RECOMMENDATIONS FOR THE DESIGN OF

ACCESSIBLE RESIDENTIAL KITCHENS AND BATHROOMS

BY

DONALD SOSNA

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- Archaeology 0324
- Cultural 0326
- Physical 0327

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- General 0310
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- Banking 0770
- Management 0454
- Marketing 0338

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Economics
- General 0501
- Agricultural 0503
- Commerce-Business 0505
- Finance 0508
- History 0509
- Labor 0510
- Theory 0511

Folklore 0358
Geography 0366
Gerontology 0351
History
- General 0578
- Ancient 0579
- Medieval 0581
- Modern 0582
- Black 0328
- African 0331
- Asia, Australia and Oceania 0332
- Canadian 0334
- European 0335
- Latin American 0336
- Middle Eastern 0333
- United States 0337

History of Science 0585
Law 0398
Political Science
- General 0615
- International Law and Relations 0616
- Public Administration 0617

Recreation 0814
Social Work 0452
Sociology
- General 0626
- Criminology and Penology 0627
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- Ethnic and Racial Studies 0631
- Individual and Family Studies 0628
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- General 0306
- Anatomy 0287
- Biostatistics 0308
- Botany 0309
- Cell 0379
- Ecology 0329
- Entomology 0353
- Genetics 0369
- Limnology 0793
- Microbiology 0410
- Molecular 0307
- Neuroscience 0317
- Oceanography 0416
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- Veterinary Science 0778
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Biophysics
- General 0786
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- General 0566
- Audiology 0300
- Chemotherapy 0992
- Dentistry 0567
- Education 0350
- Hospital Management 0769
- Human Development 0758
- Immunology 0982
- Medicine and Surgery 0564
- Mental Health 0347
- Nursing 0569
- Nutrition 0570
- Obstetrics and Gynecology 0380
- Occupational Health and Therapy 0354
- Ophthalmology 0381
- Pathology 0571
- Pharmacology 0419
- Pharmacy 0572
- Physical Therapy 0382
- Public Health 0573
- Radiology 0574
- Recreation 0575
- Speech Pathology 0460
- Toxicology 0383

Home Economics 0386

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- General 0485
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- Biochemistry 0487
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- Organic 0490
- Pharmaceutical 0491
- Physical 0494
- Polymer 0495
- Radiation 0754

Mathematics 0405
Physics
- General 0605
- Acoustics 0986
- Astronomy and Astrophysics 0606
- Atmospheric Science 0608
- Atomic 0748
- Electronics and Electricity 0607
- Elementary Particles and High Energy 0798
- Fluid and Plasma 0759
- Molecular 0609
- Nuclear 0610
- Optics 0752
- Radiation 0756
- Solid State 0611

Statistics 0463

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Applied Mechanics 0346
Computer Science 0984
Engineering
- General 0537
- Aerospace 0538
- Agricultural 0539
- Automotive 0540
- Biomedical 0541
- Chemical 0542
- Civil 0543
- Electronics and Electrical 0544
- Heat and Thermodynamics 0348
- Hydraulic 0545
- Industrial 0546
- Marine 0547
- Materials Science 0794
- Mechanical 0548
- Metallurgy 0743
- Mining 0551
- Nuclear 0552
- Packaging 0549
- Petroleum 0765
- Sanitary and Municipal 0554
- System Science 0790

Geotechnology 0428
Operations Research 0796
Plastics Technology 0795
Textile Technology 0994

PSYCHOLOGY
General 0621
Behavioral 0384
Clinical 0622
Developmental 0620
Experimental 0623
Industrial 0624
Personality 0625
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RECOMMENDATIONS FOR THE DESIGN OF ACCESSIBLE RESIDENTIAL KITCHENS AND BATHROOMS

BY

DONALD SOSNA

A Thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements for the degree of

MASTER OF ARCHITECTURE

ABSTRACT

Appropriate changes in the physical environment can greatly improve the level of accessibility for persons with disabilities. This thesis provides design recommendations for eliminating barriers that prevent or interfere with the safe and optimal performance of the activities of daily living. The needs of six disability groups are described—low vision individuals, blind individuals, hard of hearing individuals, deaf individuals, mobility aid users, and wheelchair users. The thesis focuses on new residential kitchen and bathroom environments. Topics include design principles for planning accessible environments for each disability group, special considerations to assist each design group interpret the environment, characteristic problems of each design group, and related disability groups. The design recommendations emphasize accessibility, human energy conservation, communication through sensory means and social interaction, safety, security, privacy, normalcy, and integration and interdependence.

An index is provided to allow easy access to specific recommendations.

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ILLUSTRATIONS

Figure		Page
3.1	Door Opening Device with Texture Warning	24
3.2	Lighting Device - Factor Effecting Glare, from Christiansen and Baum 1991, 723	27
3.3	Recommended Cooktop Element Arrangements, "half-moon" from Independent Living Centre, N.S.W. 1987a, 12; "staggered" from Christiansen and Baum 1991, 730	35
3.4	Low Vision Kitchen Plan, Design Suggestions	42
3.5	Low Vision Kitchen, Design Suggestions	43
3.6	Low Vision Bathroom Plan, Design Suggestions	44
3.7	Low Vision Bathroom, Design Suggestions	45
4.1	Critical Cane Dimensions (touch technique), side view from Panero and Zelnik 1979, figure 3.7; top view from ANSI 1980, 62	47
4.2	Guide Dog, from Panero and Zelnik 1979, figure 3.8	47
4.3	Door Opening Device with Texture Warning	51
4.4	Recommended Cooktop Element Arrangements, "half-moon" from Independent Living Centre, N.S.W. 1987a, 12; "staggered" from Christiansen and Baum 1991, 730	58
4.5	Blind Kitchen Plan, Design Suggestions	63
4.6	Blind Kitchen, Design Suggestions	64
4.7	Blind Bathroom Plan, Design Suggestions	65
4.8	Blind Bathrooom, Design Suggestions	66
5.1	Lighting Device - Factor Effecting Glare, from Christiansen and Baum 1991, 723	73
5.2	Hard of Hearing Kitchen Plan, Design Suggestions	80
5.3	Hard of Hearing Kitchen, Design Suggestions	81
5.4	Hard of Hearing Bathroom Plan, Design Suggestions	82
5.5	Hard of Hearing Bathroom, Design Suggestions	83

ILLUSTRATIONS

Figure		Page
6.1	Guide Dog, from Panero and Zelnik 1979, figure 3.8.....	84
6.2	Lighting Device - Factor Effecting Glare, from Christiansen and Baum 1991, 723.....	88
6.3	Deaf Kitchen Plan, Design Suggestions.....	94
6.4	Deaf Kitchen, Design Suggestions.....	95
6.5	Deaf Bathroom Plan, Design Suggestions.....	96
6.6	Deaf Bathroom, Design Suggestions.....	97
7.1	Walker, Clearance, from Panero and Zelnik 1979, figure 3.6.....	98
7.2	Crutches, Clearances, from Panero and Zelnik 1979, figure 3.5.....	99
7.3	Preferred Sitting Work Surface and Knee Space Clearances, work surface height from Independent Living Centre, N.S.W. 1987a, 6; width from Mace 1991, 107.....	100
7.4	Standing Height Work Surface Clearance with Pull-out Board.....	101
7.5	Sitting Work Surface with Stool Clearances, from Panero and Zelnik 1979, 2.4.....	101
7.6	Maximum and Minimum Reach Height for Standing Mobility Impaired People, from Mace 1991, 112.....	102
7.7	Clear Width of Doorway, Hinged Doors, from CSA 1990, 81.....	105
7.8	Clear Width of Doorway, Sliding and Folding Doors, from ANSI, 33...	105
7.9	Minimum Kitchen Maneuvring Space, from CSA 1990, 97.....	109
7.10	Storage Trolley, from Independent Living Centre, N.S.W. 1987a, 11...	110
7.11	Recommended Cooktop Element Arrangements, "half-moon" from Independent Living Centre, N.S.W. 1987a, 12; "staggered" from Christiansen and Baum 1991, 730.....	116
7.12a	Minimum Water Closet Maneuvring Space, from ANSI 1980, 37.....	121
7.12b	Minimum Water Closet Maneuvring Space, from ANSI 1980, 37.....	122
7.13	Sloping Grab Bar Clearances, from Kelly 1987, 59.....	122
7.14	Bathtub Maneuvring Space, from ANSI 1980, 40.....	123

