a relatively new facility, Figure 4.28 shows how the signage (with large type in French and small type in English) has degenerated to the point of being practically unreadable.

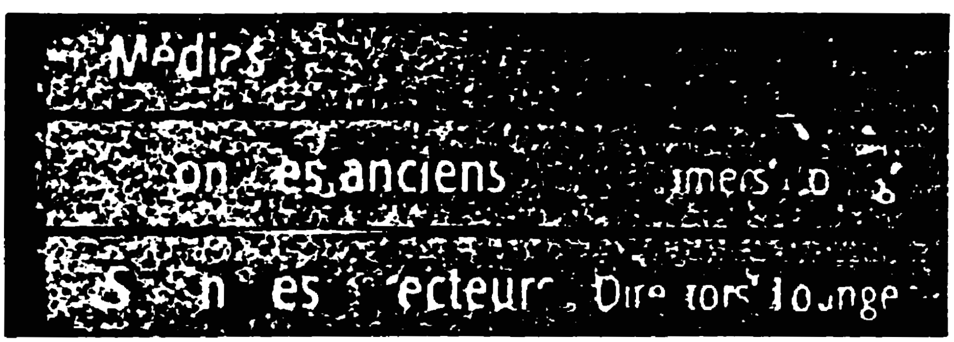

Figure 4.28 Damaged signage, Montréal.

4.1.4 Wayfinding Tasks

After analyzing the various components described above, a series of tasks common to all hockey games and arenas were performed at each venue to discover how well the visual and aural cues aided a visitor. The tasks were:

1. finding a numbered seat,
2. finding and buying a variety of meals and beverages,
3. locating a washroom,
4. locating a bank machine,
5. using a pay telephone, and
6. exiting the building at the end of the game to take public transportation.

Covington and Hannah's (1997) checklist for accessibility requirements for sports facilities and a paper by Raubal and Egenhofer (1998) on wayfaring in the airports of Frankfurt, Germany and Vienna, Austria were invaluable in determining the tasks to be performed and benchmarks to be achieved.

Understanding the details of the visual processing elements required to complete these tasks is still incomplete. Treisman (1986) notes that the "perception of meaningful wholes in the visual world apparently depends on complex operations to which a person has no conscious access, operations that can only be inferred on the basis of indirect evidence." The four Gestalt laws (proximity, similarity, continuity, and closure) govern, to a large extent, how all people perceive their surroundings (Walk, 1994; Zakia, 1997), and detailed examination of their role in the perception and execution of these tasks was not performed in this MDP.

Wayfinding Task / Venue	Vancouver	Calgary	Edmonton	Toronto	Ottawa	Montreal
Seating	3	1	3	2	3	4
Concessions	4	2	2	3	4	3
Washrooms	3	1	3	3	4	3
Bank Machine	3	3	4	3	4	3
Telephone	2	2	2	2	4	3
Exit to Public Transportation	2	1	2	1	5	2

Key: Higher numbers indicate more problematic situations.

Table 2: Rating of Wayfinding Task by Venue

4.1.4.1 Seating

One of the first tasks a patron undertakes when attending a game is to find the seat that has been purchased. Edmonton (Figure 4.29) provides clear directions in the main corridor area that enable patrons to quickly and easily determine the direction they need to locate to find their section. Once reaching the appropriate section, flashlight-bearing ushers are available to assist patrons to find their seats; given that the row and seat numbers are not particularly prominent, and the stairways can be problematic, management of the facility has decided to address their shortcomings by providing people to perform tasks that could be served by improved design and building standards. While this is an expensive solution in terms of worker salaries, it is, nevertheless, a practical one, given the extant situation.

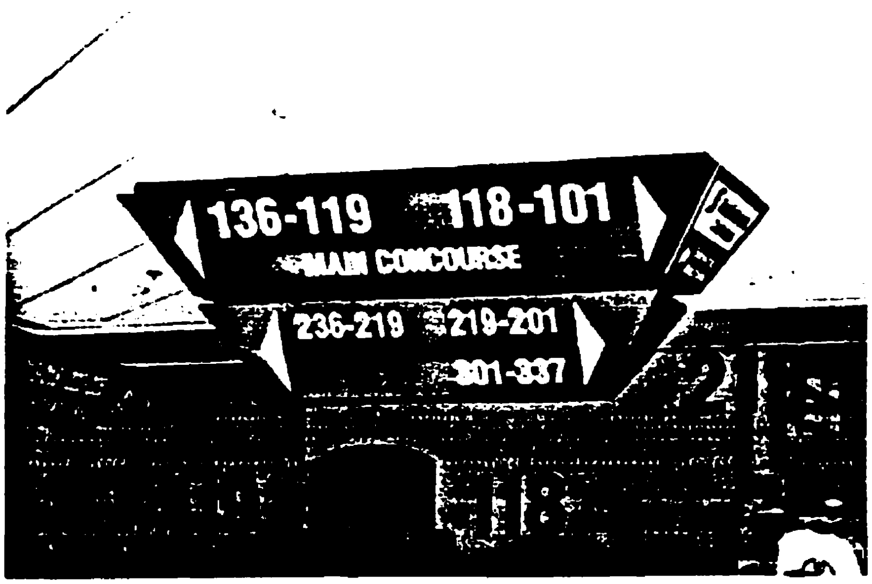

Figure 4.29 Seat directional signage in main concourse, Edmonton.

The other facility that performed well in this category is Calgary, and for a similar reason; Figure 4.30 illustrates main corridor signage into the lower bowl area. Easy to read, both from typographic and colour standpoints (white figures on blue ground, which ranks highly; see Chart 1), visible from the side as well as face-on from the corridor, Calgary was the easiest venue to find a seat in without assistance. Ushers are available to help visitors, but there seemed to be fewer than in Edmonton (which often has two at each entry port) and those who were there were generally not equipped with flashlights.

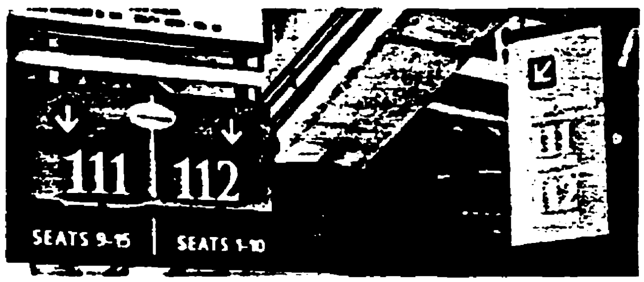

Figure 4.30 Seat signage for lower bowl area, Calgary.

Of the other four venues, Vancouver, Toronto, and Ottawa performed adequately. On one hand, Vancouver's signage is certainly sufficient and easy to read, but there are even fewer ushers than in Calgary. On the other hand, Vancouver will provide, with advance notice to the arena management, personal escorts for persons with visual impairment; the catch is to know that this is available, and to call prior to the game to arrange assistance.

Locating a seat in Toronto is not a difficult task, although the fact that there are some levels that one cannot walk around fully can make it somewhat of a challenge if a patron takes the wrong elevator bank up to their level. Unless one retraces one's steps, and goes up or down to find the appropriate access point, an interesting adventure can ensue: the evaluator's excursion included visiting some of the food service kitchens.