ILLUSTRATIONS

Figure		Page
7.15	Shower Maneuvring Space, from ANSI 1980, 42	124
7.16	Bathtub and Shower Control Clearances, bathtub from CSA 1990, 92; shower from ANSI 1980, 43	124
7.17	Bathtub Grab Bar Clearances, from CSA 1990, 92	125
7.18	Shower Grab Bar Clearnaces, from CSA 1990, 95	126
7.19	Shower Seat Preferred Design, from ANSI 1980, 42	126
7.20	Mobility Aid Kitchen Plan, Design Suggestions	129
7.21	Mobility Aid Kitchen, Design Suggestions	130
7.22	Mobility Aid Bathroom Plan, Design Suggestions	131
7.23	Mobility Aid Bathroom, Design Suggestions	132
8.1	Typical Dimensions of Wheelchairs Commonly Used by Adults, from CSA 1990, 106	133
8.2	Raised Tub Clearances	134
8.3	Pivoting Turn, Clearances, from Mace 1991, 108	136
8.4	Pivoting Turn, Optimal Clearances, from ANSI 1980, 61	137
8.5	T-Turn, Clearances, from Mace 1991, 108	137
8.6	Knee Space, Minimal Clearances, from CSA 1990, 91 and 98	139
8.7	Knee Space, Preferred Clearances, work surface height from Independent Living Centre, N.S.W. 1987a, 6; width from Mace 1991, 107	139
8.8	Toe Space, Clearance, from CSA 1990, 91	140
8.9	Forward Reach, from CSA 1990, 104	141
8.10	Side Reach, from CSA 1990, 105	141
8.11	Recommended Approach to Pull-out and Side-hinged Door Units	143
8.12	Clear Width of Doorway, Hinged Doors, from CSA 1990, 81	145
8.13	Clear Width of Doorway, Sliding and Folding Doors, from ANSI, 33	145
8.14	Minimum Doorway Maneuvring Space, Side-hinged Door, Front Approach, Pull Side, from CSA 1990, 83	146

Figure		Page
8.15	Minimum Doorway Maneuvring Space, Side-hinged Door, Front Approach, Push Side, from CSA 1990, 83	146
8.16	Minimum Doorway Maneuvring Space, Side-hinged Door, Latch Side Approach, Pull Side, from CSA 1990, 84	147
8.17	Minimum Doorway Maneuvring Space, Side-hinged Door, Latch Side Approach, Push Side, from CSA 1990, 84	147
8.18	Minimum Doorway Maneuvring Space, Side-hinged Door, Hinge Side Approach, Pull Side, from CSA 1990, 84	148
8.19	Minimum Doorway Maneuvring Space, Side-hinged Door, Hinge Side Approach, Push Side, from CSA 1990, 84	148
8.20	Minimum Doorway Maneuvring Space, Sliding Door, Front Approach, from ANSI 1980, 35	149
8.21	Minimum Doorway Maneuvring Space, Sliding Door, Latch Side Approach, from ANSI 1980, 35	149
8.22	Minimum Doorway Maneuvring Space, Sliding Door, Sliding Side Approach, from ANSI 1980, 35	149
8.23	Minimum Kitchen Maneuvring Space, from CSA 1990, 97	153
8.24	Alternative Pantries, Partial Wheel-in and Pull-out, from Independent Living Centre, N.S.W. 1987a, 10 and 11	155
8.25	Storage Trolley, from Independent Living Centre, N.S.W. 1987a, 11	155
8.26	Recommended Cooktop Element Arrangements, "half-moon" from Independent Living Centre, N.S.W. 1987a, 12; "staggered" from Christiansen and Baum 1991, 730	162
8.27	Minimum Handbasin Maneuvring Space, from CSA 1990, 91	166
8.28	Minimum Water Closet Maneuvring Space, from ANSI 1980, 37	168
8.29	Wheelchair Water Closet Transfer, Parallel Approach, from ANSI 1980, 65	169
8.30	Wheelchair Water Closet Transfer, Reverse Diagonal Approach, from ANSI 1980, 65	170
8.31	Wheelchair Water Closet Transfer, Diagonal Approach, from Mace 1991, 176	171
8.32	Wheelchair Water Closet Transfer, Perpendicular Approach, from Mace 1991, 177	171

ILLUSTRATIONS

Figure		Page
8.33	Wheelchair Water Closet Seat Height.....	172
8.34	Wheelchair Water Closet Grab Bar Clearances, from CSA 1990, 90.....	172
8.35a	Wheelchair Bathtub, Minimum Maneuvring Space, from ANSI 1980, 40.....	173
8.35b	Wheelchair Bathtub, Minimum Maneuvring Space, from ANSI 1980, 40.....	174
8.36	Wheelchair Shower, Minimum Maneuvring Space, from ANSI 1980, 42.....	174
8.37	Wheelchair Bathtub Transfer, Forward Approach, from Mace 1991, 180.....	175
8.38	Wheelchair Bathtub Transfer, Parallel Approach with a Transfer Surface from Mace 1991, 152 and 153.....	176
8.39	Wheelchair Bathtub Control Clearances, from CSA 1990, 92.....	177
8.40	Wheelchair Shower Control Clearances, from ANSI 1980, 43.....	177
8.41	Wheelchair Bathtub Grab Bar Clearances, from CSA 1990, 92.....	178
8.42	Wheelchair Shower Grab Bar Clearnaces, from CSA 1990, 95.....	179
8.43	Shower Seat Preferred Design, from ANSI 1980, 42.....	179
8.44	Wheelchair Kitchen Plan, Design Suggestions.....	183
8.45	Wheelchair Kitchen, Design Suggestions.....	184
8.46	Wheelchair Bathroom Plan, Design Suggestions.....	185
8.47	Wheelchair Bathroom, Design Suggestions.....	186

TABLE OF CONTENTS

ABSTRACT..... ii

ACKNOWLEDGMENTS..... iii

LIST OF ILLUSTRATIONS..... iv

DEFINITIONS..... xii

Chapter

1. INTRODUCTION..... 1

    Background

    Purpose

    Scope

    Methodology

    Organization of Thesis

2. LITERATURE REVIEW..... 15

    Review of Existing Literature

    Key Sources

3. LOW VISION INDIVIDUALS..... 19

    Disability Definition and Limitations

    Design Principles for Planning Accessible Environments for Individuals with Low Vision

    Design Recommendations for Building Components Common to Kitchens and Bathrooms

    Design Recommendations for Building Components Specific to Kitchens

    Design Recommendations for Building Components Specific to Bathrooms

    Illustrated Design Suggestions

4. BLIND INDIVIDUALS..... 46

    Disability Definition and Limitations

    Design Principles for Planning Accessible Environments for Blind Individuals

Design Recommendations for Building Components Common to Kitchens and Bathrooms

Design Recommendations for Building Components Specific to Kitchens

Design Recommendations for Building Components Specific to Bathrooms

Illustrated Design Suggestions

5. HARD OF HEARING INDIVIDUALS..... 67

Disability Definition and Limitations

Design Principles for Planning Accessible Environments for Hard of Hearing Individuals

Design Recommendations for Building Components Common to Kitchens and Bathrooms

Design Recommendations for Building Components Specific to Kitchens

Design Recommendations for Building Components Specific to Bathrooms

Illustrated Design Suggestions

6. DEAF INDIVIDUALS 84

Disability Definition and Limitations

Design Principles for Planning Accessible Environments for Deaf Individuals

Design Recommendations for Building Components Common to Kitchens and Bathrooms

Design Recommendations for Building Components Specific to Kitchens

Design Recommendations for Building Components Specific to Bathrooms

Illustrated Design Suggestions

7. MOBILITY AIDS USERS..... 98

Disability Definition and Limitations

Design Principles for Planning Accessible Environments for Mobility Aid Users

Design Recommendations for Building Components Common to Kitchens and Bathrooms

Design Recommendations for Building Components Specific to Kitchens

Design Recommendations for Building Components Specific to Bathrooms

Illustrated Design Suggestions

8. WHEELCHAIR USERS..... 133

Disability Definition and Limitations

Design Principles for Planning Accessible Environments for Wheelchair Users

Design Recommendations for Building Components Common to Kitchens and Bathrooms

Design Recommendations for Building Components Specific to Kitchens

Design Recommendations for Building Components Specific to Bathrooms

Illustrated Design Suggestions

9. CONCLUSIONS..... 187

General Summary

Assessment and Conclusions

Identification of Areas of Additional Research

Appendix

1. Universally Accessible Design..... 192

BIBLIOGRAPHY..... 196

INDEX..... 202

DEFINITIONS

ACCESSIBILITY is the ability to circulate without hindrance; the freedom to perform daily living activities; the rights and means to maintain privacy; the knowledge that the user is "in control" requiring minimum outside assistance. (Raschko 1982, 2.)

ACTIVITIES OF DAILY LIVING (ADL): A number of tasks that people undertake, daily and regularly, and that are essential to their physical autonomy (such as cooking, eating, toileting). (CMHC 1989a,v.)

ADAPTABILITY is closely related to that of residential accessibility, and can be interpreted as "being able to accommodate the changing needs of individuals", in their living environment. As people age-in-place (or in cases of a delimiting accident) any loss of physical or sensory function, or any increase of frailty, poses special challenges in designing a supportive environment for independent living. Rather than requiring the occupant to move away, or to make unnecessary changes in their life-style, it is important to ensure that the housing environment can be adapted to meet the occupant's changing needs, i.e.:

- to ensure that disabilities do not become handicaps;
- to make the built environment more supportive of physical and sensory needs;
- to include, or to allow for the introduction of new products, that are supportive of reduced functional ability;
- to design and select furnishings and equipment that will heighten and reinforce performance, in the activities of daily living. (Associated Planning Consultants Inc., report written for ARCOR, no date, 1-6 and 1-7.)

UNIVERSAL DESIGN incorporates design features that:

- are supportive (ease of operation and maintenance);
- are adaptable (possess features that serve a variety of users; residence allows for the introduction of new products, that are supportive of reduced functional ability);
- are accessible to all users; and
- provide for life safety. (Null 1988, 242.)
- universal design is synonymous with universally accessible design

INTRODUCTION

BACKGROUND

Creating accessible environments for persons with disabilities has been gaining increasing attention in recent years. Much of this effort has been directed toward removing architectural barriers for people who are mobility impaired, especially those who are wheelchair users. In comparison, the accessibility needs of sensory-impaired individuals has been slow in developing. An on-going problem has been that information "developed through research has not found its way, in a usable form, into the hands of designers and architects."[1]

Another factor which has influenced the way we build accessible residential environments is the National and Provincial Building Codes. These codes have had the positive effect of forcing developers and designers to consider the needs of disabled people. However, Building Codes are minimal standards, not optimal standards. In addition, most residential environments need not meet the Accessibility criteria in the building codes.

The great majority of new housing is designed with able-bodied persons in mind. This attitude is slowly changing. Some new housing is being designed with disabled people in mind. These new environments will assist everyone, as they proceed through the various life cycles by lessening the need for redesigning, especially in later years.[2]

---

1 Raschko 1982, 1, citing Ronald Mace, Private communication letter, 15 April, 1980. This concern was repeated by Regnier and Pynoos 1987, 3 and by John Lane in a conversation October, 1992.

2 Raschko 1982, 23, citing Rolf Faste, "New System Propels Design for the Handicapped," Industrial Design (July/August 1978): 53.

PURPOSE

This thesis constitutes phase one of a three phase study of the development of a universally accessible and adaptable residential kitchen and bathroom environment. Other phases of this study are to be performed by other students or by the Canadian Institute for Barrier-Free Design.

PHASE ONE: DESIGN RECOMMENDATIONS

The purpose of this thesis is to develop a reference manual containing design recommendations that meet the accessibility needs of six different disability groups in residential kitchen and bathroom environments. The six disability groups are low vision, blind, hard of hearing, deaf, mobility aids, and wheelchair. The design recommendations are intended to create an environment that will enhance the abilities of an disabled individual in order to enable them to better perform the activities of daily living.

PHASE TWO: CASE STUDIES (not part of this thesis)

Phase two, case studies, will evaluate how the recommendations identified in phase one may be applied, for example, establish an accessibility hierarchy for each disability and for cross disabilities. The purpose of phase two is to determine the relative importance of each design recommendation for each disability, to identify design recommendations which meet the needs of all disability groups, and to identify design recommendations which pose conflicting requirements among the disability groups.

PHASE THREE: PROTOTYPES (not part of this thesis)

Phase three will integrate the findings of phase two to determine which features must be "built-in" so that the kitchen and bathroom may be adjusted to the level of accessibility

needed by the occupant latter on. The purpose of phase three is to develop a prototypical "universally accessible and adaptable" kitchen and bathroom to test the design recommendations objectively. This may lead to several prototypes because the needs of the various disability groups may conflict and not be reasonably resolved in a single prototype.

BASIC FACTORS

For disabled individuals, the performance of the various tasks that make up the activities of daily living requires an environment, equipment, and furnishing that will help the user, as much as possible, to pursue an independent life. Basic factors[3] that must be considered to support this goal include:

- Accessibility is the ability to circulate without hindrance; the freedom to perform daily living activities; the rights and means to maintain privacy; the knowledge that the user is "in control" requiring minimum outside assistance.[4]
- Human energy conservation (low maintenance and task energy conservation): The design should be such that features are easy to maintain and use, such as frost-free refrigerators, single lever taps, lever door handles, etc. As a rule-of-thumb everything should be operable with one hand because the second hand may be needed to maintain balance, or it may not be functional.[5]
- Communication through sensory (e.g.., tactile) means and social interaction:
  - ◊ Sensory Communication: Individuals need creative sensory environments which optimize an individual's sensory capabilities and encourages the use of multiple sensory (light, sound, surface texture) communication.[6]

---

[3] Raschko 1982, 4. Raschko listed seven factors that must be considered in the design of a supportive environment: "1. Accessibility (usability); 2. Ease of circulation–space and traffic patterns (above all, the environments should enhance the three "C's": comfort, convenience, and contentment (choice); 3. Human energy conservation (low maintenance); 4. Communication: through (a) sensory (e.g., tactile) means and (b) social interaction; 5. Safety; 6. Security; and 7. Privacy."

[4] Raschko 1982, 2. [5] CMHC 1988b, 8. [6] Hiatt 1987, 341.