Ottawa's prime source of problems ensues from the small size and colours used (beige figures on a purple ground) of the corridor signage, but once the appropriate section is located, finding a seat is a reasonably easy chore. The row and seat numbers is superior to all the other facilities, but getting to the section is difficult.

Montréal's confusing row signage (Figure 4.31) makes locating a place in the bowl area a distinct challenge, as it is not clear which row is indicated by the number. In finding a seat, the evaluator found the only way to determine which row was represented was to count down from the top, as the lettering of rows is not consecutive.

Figure 4.31 Upper bowl seating with seat row markings, Montréal.

4.1.4.2 Concessions

After finding one's seat, the next usual requirement is to purchase a beverage and something to eat. This task become one of the most interesting for the evaluator, in part due to the wide variation of "specialty" foods available at the venues. Vancouver and Toronto had the most variety of foods available, with many of the concessions leased out to well-known local or chain restaurants — Vancouver has a White Spot and a Boston Pizza, while Toronto had several Shopsy's Deli stalls and a kosher hot dog stand, for example — although the variety played little, if any, part in determining the net evaluation of how easy it was to find.

Edmonton and Calgary displayed the best performance in arrangement of concessions, organization of service queues, and convenience of having a range of choices within reasonable proximity of selected seats, even though Calgary's food and beverage selection was somewhat restricted, compared to other venues. Edmonton was superior in the organization of service queues, even in restricted areas. Given that this was performed without any formal signage or direction is likely due to the age of the facility and the previous experience of the majority of the attendees. Even during intermissions, there was little difficulty in threading through the crowd without spilling a beverage.

What made Vancouver problematic was the confusion about how the service queue system work. Given that the game attendance was low on the evening of the site visit because of a transit strike, a "normal" crowd would be a challenge to navigate.

Toronto's range and number of concessions was occasionally overwhelmed with service queues invading main walking areas before the game and during intermissions. More appropriate placement, and perhaps a slight reduction of numbers, would solve this problem.

Ottawa and Montréal both suffered from problematic situations. While Ottawa's concessions were laid out utilizing the shopping mall "food court" concept, which became extremely chaotic during peak periods. The condiments, napkins, and utensils are located in the centre of the widened aisle area, which resulted in very little room for other patrons to pass through, or for people to readily obtain whatever they required. Combined with the disorganized service queues, the beverage spills on the polished concrete floor creating hazardous footing, and the concentration of concessions in a relatively small area, rather than being strung out more throughout the corridor, made for a number of harrowing moments during intermissions.

Montréal's greatest problem was due to the narrowness of the corridors between the seats and the concessions. Attempting to walk against the "flow" of the main traffic which carrying a beverage and tub of popcorn became a challenge when faced with an onrush of other patrons in the constrained spaces. The poor air quality and lack of signage did little to ameliorate the situation.

4.1.4.3 Washrooms

The most pressing problem in locating a washroom in all the venues was the inherent problem of crowding during intermissions. Even though facilities overbuild the quantity and size (particularly for women), queues inevitably resulted, with the only instance observed of a lack of a line-up was in the premium seating area in Toronto; this is due to the fact that the washroom was larger than those available in the main public corridors and was available to a substantially smaller number of potential users.

Because of its excellent signage, Calgary's facilities were the most easily visible of all the venues (Figure 4.32), although inside, they were on the small side, resulting in large line-ups at intermission. The sole detraction in locating them was that there was no signage visible if one was walking along extremely close to that wall, however, this was only slightly problematic during non-busy times, and a non-issue when busy, as this is where the queue formed.

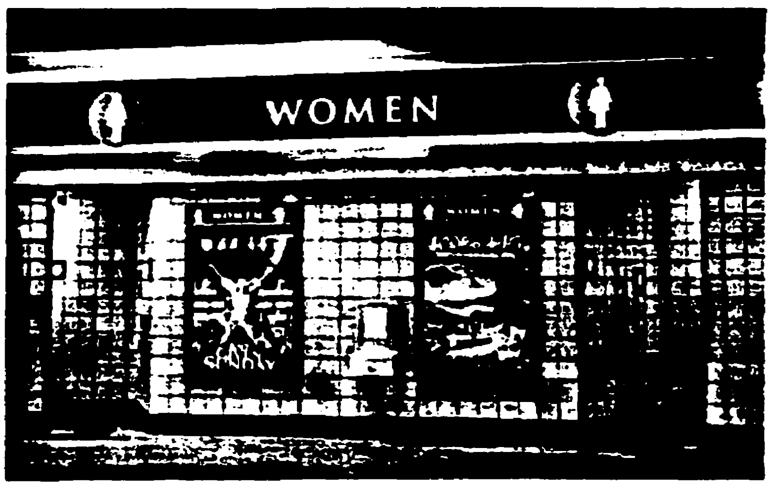

Figure 4.32 Bathroom entrance, Calgary.

Edmonton also did an excellent job with providing signage for their facilities. While universal pictographs were perhaps reduced in size, the text was large and easy to read both from a typographic and colour standpoint (Figure 4.23).

The other venues laboured under a range of problematic conditions. Vancouver's signage, while large and easily understood regarding content, did a questionable job in adequately displaying the direction the facility was located (Figure 4.27).

There is good and bad news regarding finding bathrooms in Toronto, in addition to the situation noted above. The good news is that in the main public areas, there are also signs noting the location of the next nearest washroom, as a convenience to patrons; the bad news, illustrated in Figure 4.33, is the inability to discern at a distance which doors services which gender (men are the one door to the left with a second door not visible, women have the two doors on the right, but unless a person is standing within 3 m of the sign, it is extremely difficult to determine).

Figure 4.33 Men's and women's bathrooms, Toronto.

Finding a washroom in Ottawa was also a sometimes challenging task because of the signage, where the problem is not dissimilar to Toronto. Located high up, the main sign was virtually invisible when viewed edge-on (Figure 4.25) and the only sign visible when in front of the entry (Figure 4.26) was frequently obscured by patrons either walking past or queued up, or lost in the visual clutter of the tile wall behind the sign.

What little washroom signage was available in Montréal was small, high up, and infrequent, although there were occasional signs scattered about, telling where the nearest facility was. In fact, finding the bathroom in Montréal was the most difficult of all tasks across all venues.

4.1.4.4 Bank Machine

While the in-house restaurants and souvenir stands generally took credit cards or had debit terminals, the overwhelming majority of economic transactions took place using cash, thus it seemed appropriate in discussing common tasks at a facility to add the act of finding the bank machine (ATM or Automatic Teller Machine) at each venue and examining its placement and utilization. Each venue had at least one machine that appeared to enjoy a varying degree of popularity among the patrons.

Vancouver and Toronto had the easiest machines to locate and seemed to have the shortest queues; a possible reason for this was because there were several machines in the main concourse and service was relatively quick. Bank machines on the major concourses in good locations; line-ups short and not intruding on general circulation.

Two machines were located in Montréal, despite the chronic problem of minimal signage, but they were well-located near the major pedestrian entrances. Only one machine was located in Edmonton, near the primary entrance, the souvenir shop, and restaurant, and minimal queues were observed. The placement of the machines in these four venues was arranged so that any queues did not intrude on the general circulation of patrons through the main corridor.