- ◊ Social Interaction: The individual needs socialization through spatial design, furniture design and arrangement, etc. An emphasis on promoting socialization, however, should be coupled with an understanding of privacy and the need to control, manage, and sometimes avoid social interaction.[7]

- Safety: Disabled people have a strong preference for features that increase their safety, such as smoke detectors, nonslip surfaces, etc. One decision facing designers is how far to take the effort to ensure personal safety in light of existing monetary constraints. Features that offer protection from fires, prevent falls, and permit summoning help quickly in case of need are probably cost effective in the long run.[8]
- Security: Security from personal assault, street robbery, and burglary should be considered in the design of a residence and the selection of a site.[9]
- Privacy: Privacy reflects the ability for an individual to control those factors that directly interfere with its actualization—such as control over visual, auditory, or physical intrusions. The extent to which one may maintain privacy depends upon one's ability to control access to both one's home and one's person. Two factors generally influence one's level of privacy. The first, "privacy from one's neighbours," implies that one can control those elements that ensure seclusion from other residents—freedom from outside noise and personally controlled space in front of and behind one's residence. The second factor, the amount of "privacy from one's family" implies that one has a "personal space."[10]
- Normalcy[11]: People do not wish to be identified as impaired and will be resistant to design solutions which do not look residential or "normal". Designers should maintain a commonplace residential look with safety features and aids being well designed, attractive, and free of stereotype associations.

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7 Regnier and Pynoos 1987, 8.
8 Moos et al. 1987, 198.
9 Regnier 1987, 223.
10 Butterfield and Weidemann 1987, 141-142.
11 The two factors "normalcy" and "integration and interdependence" were introduced by John Lane in a meeting in January, 1992.

- Integration and Interdependence[11]: A supportive environment to promote independence is more than the dwelling unit and its characteristics. To maximize independence one must also consider various living arrangements, community support services, and the role of an individual at home and in society. A supportive environment must be flexible enough to allow a disabled individual to live alone, or live within a family, and allow individuals with different disabilities to live congruently together. Supportive services, such as attendant care or Meals-on-Wheels, allow a disabled individual to live independently by enabling them to function at their optimal level. A supportive environment must enable an individual to interact confidently with others so that the individual can contribute to society.

SCOPE

The limitations of this thesis are:

- Six disability groups are studied in this thesis. They are defined as follows:
  - ◊ Low Vision Individuals: People who have sight but are legally blind[12], this includes those with tunnel vision, depth perception problems, other light reducing problems and cataracts.
  - ◊ Blind Individuals: People with no sight;
  - ◊ Hard of Hearing Individuals: People who use hearing aids and people with partial hearing who obtain some information from the environment using visual cues, this may include lip reading;
  - ◊ Deaf Individuals: People with no hearing;
  - ◊ Mobility Aid Users: People with weak lower limbs who have difficulty walking or standing and use walkers, crutches, or other walking aids; and
  - ◊ Wheelchair Users: People who use wheelchairs.

- The study focuses on typical residential kitchens and bathrooms only. These two areas were chosen because when an individual has a change in physical or sensory ability the kitchen and bathroom usually contain the most obstacles in the home that impede the resident from carrying out their activities of daily living. The kitchen and the bathroom are two of the three key functional areas of a home. The third is the bedroom and it generally has few barriers.

- The study covers prototypical residential construction . However, the information can be applied to designing or adapting residential environments as well.

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[12] Legal blindness is defined as a visual acuity in both eyes with best corrective lenses of 20/200 or less and/or if the greatest diameter of the field of vision in both eyes is less than 20 degrees. (Richesin et al. 1987, 6)

- This thesis' recommendations must meet minimum structural, health and safety standards, such as the National Residential Code, CSA standard, etc.

- This study does not address the accessibility needs of children up to the cognitive age of 10+ [13] or people with cognitive disabilities[14]. These groups were excluded because safety concerns require them to have a different standard of accessibility from the seven groups under study. The needs of these two groups will have to be addressed in a future study.

- This study does not address multi-disability design requirements nor conflicting design recommendations. These issues will have to be discussed in a subsequent phase.

- This study does not provide an in-depth description of the disabilities under study. For a greater understanding of the disabilities see:
  - ◊ Hopkins, H.L. and Smith, H.D., editors. 1988. Willard and Spackman's Occupational Therapy (7th edition). New York: J.B. Lippincott;
  - ◊ Pedretti, L.W. and Zoltan, B. 1990. Occupational Therapy: Practice Skills for Physical Dysfunction (3rd edition). Toronto: C.V. Mosby Co.; or,
  - ◊ Trombly, G., editor. 1987. Occupational Therapy for Physical Dysfunction (3rd edition). Baltimore: Williams and Wilkins.

- And, this study is not concerned with cost limitations.

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[13] Dr. Richard Stanwick, local pediatrician who has published in the area of children's safety, from a conversation, October, 1992.

[14] The needs of people with cognitive disabilities have not been included with the exception of a paragraph on low vision and blind individuals with cognitive disabilities.

METHODOLOGY

The methodology of this thesis involved three sources: a literature review, interviews with "development experts", and consultations with "testing experts." The methodology employed in this thesis involved both deductive[15] and inductive[16] research.

LITERATURE REVIEW

A literature review was undertaken to determine the current state of knowledge and practice of designing accessible kitchen and bathroom environments. The following title terms, based upon the University of Manitoba Bridge headings, were used in the literature review:

- architecture, aged;
- architecture, handicapped;
- architecture, hearing handicapped;
- architecture, physically handicapped;
- architecture, visually handicapped;
- barrier-free design;
- dwellings, aged;
- dwellings, handicapped; and,
- housing, handicapped.

In addition to the libraries at the University of Manitoba, the resource libraries of various institutions throughout the city were used.

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[15] Deduction is "the process of reasoning from general principles to particular instances." Theodorson and Theodorson 1970, 104.

[16] Induction is "the process of reasoning from individual instances to general principles, deriving general conclusions from individual observations." Theodorson and Theodorson 1970, 199.

INTERVIEWS WITH "DEVELOPMENT EXPERTS"

The general objective of the interviews with "development experts" was to develop a set of design recommendations detailing the critical issues in an accessible kitchen and bathroom environment for each disability.

An interview lasting approximately an hour was held with each selected "development expert". The "development expert" was responsible for two related disability groups. They were asked what the critical design features for each disability were (e.g..: "What are the critical issues regarding grab bars for mobility aid users?"). Following the interview, the information gained from the interview and information gained from the literature search were collated. A set of design recommendations was then drafted for each disability. This first draft of design recommendations was then reviewed by the same "development expert". Upon review of the first draft, a second draft of the design recommendations for each disability group was produced, incorporating the comments provided by the "development experts". The second draft, a semi-final draft of the thesis, was then given to the "testing experts".

The specific objectives of the interviews with "development experts" were to:

- verify the findings of the literature review;
- gain a greater understanding of the needs of each disability;
- discover some of the nuances missing from the literature search;
- determine the preference of one design solution over another;
- identify potential areas of conflict in dual disability situation; and,
- enquire regarding further information sources.

The "development experts" and their areas of expertise were:

- Bruce Koskie. Rehabilitation Counsellor, Deaf Program. Society for Manitobans with Disabilities Inc. Winnipeg, Manitoba: Hard of Hearing and Deaf.
- John Lane. Executive Director. Canadian Paraplegic Association, Manitoba Inc. Winnipeg, Manitoba: Wheelchair and Mobility Aids.
- Lynn Mayor. Home Management Instructor. Canadian National Institute for the Blind, Manitoba Division. Winnipeg, Manitoba: Low Vision and Blind.

CONSULTATIONS WITH "TESTING EXPERTS"

The general objective of the consultations with "testing experts" was to verify the findings which were developed in the previous two stages.

The "testing experts" were divided two group: specialists and generalists. A specialist being an individual who has an in-depth understanding of two related disabilities. A generalist being a person who has a good understanding of the accessibility need of all the disabilities.

The specialist "testing experts" were given a semi-final draft of this thesis containing the design recommendations of all six disability groups. The specialist "testing experts" were asked to comment upon their areas of expertise, as well as, upon any other aspects in the document.

The generalist "testing experts" were given a semi-final draft of the thesis containing a statement of the research problem, scope, and methodology; the design recommendations of all seven disability groups; and, the bibliography. The generalist "testing experts" were asked to make comments on any part of the package they received.

The specialist "testing experts" and their areas of expertise were:

- Don Ament. Housing Development Co-ordinator. Ten Ten Sinclair Housing Inc. Winnipeg, Manitoba.
- Ellen Barrett. Rehabilitation Teacher. Canadian National Institute for the Blind, Manitoba Division. Winnipeg, Manitoba.
- Catherine Shearer. Co-ordinator of Speech Reading. Rehabilitation Resources. Society for Manitobans with Disabilities Inc. Winnipeg, Manitoba.

The generalist "testing experts" were:

- Patricia Falta. Architect and educator. Expert in accessible housing. Montreal, Quebec.
- Donna Collins. Head of Product Display and Demonstration Facility. ARCOR (Canadian Aging and Rehabilitation Product Development Corporation). Winnipeg, Manitoba.

ORGANIZATION OF THESIS

This thesis consists of nine chapters and an appendix. The objectives of each chapter are summarized as follows:

CHAPTER ONE: INTRODUCTION

This chapter states the background, purpose, scope, methodology, and the overall organization of the thesis.

CHAPTER TWO: LITERATURE REVIEW

This chapter provides a brief review of the existing literature on accessible design for each disability group and lists the key sources used in the formation of this thesis.

CHAPTERS THREE THROUGH EIGHT detail the design recommendations for each of the six disabilities under study. These six chapters share a common format. Each of these chapters is composed of these six parts:

- *Part one*: **Disability Definition and Limitations** defines the disability, lists special considerations the designer must be aware of when designing for the disability, lists characteristic problems members of the disability face, and provides information on the needs of related disability groups.
- *Part two*: **Design Principles for planning accessible environments for the disability**. For each disability a set of design principles is provided. By following these design principles an individual will be able to design an accessible residential environment for members of that disability.
- *Part three*: **Design recommendations for building components common to kitchens and bathrooms**. This section lists design recommendations for building components, such as walls, floors, and windows, which are common to kitchens and bathrooms.

- *Part four*: **Design recommendations for building components specific to kitchens.** This section lists design recommendations for building components, such as sinks, cooking facilities, and refrigerators, which are found in kitchens.
- *Part five*: **Design recommendations for building components specific to bathrooms.** This part lists design recommendations for building components, such as water closets, handbasins, and bath tubs, which are found in bathrooms.

Parts three, four, and five form the basic data detailing the critical design features necessary to design accessible kitchens and bathrooms for the disability. The information is arranged in a standard format: building component, design principle, design recommendation. The rationale for a design recommendation is provided when one has been identified in the literature review process or during the interviews with "experts".

- *Part six*: **Illustrated design suggestions**. Part six comprises four annotated drawings, a plan and a perspective of a kitchen and bathroom. The drawings and annotations suggest possible ways a designer may provide an accessible environment for persons with the disability.

CHAPTER THREE: LOW VISION INDIVIDUALS

This chapter provides design recommendations for accessible kitchens and bathrooms for low vision individuals.

CHAPTER FOUR: BLIND INDIVIDUALS

This chapter provides design recommendations for accessible kitchens and bathrooms for blind individuals.

CHAPTER FIVE: HARD OF HEARING INDIVIDUALS

This chapter provides design recommendations for accessible kitchens and bathrooms for hard of hearing individuals.

CHAPTER SIX: DEAF INDIVIDUALS

This chapter provides design recommendations for accessible kitchens and bathrooms for deaf individuals.

CHAPTER SEVEN: MOBILITY AIDS USERS

This chapter provides design recommendations for accessible kitchens and bathrooms for individuals who use mobility aids.

CHAPTER EIGHT: WHEELCHAIR USERS

This chapter provides design recommendations for accessible kitchens and bathrooms for individuals who use wheelchairs.

CHAPTER NINE: CONCLUSIONS

This chapter provides a general summary of the thesis, states conclusions, and identifies areas of further research.

APPENDIX: UNIVERSALLY ACCESSIBLE DESIGN

This chapter provides conflicting design recommendations and built-in features for consideration by individuals who wish to continue with phase two and three of this study.

REVIEW OF EXISTING LITERATURE

The review of existing literature relating to residential kitchen and bathroom environmental accessibility revealed two forms of information. One form of information was based upon design guidelines and building codes. This information was prescriptive, listing maximum and minimum standards of accessibility. The second form of information was based upon the accessibility needs of a specific user group. This information generally was performance oriented, listing optimal standards of accessibility for the specific user group which was studied. The review of the literature also revealed an enormous variation in the amount of information existing for each disability.

As stated in the introduction, the accessibility needs of wheelchair bound individuals is well documented. However, this information is limited primarily to manual wheelchairs. The accessibility requirements for electric wheelchairs and scooters have not been standardized. The accessibility requirements of electric wheelchairs and scooters are emerging as important issues because more and more people are using these two types of wheelchairs in their home.

It should be noted that many researchers stated that residential environments for wheelchairs are often overly spacious and need not provide a 1500mm (60") circular clear floor space in the bathroom and kitchen if the designer provides sufficient clear floor space for the wheelchair user to function. However, the 1500mm (60") circular clear floor space provides a good standard for public settings because it can accommodate the needs of a broad spectrum of functional abilities among the disabled population.[1]

The accessibility needs of those using mobility aids are well documented.

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[1] Moakley 1987, 248-251.

Researches recognize deaf people and hard of hearing people as two design groups, but research findings are often presented as if they are one design group. Very little information exists on the design needs of deaf and hard of hearing people. This may be because the Deaf community has focused much of their energies on defining their position in society. Two conflicting views exist. Some wish to "mainstream" Deaf people with the general populace. Others consider the Deaf community as a cultural group, not a disabled group, and have been gaining recognition of their language and life-style as a culture.[2]

Researchers recognize blind people and low vision people as two distinct design groups, but research findings are often presented as if they are one design group. The accessibility needs for blind and low vision individuals in kitchen environments is found scattered in various sources. Little information exists on residential bathroom environments.

[2] Trudy Blight of Blight Dandewich and Associates, May, 1992.

KEY SOURCES

The information from many sources has been utilized during the development of this thesis. The sources which I feel have contributed the most are:

- ANSI. 1980. American National Standard Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.

  This standard specifies technical requirements on how to make housing and other facilities barrier-free and therefore accessible and safely usable by persons with physical or sensory disabilities. The standard contains minimum requirements based on adult dimensions.

- Barnes, Karin J. 1991. Modification of the Physical Environment. Chap. in Occupational Therapy: Overcoming Human Performance Deficits.

  This document "identifies factors in the physical environment which can interfere with optimal performance, evaluates strategies for eliminating architectural barriers, and identifies important considerations in adapting the home or work environment for individuals with reaching limitations."[3]

- Blight, Trudy. 1985. Fourth-year major paper on the Kiwanis Centre for the Deaf for the Department of Interior Design, Faculty of Architecture, University of Manitoba.

  This paper is a post-occupancy report on the Kiwanis Centre for the Deaf. The paper provides an understanding of how to design an institutional setting for deaf people and provides suggestions on how to make the Kiwanis Centre for the Deaf more accessible.

- CSA. 1990. Barrier-Free Design: A National Standard of Canada.

  This standard specifies technical requirements on how to make housing and other facilities barrier-free and therefore accessible and safely usable by persons with physical or sensory disabilities. The standard contains minimum requirements based on adult dimensions.

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[3] Christiansen and Baum 1991, 701.