The remaining facilities appeared problematic. Again, somewhat obscure signage (Figure 4.34) made finding the machine in Ottawa a challenge. Additionally, they were located in a small area off the main public corridor, next to the pay telephones, but the pictogram used to indicate the machine — a dollar sign — was not immediately clear to the evaluator. If it had not been for the telephone pictogram in the same location, an inquiry would have been made to an usher to ask where the nearest machine was for the purposes of this task.

Figure 4.34 Directional signage for bank machine and telephones, Ottawa.

Because they rely almost exclusively on pictograms, signage in Ottawa suffers from the lack of a universal standard for indicating the location of an ATM. ISO 7001 has a recommendation for currency exchange, but not for an ATM. Additionally, once the machine is located, visually impaired patrons may also have difficulty reading the display. Both of these problems are being addressed by work currently in progress with Dr. John Gill of the Royal National Institute for the Blind in London, England, who is developing Tiresias, a display font specifically for use in such terminals, as well as the signage to direct people to them (Gill, 2000).

Calgary is also a problematic situation. There are only two bank machines in the building and they are so situated in corners of the building that the line-up runs diagonally in a straight line into the main pedestrian route and intrudes on the ability of patrons to circulate throughout the area. Orienting the machines to be parallel, instead of perpendicular, to one wall, or moving them to a less congested section of corridor would alleviate this situation and reduce the bottlenecking that occurs. Despite the positioning, the machines were highly popular, with the longest queues observed at any of the buildings, which did nothing to exacerbate their effect in disrupting the flow of pedestrian traffic past them.

4.1.4.5 Telephone

Despite the advent of cellular telephones, there is still a need for public pay telephones, as well as TDD devices, in such facilities, although no such specific requirement is specified in the NBC; Sentence 3.2.4.22. (5) only requires "that emergency telephones are located in each floor area near exit stair shafts."

All venues, with the exception of Calgary and Montréal, had a range of public telephones and TDD stations (there is no TDD available in Calgary) easily observed and available. The ease with which this task was completed (despite Ottawa's recurrent signage problem) led the observer to believe that this was not a sufficiently complex operation to warrant extensive comments. Given the lack of impact of the perceptual concerns studied in this MDP, with the exception of those dealing with ambient and communication sound, which were not found to be of much consequence in any of the venues, this task could well be rejected in any subsequent research in this area.

4.1.4.6 Exit to Public Transportation

The venues that are downtown or have good proximity to mass transit (Vancouver, Calgary, Edmonton, Toronto, and Montréal) all had prominent signage to direct patrons to the service, and did an excellent jobs in differentiating between the different options available, which ranged from light rail, subways, commuter trains, and buses. Toronto has an enclosed link to Union Station, Montréal has a similar one to Métro, while Calgary and Vancouver have covered walkways.

Ottawa is the most notable exception to this situation. Because of the dearth of public transportation to the arena (express buses run just before and immediately after events), it was not surprising to observe that there was minimal signage to direct patrons to the bus pickup area. Once outside the arena, there is no signage in the parking lot either, resulting in some patrons attempting to cut through a parking lot with the bus shelter in sight, only to find themselves having to retrace their steps when confronted with a chain-link fence 1.5 m high separating the shelter from the parking lot. Given the high standard of OC Transpo (the regional municipal transit authority) service once the buses arrive, fill, and depart, as well as the routes serviced, it is only natural to assume that problems in delivering patrons rests with the facility.

4.2 Conclusions

The most startling fact observed in the course of the site visits was the fact that each venue did one thing extraordinarily better than the others (signage in Calgary, for example), and one thing much poorer than the others (ambient sound in Edmonton), with virtually no overlap, as shown in Tables 1 and 2, pages 36 and 67. Whether the building was old or new, specifically designed for hockey or more than one sport, or privately- or publicly-financed, did not matter. When this was mentioned in the later visits, every guide expressed surprise and curiosity about what their site did well (or not so well!), and how it compared to the others. That such disparity exists was both interesting and puzzling, as given the limited number of venues, purposes, and designers, a casual observer might have expected a higher degree of similarity.

That being said, there was no one venue that performed sufficiently well in all categories to be used as an overall model for either retrofitting existing facilities or to create new ones. At best, one could look at Toronto as having the most appropriate range solutions installed, although their shortcomings have been previously noted. But given the fact that it is the newest, that should have been perhaps expected in such a survey that was conducted for this MDP.

On the negative side, the author was somewhat surprised about how poorly (with the notable exception of the handrails throughout the lower bowl area) Montréal performed in this review, given its relatively recent construction date. Original expectations were that the two oldest facilities (Calgary and Edmonton) would fare poorest in the review, and while they certainly have their faults, overall impressions would rank Montréal below them.

There were also other factors that were not considered in this review that could have been analyzed. One would be to examine the seating more closely, including accesses from the aisles and stairways. This situation can be problematic for people having to deal with visual impairments while trying to manoeuvre a child, a concession item, or an umbrella all at the same time. Vancouver has installed drink holders on the backs of seats to reduce tripping, for example, and Toronto has seats on aisles with flip-up arms to accommodate large-sized patrons.

The fact remains, however, that there is no one "best" solution to any problem, and by conducting such reviews as is contained in this MDP, distributing the information among and between the participants, and looking for cost-effective and innovative solutions, that not only hockey arenas, but other large structures similarly used for a large number of patrons, can be improved for the visual- and hearing-impaired.

5. Recommendations

5.1 Existing Construction

It would be both simplistic and foolish to promulgate a series of recommendations that would involve only "total" solutions: each building is unique — architecturally, financially, and, in its own way, emotionally, from the standpoint of "sense of place" — from the others. Moreover, merely instituting a series of physical changes, whether structural or other, entails interaction with a host of other factors involved in the management of such buildings, most importantly, economic realities.

Gifford and Martin (1991) define "desireability" of implementing changes as the product of urgency times the number of persons affected, divided by the cost. Those venues with signage perceived as lacking would find that improving it, perhaps in conjunction with ensuring that patrons can provide feedback on effectiveness, would be a worthwhile investment.

Yet it is often small things — a plethora of feedback cards, brochures detailing services for patrons, helpful staff, even carpets for service animals to keep them warm on cold concrete floors — that can bridge the gap between a poor and a comfortable experience. Such touches can often be instituted at lower cost than retrofitting massive structural renovations; see Appendix 4 for an example of the brochure available in Toronto.

5.2 Future Construction

One major hope is for changes to the National Building Code, as well as provincial standards, to require future construction to be more assistive for the visual- and hearing-impaired. Many of the appropriate solutions are easily implemented (both from design and cost perspectives) at the drawing board, although instituting such changes would likely require a great deal of political will on behalf of federal and provincial legislators. Whether or not they can be persuaded to "do the right thing" in this regard will likely become easier as architects, contractors, and other members of the building industry find that such adjustments not only become in their "best interest," but will be demanded by more cognizant and sensitive clients.

As a start, an extensive examination of current implementation of the Americans with Disabilities Act (ADA) should be conducted, with a view towards incorporating appropriate architectural sections into the National Building Code. In conjunction with such a review, other studies of the effectiveness of those portions of ADA that deal specifically with visual- and hearing-impaired persons, which may well include an update of publications issued by the U.S. Department of Housing and Urban Development, Office of Policy Development and Research (1979), would be appropriate. Examination of how these factors contribute to the state of other hockey arenas (primarily in the United States, but also around the world) would allow provide insights into additional solutions.