- Mace, Ronald (Barrier-Free Environments). 1991. The Accessible Housing Design File. This book is a guide to developing an accessible home environment. The book is organized by room type. The material is presented according to general disability categories (mobility, hearing and visual) and related modifications. Well annotated illustrations are provided.
- Regnier, Victor and Pynoos, Jon, eds. 1987. Housing the Aged: Design Directives and Policy Considerations.

  "The content of this book is presented from the perspective of a variety of disciplines and covers housing environments for the well/active, moderately impaired, and frail elderly. This book summarizes most of the important research of this period... and interprets (these) research findings into meaningful language and practical judgements that can be applied to problem situations."[4]
- Richesin et al. 1987. Access needs of Blind and Visually Impaired Travellers in Transportation Terminals: A Study and Design Guidelines.

  "This report presents design recommendations and guidelines for meeting the access needs of blind and visually impaired travellers in transportation terminals. It describes how blind and visually impaired persons orient themselves and move through the environment. Legal blindness and various types of visual impairment are described; the effects of aging on vision are discussed; and demographics for the Canadian blind and visually impaired population are cited."[5]

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[4] Regnier and Pynoos 1987, viii and ix.

[5] Richesin et al. 1987, report documentation form.

LOW VISION INDIVIDUALS

DISABILITY DEFINITION AND LIMITATION

The "low vision individuals" design group is defined in this paper as people who have sight but are legally blind, this includes those with tunnel vision, depth perception problems, other light reducing problems, and cataracts. (Legal blindness is defined as a visual acuity in both eyes with best corrective lenses of 20/200 or less and/or if the greatest diameter of the field of vision in both eyes is less than 20 degrees. Richesin et al. 1987,6.)

Special considerations to assist this group interpret the environment are:

- Orientation: A good building design is one that is easily understood by low vision users. It focuses on distinctive and simple planning with sufficient accessible information regarding the environment. Various techniques are recommended to achieve the desired design: optimum use of colour brightness/contrast; careful use of illumination; well defined tactile cues; and, most importantly, consistency and uniformity.[1] In familiar environments low vision users may rely on a mental image of the space. This mental image is sometimes referred to as a cognitive map. Initially the mental image consists of direct and simple information; such as the shape of a route and landmarks along the route. As individuals are further exposed to a specific space, they gain a greater understanding of more complex interrelationships of objects and points.[2]
- Illumination: Most visually impaired individuals see better in bright light. However, some see better in subdued light, i.e.: people with cataracts. The rule-of-thumb is to provide gently modulated and controllable overall light levels, combined with glarefree task lighting for close work and accent lighting for space defining contrast, avoid glare, spottiness, shadows, and lighting with a strong vertical component. It is also important to reduce the need for eyes to accommodate to different lighting conditions as the user travels from one space/room to another. All rooms should have a similar level of illumination.[3]

- Figure-Ground Contrast: Low Vision users may bump into things or have difficulty seeing objects on tables or work areas (like a white dish on a light-coloured table cloth), such objects should be thought of in terms of a figure-ground relationship.[4] At least a two or three shade difference on the grey scale, in addition to a colour difference, should exist between the figure and the ground object.[5]
- Optical Illusions: Minimize contrasts that may inadvertently create optical illusions of objects or surface changes. Even simple stripes or checkered patterns on a floor covering can be perceived as steps or openings.[5]

Some characteristic problems of low vision individuals are:

- They have a tendency to drop objects because they misjudge distances due to poor depth perception.[6]
- They have a tendency to knock objects from a surface.[6]
- They have a tendency to bump into things because they tend to look at the floor as they walk to avoid tripping and falling.[7]

Related disability groups include:

LOW VISION ELDERLY INDIVIDUALS

With aging the eye's lens thicken and yellows, as a result an elderly person requires two to three times more light than a young adult. Elderly persons find it easier to distinguish brighter, more intense colours at the warm end of the spectrum. They may have difficulty identifying the following colours: blues, greens and violets; colours containing a great deal of white like beige, light grey , pale blue and pale green; and, pastel colours.[8]

LOW VISION INDIVIDUALS WITH COGNITIVE DISABILITIES

Designing for a low vision individual with cognitive disabilities it is important to maintain uniformity and standardization. Where possible specify features which match the user's "familiar" environment: i.e., the user's "familiar" work surface height, the user's "familiar" control location, etc.[6]

DESIGN PRINCIPLES FORPLANNING

ACCESSIBLE ENVIRONMENTS FOR INDIVIDUALS WITH LOW VISION

MAXIMIZE CONTRAST

- Contrast features or surfaces that need to be differentiated.
  - ◊ Contrast may be achieved through the use of colour, texture, material, shape, size variation, and lighting.[5]
  - ◊ To emphasize an object, signify a change, or direct attention to important information, use contrast to create a figure-ground relationship. The two components should be two or three values or shades different from each other on a grey scale.[5]
- Use contrast to communicate important environmental information.
  - ◊ Novelty items tend to be most useful for way-finding.[5]
  - ◊ Size changes such as ceiling heights may convey importance, especially when these features create different ambiance in air movement or sound.[5]
- Use textural contrasts to communicate important environmental information.
  - ◊ Texture changes are useful cues for low vision users. However, repetitious textures can be monotonous.[9]
  - ◊ An obvious form of textural communication is raised lettering, which can be used to mark controls.
  - ◊ Other textural markers may include changes in the floor or wall surface, or shape coding (notches or grooves cut into a surface to identify a location).[9]

CONSISTENCY, UNIFORMITY, AND ORGANIZATION

- Consistency, uniformity, and organization assist a low vision individual develop a cognitive map of their environment. The low vision individual thus knows what to expect and knows where to locate something that is needed in their environment.[10]

- Consistency should be reflected in the overall design of the dwelling unit: its floor plan, furnishings and fixtures.[10]
- Uniformity among housing units should exist. Where possible specific "standard" features. Non-standard features tend to cause accidents.[6]
- Organization (a place for everything and everything in its place) in the placement of objects is necessary. Locations where items are stored should be organized and non-cluttered, since memory is used to locate items.[11] There should also be a sense of order to belongings and placement of items, i.e.: things used together should be kept together.[12]

MINIMIZE AND CONTROL GLARE

- Glare is produced by the sun or light reflecting off surfaces or fixtures. It can also be aggravated by exposed lighting devices; shiny, lustrous floors; and metal, plastic, or veneer furnishings. Use nonreflective surfaces and materials to minimize glare.[5]

MINIMIZE TRAVEL THROUGH RESIDENCE

- Storage: Create storage facilities near areas of use, i.e.: large pots and pan storage by cooking area, towel storage in bathroom, etc.[6]
- Services: Duplicate services when possible, i.e.: more than one telephone in the house, an informal dining area in the kitchen, etc.[6]
- As a rule-of-thumb minimize distances between two navigation points to three steps in the kitchen and bathroom. A navigation point is a permanently located fixture or texture which assists in way-finding.[6]

EASE OF OPERATION AND MANIPULATION

- Provide features which are easy to access, operate, and control, eg.: large rocker-type switches, easy-to-use controls, etc.
- Everything should be operable with one hand.[13]

MINIMIZE MAINTENANCE

- Provide features which promote simple maintenance, i.e.: easy-to-clean flooring, self-cleaning ovens, etc.

SAFETY

- Residential environments should include basic safety features.
  - ◊ Individuals with disabilities and elderly people have a strong preference for features that increase their safety, i.e.: smoke detectors, nonslip surfaces in the bathroom, no sharp edges to reduce injuries due to falls, etc.[14]
  - ◊ One decision facing designers is how far to take the effort to ensure personal safety in light of monetary constraints. Features that offer protection from fires, prevent falls and permit summoning help quickly in case of need are probably cost effective in the long run.[14]
- Safety features in the home should be readily available but unobtrusive and nontherapeutic looking. People do not wish to be identified as impaired and will be resistant to design that is institutional in appearance.[15]

DESIGN RECOMMENDATIONS FOR

BUILDING COMPONENTS COMMON TO KITCHENS AND BATHROOMS

DOORS AND DOORWAYS

Maximize Contrast

- Door frames should be of a contrasting colour to the door and wall.[16]
- Door opening devices (knobs, levers) should be a contrasting colour to the door.[17]
- The door opening device may be textured to indicate that the door leads to a potentially dangerous situation, eg.: stairs.[18]

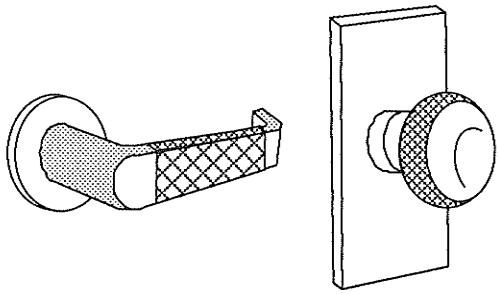


Figure 3.1: Door Opening Devices with Texture Warnings

Consistency, Uniformity, and Organization

- Maintain door opening device type (knob, lever) and height above floor throughout the house.[6]

Safety

- Doors should be kept either fully open or fully closed to keep a low vision user from accidently walking into it. It may be advantageous to provide a door closer on doors.[6]
- Sliding doors are a practical option to minimize people from walking into doors.[7]
- The door frame should be made of a soft material (wood, rubber). Many injuries occur when an individual walks into the door frame.[6]
- Thresholds should be avoided. If a threshold must exist it should be no more than 15mm (5/8") high.[19]

FLOORING

Maximize Contrast

- Floors should be a contrasting colour to the wall or adjacent vertical surface. If the floor is of a similar colour to the wall, a border treatment may define the edge between the two surfaces.[6]
- A change in flooring (texture and/or hardness) may act as a location cue indicating a change in planning. Each room may be given a unique flooring surface to define it.[20]
- Texture strips may be placed in front of dangerous areas, eg.: in front of cooktop or before level changes.[18]

Minimize and Control Glare

- Select matt flooring materials.[21]
- Use non-gloss waxes.[6]

Minimize Maintenance

- Flooring should have some visual/textural indicator to assist low vision individuals in sectioning the floor while cleaning.[6]

Safety

- Choose slip-resistant flooring.[6]
- Floor mats and throw rugs should be avoided where possible. If they must exist, they should be securely attached to the floor and not be able to bunch up under one's feet.[7]
- Avoid floor coverings with patterns and strips which blend and create optical illusions.[4]

HARDWARE AND ELECTRICAL

Maximize Contrast

- The electrical plate should be in a contrasting colour to the wall and the electrical switch/ outlet should be in a contrasting colour to the electrical plate.[22]

Ease of Operation and Manipulation

- Control devices should have large print indicators and easy-to-grip handles. Most control devices can be fitted with braille/tactile or colour-coded overlays.[6]

LIGHTING DEVICES

Minimize and Control Glare

- Fluorescent light characteristically provides little contrast because it is even lighting and casts only soft shadows. This makes fluorescent lighting ideal for general lighting.[23] However, fluorescent lighting is normally harsh because it is in the blue end of the spectrum (natural light fluorescent tubes are available and are preferred by low vision individuals) and the inherent flicker of this type of light presents problems for some people. It is possible to reduce the flicker effect by linking two fluorescent tubes so that they operate in phase opposition. Alternatively the addition of diffusers (lattice type coverings) or translucent shades around fluorescent fixtures also reduces the flicker effect. Another effective strategy is to mount the lights on a wall behind valances which would require the light to bounce off the ceilings and walls.[24]
- Incandescent light, compared to fluorescent light, is generally more directional, more continuous, more easily varied, and more of a point source. This makes incandescent light generally better for near-work tasks, such as reading, especially when the reader can adjust the focus and intensity of the light. Incandescent light is in the yellow portion of the spectrum. It provides heavy contrast because it casts a strong shadow. Incandescent

lights in some fixtures, such as those with an uncovered bulb, can cause pinpoint glare and pools of light within relative darkness. The solutions to these problems involve the use of shades and diffusers to prevent the light from directly entering the eye.[25]

- Provide rheostats for incandescent lighting to control lighting level.[21]
- In order to prevent visual hot-spots or glare, a number of less bright lights are better than a single bright light.[26]
- In a room provide lighting from various lighting types (incandescent, fluorescent, etc.) which can be controlled by the user to establish the lighting level which they prefer.[6]
- To keep glare to a minimum the angle between the horizontal line of sight and a line from the eye to the light source must be more than 30 degrees.[27]

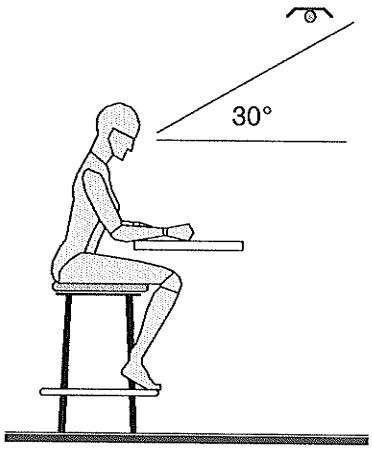


Figure 3.2: Lighting Device - Factor Effecting Glare

Ease of Operation and Manipulation

- Task lighting should be provided above all major work areas.[6]

WALLS

Maximize Contrast

- Walls should be a contrasting colour to the floor or adjacent horizontal surface.[28]

- Light-coloured wall coverings are preferred because they have a high light reflectance factor, but care should be taken to control glare.[21]

Minimize and Control Glare

- Walls should have a matt finish.[29]
- A room which has one wall textured and the remaining walls smooth may help orient a low vision individual.[11]

Safety

- Walls should not have an extremely rough, abrasive, or uneven surface which could be uncomfortable to touch.[29]
- Avoid wall projections greater than 100mm (4") within a range of 685-1800mm (27-72") above the floor.[30]

WINDOWS

Minimize and Control Glare

- Sunlight is often preferred by people with vision problems because it is neither flickering nor harsh and it is bright. However, it is not easily controlled and it causes bright and dark areas which can be a problem for people with difficulty in light adaptation.[26]
- Glare control is best obtained by exterior protection. These may include blinds, louvers, screens, trellises, fences, and arbors.[31]
- Interior glare control methods include curtains, draperies, blinds, tinted window glass, polarized window glass, prismatic window glass, and lighting the room to a similar level of brightness as exists outside. (Polarized window glass reduces glare with little loss of light or change or tint. Prismatic window glass diffuses outside light, eliminates shadow and makes lighting more even throughout.)[32]

- Rooms which face north are beneficial because harsh conditions created by sunlight are eliminated.[33] North facing rooms usually require additional lighting during the day.[6]

Safety

- Avoid hinged windows which become obstacles when open. Horizontal and vertical sliding windows which can clearly indicate their state, either open or closed, are preferred.[34]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS SPECIFIC TO KITCHENS

GENERAL PLANNING AND ORGANIZATION

Consistency, Uniformity, and Organization

- Provide storage space in or near the kitchen to offer an accessible storage option supplementing the conventional upper and lower cabinets.[35]

Minimize Travel Through Residence

- U-shaped and galley kitchens are preferred by low vision individuals because they generally minimize the need for travel. L-shaped kitchens should be avoided.[6]
- Create storage opportunities near areas of use, i.e.: storage for dishes and cutlery near the sink, storage for large posts and pans near the cooking area.[6]
- A telephone jack should be located in the kitchen.[36]
- An informal dining area should be located in the kitchen.[36]

Safety

- If food has to be carried some distance from kitchen to dining area, a storage trolley may be desirable. It can serve as a good "bumper" and carrier if the user becomes misdirected while transferring the food over a distance.[6]