Improving the utilization of POE as a tool would also be seen to be of great value in this regard, whether utilizing the manifesto of Preiser and Vischer (1991), Preiser's (1989b) more strict, performance-based format, or greater expansion of Sommer's work — or, preferably, a wholistic synthesis of the previous attempts to codify the process — with particular emphasis on "perception" versus pure "number-gathering." That POE is still practiced in Canada, Sweden, and Brazil to a greater extent than in the United States is somewhat comforting, although it is primarily done solely on publicly funded offices and health-care facilities (Bechtel, 1989; Farbstein, 1989; Parshall, 1989; Ventre, 1989; Zeisel, 1989).

5.2.1 A Proposed Solution

If presented with the opportunity to work on a potential arena project, there are a number of items that should, in particular, be addressed at the design phase to insure as many could be implemented as possible. These fall into two categories: the strictly design-related and management/operation-related.

5.2.1.1 Design-Related Issues

Floors and corridors would have textured surfaces, limiting the use of polished concrete and linoleum, with colour and texture changes directing patrons appropriately. Where possible, low-pile, antistatic carpets would installed to reduce ambient sound transmissions.

Acoustic studies to reduce transmission of sounds bouncing from ceilings would be conducted, and an appropriate solution (acoustic tile or other material, or changes in the design of the ceiling) implemented to reduce ambient transmission of sound in both bowl and public corridor areas.

Food service areas would be organized along the periphery of the main public corridors, leaving the middle free for patrons to move to and from seating areas.

Signage would be of such size as to be visible at a distance of at least 10 m, utilizing pictograms and appropriate typefaces (no preference for either serif or sans-serif). Colour of signage to harmonize with general design, but should be high on the visibility scale (Chart 1) without becoming irritating or contributing to visual clutter.

A commitment to install handrails on all stairways in the bowl area would be instrumental in providing assistance to all patrons with a reduced-accident environment, reducing legal costs for management in the event of lawsuits, and in providing positive experiences that encourage repeat business on the part of attendees.

Increased stairway marking should also implemented; this would include texture and colour, reflectivity, and enlarged size of row and seat numbers/letters to enable all patrons to find their places quickly and easily.

Major entry and exit areas should have appropriate signage to improve the flow of patrons entering the facility, as well as returning to the parking area or public transportation stop.

A percentage of seats with built-in terminals to assist the visual- and hearing-impaired to better follow the game should be installed, subsidized, if necessary, to allow their cost to be amortized over the entire budget.

5.2.1.2 Management/Operation-Related Issues

A number of the management/operation-related issues are easily achieved without excessive costs being generated: this would include the elimination of sound-and-light shows prior to the event and the ear-splitting sounds generated when the home team scores.

Producing a brochure to promote the arena's facilities for the visual- and hearing-impaired would likely increase patronage by persons so afflicted, and thus would result in a net gain of income; such an example is contained as Appendix 4. Increased promotion of all the changes from a "business-as-usual" arena has been shown (Farmer, Mulrooney, and Ammon, 1996) to generate interest from users previously not targeted for marketing campaigns.

Hand-in-hand with the increased publicity would also include providing more training for usher staff in dealing with the visual- and hearing impaired to ensure they are both sensitive to the issues and able to provide assistance in finding solutions to specific problems. Such dedicated staff, such as the Fan Advocate in Toronto and the Handicapped Services Co-ordinator in Vancouver, can be of great use as resource people for the general staff.

Additionally, feedback should be solicited on a regular and recurring basis, by in-house surveys, distribution of comment cards, and local polling to determine areas of potential problems and possible solutions. Currently, Calgary and Toronto encourage patrons to voice concerns (Calgary by use of comment cards placed throughout the facility, Toronto by use of the Fan Advocate), and incorporate suggestions when possible.

6. Suggestions for Further Research

This MDP has barely scratched the surface in investigative research, and, in fact, has raised more questions than it has answered in the collection of disparate information that previously was not connected. There are, for example, a number of existing experimental projects that have not been examined, as they are not currently being tested in Canada for a number of reasons, primarily economic ones. As well, advances in acoustics and communications technology are being made constantly, with new materials developed around the world.

6.1 Existing Experimental Projects

Some of the experimental projects currently in trial include Braille pin boards that use technology contained within the puck to pinpoint its location and transmit it to an electronic board. While technically successful at a low level, problems still remain with enabling the puck to meet the standards of the sport (for weight and temperature) while embedding the computer chip needed to transmit its location.

MCI Center in Washington, DC, another recent hockey construction project, has a number of seats equipped with interactive terminals that allow visually-impaired patrons a better view of play and hearing-impaired visitors the ability to have closed-captioning displayed. While these technologies are not "new" per se, their use with the facility is.

Continued development of the "Smartsound" public address system (Fitzgerald and Trim, 1998) needs to be monitored closely for application to arenas, and other similar proposals studied carefully for potential use.

6..2 Other Related Lines of Research

A wide range of other issues and lines of investigation arose when conducting the initial academic readings and the site visits, both from patrons, management, and individual situations observed while in the field. It became obvious that no serious study of hockey arenas could be conducted without investigating the economic situation on the Canadian NHL teams. That most of the persons interviewed for this MDP commented that it was unlikely that there would be any other teams besides Toronto and Montréal still playing in Canada within ten years was a sobering thought.

As mentioned in Section 4.2, an investigation into the ergonomics, placement, and labelling of seating could form a productive line of research in and of itself. There is also the matter of making arenas safer places, with additional research needed into air quality issues (both for patrons and players), and especially, the matter of the various styles and forms of safety glass, including installation, height, and methods to make it less hazardous to both players and spectators. Given the number of injuries incurred in the 1999–2000 hockey season, this issue has become more pressing and is of great concern to both teams and patrons.

On a larger scale, there is also the expansion of POE in order to improve the overall experience of patrons. There are many problems inherent with such broad-based investigations, however, including the assimilation of widely-diverse areas of expertise, and a perceived assumption that such lowest common denominator solutions result in poor experiences for all.

Appendix 1

Stock questions asked at each venue:

1. When was the building constructed? Has it had a refit, and if so, when? What was done and why? Did it make the building easier for the visual- and hearing-impaired to use?
2. What is the seating capacity?
3. Do you provide specific facilities for the visual- and hearing-impaired?
4. Is there much demand for these services?
5. Do you produce a publication to assist handicapped visitors?
6. What do you feel are the biggest problems in dealing with patrons who have visual or hearing difficulties?
7. Do you feel you provide these patrons with a good experience at hockey games? Why?
8. What additional facilities would you like to provide? What are the barriers to doing so?
9. How do you think your facility compares to the other NHL arenas in Canada? Why?

Depending on the answers provided, or specific items identified by the interviewer, additional follow-up questions were posed.

Appendix 2

Site Evaluation Form

Weighted average taken of results for each question in each category (weights for each question indicated on data form). The subjective question regarding "comfort level" (CL) was noted for each concern and each venue, but is not used in the primary calculation. In parentheses following each question is the basic evaluation scale; numbers posted in the raw data table that follows may fall in between those noted below in selected cases. The means and CL for each form the matrix on page 36, with additional noted remarks forming the basis of the general commentary.

Visual

Floors/Corridors

a. What are the floors made of? (Polished concrete/linoleum, 5 points; textured concrete, 3 points; carpeting, 1 point)

b. Are they decorated? (No, 5 points; coloured or textured, 3 points; coloured and textured, 1 point)

c. How wide is the main public corridor? (Walk 2–3 abreast, 5 points; 4-6, 3 points; more than 6, 1 point)

d. How wide are secondary corridors (private boxes, etc.)? (Walk 2 abreast, 5 points; 3–4, 3 points; more than 4, 1 point)

e. Amount of lighting to discern visual clues? (High (glare) or low (dim), 5 points; appropriate, 1 point)

f. Physical clearance? (Unmarked projections, obstacles, sharp corners or edges, 1 point each, to a maximum of 5)

g. What are the overall sound levels? (Excessive, 5 points; normal range of hearing, 2 points; quiet, 1 point)

h. Does the ambient sound level interfere with interpersonal communication? (Yes, 5 points; sometimes, 3 points; no, 1 point)

i. Are announcements heard easily? (No, 5 points; sometimes, 3 points; yes, 1 point)

	Vancouver	Calgary	Edmonton	Toronto	Ottawa	Montreal
a. (.15)	2	5	5	3	5	5
b. (.15)	1	5	5	1	5	5
c. (.10)	1	1	3	3	1	5
d. (.10)	3	1	1	5	3	5
e. (.10)	3	1	2	1	1	1
f. (.10)	0	1	3	1	0	4
g. (.10)	2	3	3	2	3	4
h. (.10)	2	3	3	3	4	5
i. (.10)	3	2	2	3	4	4
Mean	2	3	3	2	4	4
CL	3	3	2	2	5	5

Stairs

a. What are the stairs made of? (Polished concrete/metal, 5 points; textured concrete, 3 points; carpeting, 1 point)

b. Are they decorated? (No, 5 points; coloured or textured, 3 points; coloured and textured, 1 point)

c. Are all the stairs in a run of equal tread and riser dimensions? (No, 5 points; Yes, 1 point)

d. Are handrails provided to facilitate movement? (5 points; deduct 1 point each for handrails in lower bowl area, upper bowl area, double-level handrails, both sides of ramps, and any other example that exceeds NBC standards)

e. Are the stairs wide enough to accommodate use at busy times? (No, 5 points; Yes, 1 point)

f. What are the overall sound levels? (Excessive, 5 points; normal range of hearing, 2 points; quiet, 1 point)

g. Does the ambient sound level interfere with interpersonal communication? (Yes, 5 points; sometimes, 3 points; no, 1 point)

h. Are announcements heard easily? (No, 5 points; sometimes, 3 points; yes, 1 point)

	Vancouver	Calgary	Edmonton	Toronto	Ottawa	Montreal
a. (.175)	3	5	5	3	3	3
b. (.175)	3	2	1	3	3	3
c. (.125)	1	5	1	1	1	1
d. (.125)	3	2	4	3	3	2
e. (.10)	3	1	3	1	1	1
f. (.10)	2	2	3	1	2	3
g. (.10)	2	2	3	1	3	2
h. (.10)	2	1	3	3	2	2
Mean	3	5	4	3	2	2
CL	3	5	5	3	2	2

Signage

a. Are signs present, easy to locate, and of appropriate size? (No items, 5 points; one, 4 points; any two items, 3 points; all, 1 point)

b. Is the information readable? (No, 5 points; appropriate typography/ pictogram or colour contrast, 3 points; appropriate typography/pictogram and colour contrast, 1 point)

c. If the signs uses pictograms instead of words, are they easily translatable? (None, 5 points; some, 3 points; all, 1 point)

d. Is there sufficient information to be useful for patrons? (Needs major work, 5 points; needs some work, 3 points; needs no work, 1 point)

	Vancouver	**Calgary**	**Edmonton**	**Toronto**	**Ottawa**	**Montreal**
a. (.30)	2	1	2	3	3	4
b. (.30)	1	1	1	2	3	1
c. (.20)	3	1	3	3	4	3
d. (.20)	3	1	2	3	3	5
Mean	2	1	2	3	3	5
CL	3	1	2	2	3	5

Wayfinding Tasks

The wayfinding tasks were evaluated subjectively by ease and speed with which the task was able to be performed by the evaluator, as per the methodology discussed in Chapter 1 and illustrated on page 67.

Appendix 3

General Site Comments

1. Vancouver

Vancouver's General Motors Place, opened in 1996, is home to both the Vancouver Canucks of the NHL and the Vancouver Grizzlies of the National Basketball Association, and also hosts musical concerts and other large events. It is well situated next to a Skytrain (rapid transit) station and has a number of city and suburban bus routes within a three-block radius. While the smallest of the arenas visited (seating capacity for hockey is approximately 18,000), it has been wedged in between the Georgia Street Viaduct in downtown Vancouver, adjacent to British Columbia Place (football stadium) and the former location of Expo 86, so that urban patrons can access the facility with ease.

All handicapped visitors can take advantage of a special guest-services staffer if they require assistance. For visually-impaired persons accompanied by a guide dog, the facility provides a carpet for the dog's comfort.

2. Calgary

Calgary's Canadian Airlines Saddledome was constructed in 1984 and renovated in 1995. This unique structure was designed specifically to host the Calgary Flames, as well as some of the events for the XV Olympic Winter Games; the recent renovation was to add more private boxes and a premium club seating area in the lower bowl. Calgary is the only venue that provides postage-paid comment cards throughout the arena, and seems to take the feedback seriously, as they are in the process of producing a brochure to inform handicapped patrons of the services they offer.

Sightlines from the seating are generally excellent, with the exception being in the upper bowl where large-screen monitors are provided — Calgary is the only venue that provides such an alternative for the visually-impaired. Unfortunately, the display of penalties on the main scoreboard is very poor, with small numbers at the lower edge of the display. Because of the angle of the display, patrons in the upper bowl are deprived of this information.

3. Edmonton

Skyreach Centre, constructed in 1974 and renovated in 1994, is the oldest of the venues visited. While there is recognition on the part of the management that the building does not do a sufficient job of catering to patrons with visual and aural difficulties, doubts about the future of the Edmonton Oiler franchise (the major tenant of the building) because of ownership and escalating costs means there is neither the impetus nor the ability to construct a new facility. Because the building was specifically constructed to house hockey, it also has the most "sense of place" of all the arenas toured.

Of all the venues visited, Edmonton has the most extensive sound and light show preceding the game. All lights in the bowl area are extinguished for approximately five minutes, and extensive use of strobe and laser lights, as well as sustained, high-volume music and announcements are imposed on the audience, many of whom are trying to locate their seats prior to the singing of the national anthems. This poses a significant visual hazard and the aural component of such volume and duration could be a overwhelming contributor to hearing loss or damage, as well as disorienting patrons.

4. Toronto

The newest (opened in February 1999) venue visited, Air Canada Centre in Toronto has benefited from the presence of both Toronto Maple Leaf President Ken Dryden, who is an advocate for accessibility for older patrons, and Vice-President Tom Anselmi, who held a similar position during the early years in Vancouver at General Motors Place and who was instrumental in ensuring that a specific staff position to deal with handicapped patrons was created there. A similar person (with the official title of "fan advocate") is also in residence in Toronto (although she was not available during the site visit), and printed material describing the facilities available for handicapped patrons is also available.

5. Ottawa

Corel Centre is located in Kanata, a western suburb of Ottawa, and was opened in January 1996. Seating 18,500 patrons for hockey — the Ottawa Senators are the only primary tenant, although there are other private businesses, including a health club, contained in the building — it is unlike the other five NHL arenas in Canada, as it is neither conveniently located in or near the core nor serviced by permanent public transportation, which results in massive traffic jams and limited express bus service on event days.

The relative isolation of the facility also has meant that additional, hockey-related events, such as the All-Star Game, which has been awarded to cities with new arenas in recent years, have bypassed Corel Centre. With the withdrawal of such remunerative events (not only for the building itself, but also for the surrounding communities), resulting financial problems have impacted the installation of interior fittings to assist visually- and hearing-impaired patrons.

6. Montréal

Molson Centre was opened in the heart of downtown Montréal in 1995 to replace the Montréal Forum, located approximately 2 km to the west. The Club de Hockey Canadien, which owns both the team and the facility, refused to participate in this MDP, citing a long-standing company rule, and attempts to formally interview any personnel, either in French or English, proved fruitless. Thus, in order to complete the survey for this document, the author purchased tickets for both the English-language tour and for a hockey game.

When queried on the tour about facilities for handicapped visitors, the guide would answer either "we don't have anything like that" or simply shrug and indicate that she did not know or care to find out.

Because of the inability to take as many pictures (or specific, non-"tourist" pictures) as desired without raising suspicions, or to have access to the laptop computer used to make notes, observations about this facility are somewhat less detailed than for the other venues. While this situation interfered somewhat with a complete analysis of the facility in comparison with the other five arenas, it also had the advantage of enabling the author to experience the building as an ordinary patron instead of an acknowledged academic visitor.

AIR CANADA CENTRE BELONGS TO FANS OF ALL AGES AND ABILITIES

Services for the Mobility Impaired

- Wheeltrans Drop Off area at P1 and Gate 5 (west side) has curb cut-outs for exterior drop off.
- Box office counters are all at an appropriate height; west counter is wider to accommodate disabled users.
- All concession stands have accessible-level counter tops.
- All washrooms have accessible stalls.
- There are two "family" washrooms on each level that are appropriate for use by a mobility impaired fan and an attendant.
- There is an accessible washroom at the P1 Wheeltrans Drop Off area.
- There are three designated parking stalls in the underground parking area, available to be booked through our building operations division at (416) 815-5743. There are also several reserved spots located at the adjacent surface level parking lot.
- Seating for fans in wheelchairs and attendants: 150 for hockey and concerts; 166 for basketball. 200 aisle seats in the lower bowl have flip-up arms to allow greater comfort for larger individuals.
- Seats at the 200 level provide the same viewing as the Club Level seats.
- Accessible seating is available in most price points in the arena.

Services for the Hearing Impaired

- Payphones have volume control.
- There is a TTY phone on Level 100, north of Gate Six and on Level 300, just north of the Original Six Bar and Grill.
- Assistive listening devices are available for loan through the Fan Services Desks. There is no charge for a unit, however, photo identification or a credit card number is required as a security deposit.

Services for the Visually Impaired

- Braille and tactile signage is used throughout the facility, including elevators.

Sensitivity Training for Air Canada Centre Event Staff

- All event staff receive Disability Sensitivity Training, and are prepared to assist you.

Additional Services

- An Accessibility Advisory Group meets several times a year to review operational standards and issues.
- The facility's Fan Advocate is the designated contact person handling suggestions and questions about the accessibility of the facility on an ongoing basis.
- Wheelchairs are available through the Fan Services Desks on each level. Staff is available to assist you.

Ticket Policies

- All disabled seating is accessible for purchase through Ticketmaster at (416) 872-5000 and through the Air Canada Centre Ticket Office at (416) 815-5818. Ticket purchases for disabled seating are closely monitored by arena officials in an effort to ensure the appropriate usage of these designated areas.
- If you have tickets for disabled seating for an event and cannot use them, please notify the box office 24-hours in advance and we will reimburse you. This will provide other disabled fans priority access to the event.

While Air Canada Centre strives to meet the needs of everyone, you may come across something that our team has missed. Please call our Fan Advocate at (416) 815-5468 to advise us on how to make our accessible services even better. You can also e-mail us at fanadvocate@mapleleafsports.com.

AIR CANADA CENTRE

Bibliography

Arisz, H., Kanis, H., and Rooden M.J. (2000). How many participants: A simple statistic with some limitation. In McCabe, P.T., Hanson, M.A., and Robertson, S.A. (eds.). *Contemporary ergonomics.* Proceedings of the Annual Conference of the Ergonomics Society: Stoke Rochford Hall, England, April 2000. London: Taylor & Francis Ltd.

Arnold, D.B. and Duce, D.A. (1990). *ISO standards for computer graphics: the first generation.* London: Butterworth & Co. (Publishers) Ltd.

Arthur, P. and Passini, R. (1992). *Wayfinding: People, signs, and architecture.* New York: McGraw-Hill, Inc.

Askov, E.N. and Bixler, B. (1998). Transforming adult literacy instruction through computer-assisted instruction. In Reinking, D., McKenna, M.C., Labbo., L.D., and Kieffer, R.D. (eds.). *Handbook of literacy and technology: Transformations in a post-typographic world.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Baucom, A.H. (1996). *Hospitality design for the graying generation: Meeting the needs of a growing market.* New York: John Wiley and Sons.

Bechtel, R.B. (1989). Advances in POE methods: An overview. In Preiser, W.F.E. (ed.). *Building evaluation.* Based on the Symposium on Advances in Building Evaluation: Knowledge, Methods, and Applications, held as part of the Tenth Biannual Conference of the International Association for the Study of People and Their Physical Surroundings, Delft, The Netherlands, 5–8 July 1988. New York: Plenum Press.

Beck, R.N. (1994). The future of imaging science. In Sebeok, T.A. and Umiker-Sebeok, J. (eds.). *Advances in visual semiotics.* Berlin: Mouton de Gruyter.

Becker, F. (1989). Post-occupancy evaluation: Research paradigm or diagnostic tool. In Preiser, W.F.E. (ed.). *Building evaluation.* Based on the Symposium on Advances in Building Evaluation: Knowledge, Methods, and Applications, held as part of the Tenth Biannual Conference of the International Association for the Study of People and Their Physical Surroundings, Delft, The Netherlands, 5–8 July 1988. New York: Plenum Press.

Bednar, M.J. (1977). Introduction: On barriers. In Bednar, M.J. (ed.). *Barrier-free environments*. Stroudsburg, PA: Dowden, Hutchinson & Ross, Inc.

Birren, F. (1992). *The power of color.* Secaucus, NJ: Citadel Press.

Bringhurst, R. (1996). *The elements of typographic style.* (2nd ed.) Vancouver: Hartley and Marks.

Bruyas, M.-P., LeBreton, B., and Paulié, A. (1998). Ergonomic guildelines for the design of pictorial information. *International Journal of Industrial Ergonomics 21*, 407–413.

Canadian Commission on Building and Fire Codes. (1995) *National building code of Canada*. Ottawa: National Research Council of Canada.

Ching, F.D.K. (1975). *Building construction illustrated.* New York: Van Nostrand Reinhold Company.

Chung, J.K.W. and So, R.H.Y. (1997). Subjective loudness comparison between a head phone and a bone vibrator. In Robertson, S.A. (ed.). *Contemporary ergonomics*. Proceedings of the Annual Conference of the Ergonomics Society: Stoke Rochford Hall, England, 15–17 April 1997. London: Taylor & Francis Ltd.

Covington, G.A., and Hannah, B. (1997). *Access by design*. New York: Van Nostrand Reinhold Company.

Dagdelen Ast, G. (1977). Moline, Illinois: Planning a barrier-free environment for the elderly and handicapped. In Bednar, M.J. (ed.). *Barrier-free environments.* Stroudsburg, PA: Dowden, Hutchinson & Ross, Inc.

Dreyfuss, H. (1972). *Symbol sourcebook.* New York: McGraw-Hill Book Company.

Environmental Protection Agency. (1978). Noise: A health problem. Washington: Environmental Protection Agency.

Farbstein, J. (1989). Advances in post-occupancy evaluation applications: An overview. In Preiser, W.F.E. (ed.). *Building evaluation.* Based on the Symposium on Advances in Building Evaluation: Knowledge, Methods, and Applications, held as part of the Tenth Biannual Conference of the International Association for the Study of People and Their Physical Surroundings, Delft, The Netherlands, 5–8 July 1988. New York: Plenum Press.

Farmer, P.J., Mulrooney, A.L., and Ammon, Jr., R. (1996). *Sport facility planning and management*. Morgantown, WV: Fitness Information Technology, Inc.

Fawcett, G. and Snyder, S. (1998). Transforming schools through systemic change: New work, new knowledge, new technology. In Reinking, D., McKenna, M.C., Labbo., L.D., and Kieffer, R.D. (eds.). *Handbook of literacy and technology: Transformations in a post-typographic world*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Fitzgerald, B.M. and Trim, R.M. (1998). The "Smartsound" noise adaptive public address control system. In Thompson, P.D., Tolloczko, J.J.A., and Clarke, J.N. (eds.). *Stadia, arenas and grandstands: Design, construction and operation*. Proceedings of the First International Conference "Stadia 2000": Cardiff International Arena, Cardiff, Wales, 1–3 April 1998. London: E & FN Spon.

Genaidy, A., Beltran, J., Alhemoud, A., and Yeung, S. (2000). Use of human expertise in evaluating manual lifting tasks. In McCabe, P.T., Hanson, M.A., and Robertson, S.A. (eds.). *Contemporary ergonomics*. Proceedings of the Annual Conference of the Ergonomics Society: Stoke Rochford Hall, England, April 2000. London: Taylor & Francis Ltd.

Gifford, R. and Martin, M. (1991). A multiple sclerosis center program and post-occupancy evaluation. In Preiser, W.F.E., Vischer, J.C., White, E.T (eds.). *Design intervention: Toward a more humane architecture*. New York: Van Nostrand Reinhold Company.

Gill, J. (2000). Display font for the visually impaired. Available at http://www.tiresias.org/fonts.

Gustafsson, B. (1989). Evaluation of animal habitability in farm structures. In Preiser, W.F.E. (ed.). *Building evaluation*. Based on the Symposium on Advances in Building Evaluation: Knowledge, Methods, and Applications, held as part of the Tenth Biannual Conference of the International Association for the Study of People and Their Physical Surroundings, Delft, The Netherlands, 5–8 July 1988. New York: Plenum Press.

Hall, E.T. (1966). *The hidden dimension*. New York: Doubleday & Company, Inc.

Hochberg, J. (1994). The construction of pictorial meaning. In Sebeok, T.A. and Umiker-Sebeok, J. (eds.). *Advances in visual semiotics*. Berlin: Mouton de Gruyter.

Horberry, T.J., Purdy, K.J., and Gale, A.G. (1997). Mind the bridge! Drivers' visual behaviour when approaching an overhead obstruction. In Robertson, S.A. (ed.). *Contemporary ergonomics.* Proceedings of the Annual Conference of the Ergonomics Society: Stoke Rochford Hall, England, 15–17 April 1997. London: Taylor & Francis Ltd.

Hubel, D.H. and Wiesel, T.N. (1990). Brain mechanisms of vision. In Rock, I. (ed.). *The perceptual world.* New York: W.H. Freeman and Company.

Hunt, D.P. (2000). A redefinition of personal knowledge and a testing method to implement it. In McCabe, P.T., Hanson, M.A., and Robertson, S.A. (eds.). *Contemporary ergonomics.* Proceedings of the Annual Conference of the Ergonomics Society: Stoke Rochford Hall, England, April 2000. London: Taylor & Francis Ltd.

International Organization for Standardization. (1990). *ISO 7001: Public information symbols – index, and survey, and compilation of single sheets.* Geneva: International Organization for Standardization.

International Organization for Standardization. (1989). *ISO 9186: Procedures for the development and testing of public information symbols.* Geneva: International Organization for Standardization.

Jeffers, J.S. (1977). Barrier-free design: A legislative response. In Bednar, M.J. (ed.). *Barrier-free environments.* Stroudsburg, PA: Dowden, Hutchinson & Ross, Inc.

Jewel, D. (1978). *Public assembly facilities: Planning and management.* New York: John Wiley and Sons.

John, G. and Heard, H. (1981). Volume 1: Ice rinks and swimming pools. In *Handbook of sports and recreational building design.* London: Architectural Press.

Kennedy, J.M. (1994). Picture perception. In Sebeok, T.A. and Umiker-Sebeok, J. (eds.). *Advances in visual semiotics.* Berlin: Mouton de Gruyter.

Kvålseth, T.O. (1980). Factors influencing the implementation of ergonomics: An empirical study based on a psychophysical scaling technique. *Ergonomics (20),* 821–826.

Lemke, J.L. (1998). Metamedia literacy: Transforming meanings and media. In Reinking, D., McKenna, M.C., Labbo., L.D., and Kieffer, R.D. (eds.). *Handbook of literacy and technology: Transformations in a post-typographic world.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Lynch, K. (1960). *The image of the city.* Cambridge, MA: MIT Press.

MacDonald, A.S. (2000). Sensory encounter: The codification of "soft" qualities. In McCabe, P.T., Hanson, M.A., and Robertson, S.A. (eds.). *Contemporary ergonomics.* Proceedings of the Annual Conference of the Ergonomics Society: Stoke Rochford Hall, England, April 2000. London: Taylor & Francis Ltd.

Mace, R.L., Hardie, G.J., and Place, J.P. (1991). Accessible environments: Toward universal design. In Preiser, W.F.E., Vischer, J.C., White, E.T (eds.). *Design intervention: Toward a more humane architecture.* New York: Van Nostrand Reinhold Company.

Marans, R.W. and Spreckelmeyer, K.F. (1981). *Evaluating built environments: A behavioral approach.* Ann Arbor, MI: The University of Michigan.

McGuinness, W.J., Stein, B., and Reynolds, J.S. (1980). *Mechanical and electrical equipment for buildings.* New York: Wiley.

Meland, Ø. and Lintorp, S. (1994). Fire safety and escape strategies for a rock cavern stadium. *Tunnelling and Underground Space Technology 9(1),* 31–36.

Messier, G. (1987). *Hockey: History and analysis.* Huntington, QC: Self.

Michel, L. (1996). *Light: The shape of space.* New York: Van Nostrand Reinhold Company.

Morrissey, W. and Zajicek, M. (2000). Can sound output enhance graphical computerinterfaces? In McCabe, P.T., Hanson, M.A., and Robertson, S.A. (eds.). *Contemporary ergonomics.* Proceedings of the Annual Conference of the Ergonomics Society: Stoke Rochford Hall, England, April 2000. London: Taylor & Francis Ltd.

Null, R.L. and Cherry, K.F. (1996). *Universal design: Creative solutions for ADA compliance.* Belmont, CA: Professional Publications, Inc.

Olin, H.B. (1983). *Construction: Principles, materials & methods.* (5th ed.) Chicago, IL: Institute of Financial Education and the Interstate Printers and Publishers, Inc.

Parret, H. (1994). Synesthetic effects. In Sebeok, T.A. and Umiker-Sebeok, J. (eds.). *Advances in visual semiotics*. Berlin: Mouton de Gruyter.

Parshall, S. (1989). A hospital evaluation: The problem-seeking method. In Preiser, W.F.E. (ed.). *Building evaluation*. Based on the Symposium on Advances in Building Evaluation: Knowledge, Methods, and Applications, held as part of the Tenth Biannual Conference of the International Association for the Study of People and Their Physical Surroundings, Delft, The Netherlands, 5–8 July 1988. New York: Plenum Press.

Petersen, D.C. (1996). *Sports, convention, and entertainment facilities*. Washington, DC: ULI–the Urban Land Institute.

Preiser, W.F.E. (1989a). Preface. In Preiser, W.F.E. (ed.). *Building evaluation*. Based on the Symposium on Advances in Building Evaluation: Knowledge, Methods, and Applications, held as part of the Tenth Biannual Conference of the International Association for the Study of People and Their Physical Surroundings, Delft, The Netherlands, 5–8 July 1988. New York: Plenum Press.

Preiser, W.F.E. (1989b). Towards a performance-based conceptual framework for systematic POEs. In Preiser, W.F.E. (ed.). *Building evaluation*. Based on the Symposium on Advances in Building Evaluation: Knowledge, Methods, and Applications, held as part of the Tenth Biannual Conference of the International Association for the Study of People and Their Physical Surroundings, Delft, The Netherlands, 5–8 July 1988. New York: Plenum Press.

Preiser, W.F.E. and Vischer, J.C. (1991). An introduction to design intervention: A manifesto for the future of environmental design. In Preiser, W.F.E, Vischer, J.C., White, E.T (eds.). *Design intervention: Toward a more humane architecture*. New York: Van Nostrand Reinhold Company.

Rabal, M. and Egenhofer, M.J. (1998). Comparing the complexity of wayfinding tasks in built environments. *Environment and Planning B: Planning and Design* 25, 895–913.

Sheard, R.K. (1998) Stadia and arena through the ages. In Thompson, P.D., Tolloczko, J.J.A., and Clarke, J.N. (eds.). *Stadia, arenas and grandstands: Design, construction and operation.* Proceedings of the First International Conference "Stadia 2000": Cardiff International Arena, Cardiff, Wales, 1–3 April 1998. London: E & FN Spon.

Sommer, R. (1983). *Social design.* Englewood Cliffs, NJ: Prentice-Hall, Inc.

Stabler, K.M. and van den Heuvel, S. (2000). Deign issues and visual impairment. In McCabe, P.T., Hanson, M.A., and Robertson, S.A. (eds.). *Contemporary ergonomics.* Proceedings of the Annual Conference of the Ergonomics Society: Stoke Rochford Hall, England, April 2000. London: Taylor & Francis Ltd.

Stevens, S.S. (1975). *Psychophysics.* New York: John Wiley and Sons.

Strachan, A. (ed.) (1999). *One hundred years of hockey.* Toronto: Key Porter Books.

Thomson, N., Dendy, E., and de Deney, D. (eds.) (1984). *Sports and recreation provision for disabled people.* London: Architectural Press.

Toji, S. (2000). *The new ANSI standards for ADA signage.* Available at http://www.signweb.com/ada/cont/ansi.html.

Treisman, A. (1986). Features and objects in visual processing. In Rock, I. (ed.). *The perceptual world.* New York: W.H. Freeman and Company.

U.S. Department of Housing and Urban Development, Office of Policy Development and Research. (1979). *Access to the built environment: A review of literature.* (HUD-PDR-405). Washington, DC: U.S. Department of Housing and Urban Development, Office of Policy Development and Research.

Ventre, F.T. (1989). Big buildings: How they challenge evaluation thought and practice. In Preiser, W.F.E. (ed.). *Building evaluation.* Based on the Symposium on Advances in Building Evaluation: Knowledge, Methods, and Applications, held as part of the Tenth Biannual Conference of the International Association for the Study of People and Their Physical Surroundings, Delft, The Netherlands, 5–8 July 1988. New York: Plenum Press.

Vischer, J.C. (1991). Summing up opinions on architecture and social change. In Preiser, W.F.E., Vischer, J.C., White, E.T (eds.). *Design intervention: Toward a more humane architecture.* New York: Van Nostrand Reinhold Company.

Vos, J. and Smoorenburg. (1985). Penalty for impulse noise, derived from annoyance ratings for impulse and road traffic sounds. *Journal of the Acoustical Society of America 77(1)*, 193–201.

Walk, R.D. (1994). Visual perceptual organization. In Sebeok, T.A. and Umiker-Sebeok, J. (eds.). *Advances in visual semiotics*. Berlin: Mouton de Gruyter.

Wang, Z. (2000). *Measuring attitudes of ridership regarding the design of LRT stations using CAD and VR as an assessment tool.* Masters Design Project, Faculty of Environmental Design. Calgary, AB: University of Calgary.

Weaver, J.H. (1997). *Conquering statistics: Numbers without the crunch*. New York: Plenum Press.

White, E.T. (1991). *Post-occupancy evaluation and the corporate architect*. Tucson, AZ: Architectural Media Ltd.

Williams, W. (1999). *Footcandles and lux for architectural lighting* (2.1 ed.). Available at http://www.escape.ca/~williams/library/illum.htm.

Wilson, C.E. (1989). *Noise control: Measurement, analysis, and control of sound and vibration*. New York: Harper & Row, Publishers, Inc.

Wilson, F. (1984). *A graphic survey of perception and behavior for the design professions*. New York: Van Nostrand Reinhold.

Wilson, T. (1997). Overtaking on the Trans-Canada Highway: conventional wisdom revised. In Robertson, S.A. (ed.). *Contemporary ergonomics*. Proceedings of the Annual Conference of the Ergonomics Society: Stoke Rochford Hall, England, 15–17 April 1997. London: Taylor & Francis Ltd.

Zakia, R.D. (1994). *Perceptual quotes for photographers*. Rochester, NY: Zimzum Press.

Zakia, R.D. (1997). *Perception and imaging*. Newton, MA: Butterworth–Heinemann.

Zeisel, J. (1989). Towards a POE paradigm. In Preiser, W.F.E. (ed.). *Building evaluation*. Based on the Symposium on Advances in Building Evaluation: Knowledge, Methods, and Applications, held as part of the Tenth Biannual Conference of the International Association for the Study of People and Their Physical Surroundings, Delft, The Netherlands, 5–8 July 1988. New York: Plenum Press.