WORK SURFACES (COUNTERTOP)

Maximize Contrast

- The work surface should be a contrasting colour to the floor.[6]
- The work surface should be a contrasting colour to the back splash.[37]
- The work surface should be a contrasting colour to the cabinets.[21]
- Thefront edge of the work surface should be a contrasting colour to the work surface.[21]

- The work surface should have area of different colour and texture to provide opportunities for contrast – a dark area is especially useful when working with flour, for example and a light surface where it is easier to see dirt or locate lost items.[37] These contrasting colour and texture areas should extend the full depth of the work surface, leading edge to backsplash, to provide a textural point of reference to assist in way-finding.[6]
- Provide a small area of contrasting colour on the backsplash to assist low vision users to determine measurements while using clear measuring instruments, i.e.: a small area of dark on a white backsplash to help determine the amount of milk in a glass cup.[38]
- If task lighting is attached to the underside of cabinets, they should be installed as close to the front of the cabinet as possible. Protect from direct light from the source reaching the eye.[39]

Minimize and Control Glare

- A matt finish on the work surface helps to minimize glare.[21]

Minimize Travel Through Residence

- Avoid long stretches of uninterrupted work surface, 1830mm (72") maximum.[6]

Ease of Operation and Manipulation

- Low vision users find it easier to slide goods and utensils along the work surface than try and walk with them.[40]

Safety

- Edges on work surfaces should be rounded to protect an individual from accidental injury.[15]

SINK

Maximize Contrast

- The sink should be a contrasting colour to the work surface.[6]
- Faucets should have contrasting colours to indicate hot and cold.[15]

Ease of Operation and Manipulation

- Single-lever faucet controls are preferred.[41]
- Faucets with a spray attachment so pans can be filled without placing them in the sink are preferred.[41]

CABINETRY

Maximize Contrast

- Handles should be in a contrasting colour to the cabinet.[22]
- Varied shaped or textured handles should be used for ease of identification.[42]
- There should be a surface texture change to indicate one is inside a cabinet.[6]

Consistency, Uniformity, and Organization

- Provide built-in features which create predictability to make it easier for low vision individuals to find things, eg.: knife racks, dish racks, drawer dividers, storage inserts, different shapes and colours of storage containers.[43]

Minimize and Control Glare

- Cabinetry surfaces should have a matt finish.[37]

Ease of Operation and Manipulation

- Provide D-shaped or lever handles on cabinets.[44]

- Maximize storage visibility and accessibility by providing pull-out racks, pull-out shelving, flexible shelving, lazy-Susan corner cabinets, hanging pull-down storage, etc.[44]

Minimize Maintenance

- Enclosed cabinetry is preferred to open shelving because it is easier to maintain.[44]

Safety

- Swing out doors are a potential hazard because low vision individuals tend to run into them if left open. Upper cabinetry doors should be either lift up flap, a roll-down shutter (tambour), or a roller blind.[37]
- Under work surface storage should be drawers or pull-out devices. Avoid conditions where the user will have to bend down and reach inside an enclosed space.[6]

COOKING FACILITIES

Maximize Contrast

- Controls should be a contrasting colour to the adjacent surface.[6]
- Controls should be marked so they can be read by touch.[37]
- Cooktop:
  - ◊ The cooking elements should be a contrasting colour to the adjacent surface.[6]

Ease of Operation and Manipulation

- A heat-resistant work surface should be located next to all cooking facilities.[45]
- Controls should be large and easy to operate. A positive click or sensation should occur upon return to the "off" position and each control should have a pilot light to indicate when "on".[46]

- Cooktop:
  - ◊ The cooking elements should be slightly higher than the adjacent surface. This enable the user to centre the pot on the cooking element quickly.[6]
  - ◊ Avoid ceramic cooktops. Low vision users have a tendency to misjudge distances, a heavily placed pot may damage the ceramic surface.[6]
- Wall Oven:
  - ◊ Wall ovens with interior lights are preferred to free-standing ranges.[47] The wall oven should be placed such that the most often used oven shelf is level with the surface of the work surface.[48]
  - ◊ Controls should be located at the top of the wall oven. This brings the controls closer to eyelevel.[6]
- Microwave:
  - ◊ Provide space in front of the microwave on the work surface so that items may be set down. The work surface in front of the microwave should be heat-resistant. If no work surface space is available in front of the microwave a pull-out board in front of the microwave is advised. The pull-out board, however, may prove dangerous if the low vision individual accidently bumps into it.[6]
  - ◊ A touchpad control with a textural indicator is the preferred control method, a dial control is a secondary choice.[6]

Minimize Maintenance

- Cooktop:
  - ◊ Sealed cooking elements are preferred because they are easier to clean.
- Wall Oven:
  - ◊ Self-cleaning ovens are preferred.[47]

Safety

- Electric cooking devices are preferred to gas operated cooking devices.[49]
- A work surface cooktop and a wall oven is preferred to a range. Using a wall oven one need not bend down while reaching inside the oven, this reduces the risk of burns from contact with the upper element.[6]
- Cooktop:
  - ◊ Cooking elements should be arranged in a half-moon or staggered layout to eliminate the risk of burning while reaching across the front element to a rear one.[48]

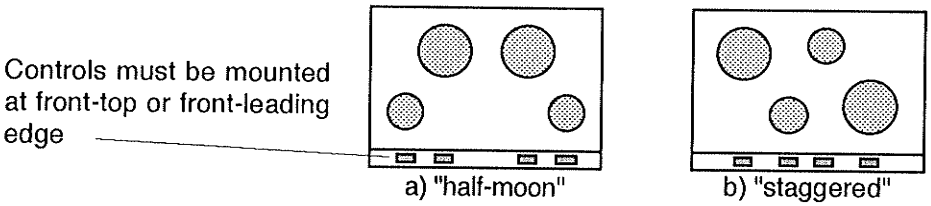


Figure 3.3: Recommended Cooktop Element Arrangements

  - ◊ Controls should be located at the front of the cooktop because they eliminate the risk of burning while reaching across the cooking elements.[49] Controls located at the side of the cooktop should be avoided because they may cause spills when an operator slides pots along the work surface.[6]
  - ◊ The control layout should relate visually to the heating element layout.[50]
- Wall Oven:
  - ◊ A wall oven with a side-opening door and heat-resistant, pull-out shelf below often is more accessible than a drop-down door wall oven. But, side-opening door wall ovens tend not to be as well insulated as drop-down door wall ovens and individuals may burn themselves on the side-opening oven door. Also, self-cleaning side-opening ovens are not commonly attainable and individuals may become injured while cleaning the oven. In an emergency a drop-down door wall oven allows a surface to place hot items on. When chosing a wall oven one may need to look at the trade-offs for each wall oven type.[19]

REFRIGERATOR

Consistency, Uniformity, and Organization

- A large refrigerator is preferred so that food can be organized easier.[6]
- Side-by-side refrigerator/freezers are preferred because generally items are easier to organize within them (more storage baskets and compartments than a standard up-right refrigerator).[6]

Ease of Operation and Manipulation

- A work surface should be located near the refrigerator.[6]
- The temperature control dial should be large, easy to read, and easy to manipulate.[19]
- Crisper drawers should open at least three quarter the way open and the drawer should have back stops.[19]
- Shelves should be adjustable, pull-out, and non tipping.[51]

Minimize Maintenance

- Frost-free refrigerators are preferred.[51]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS SPECIFIC TO BATHROOMS

GENERAL PLANNING AND ORGANIZATION

Maximize Contrast

- Major bathroom elements should be in a contrasting colour to the floor and wall.[6]

Minimize and Control Glare

- The bathroom lighting should be controlable. This would help reduce the glare from many of the shiny surfaces (porcelain, mirrors and metal) in the bathroom.[52]

Minimize Travel Through Residence

- A storage closet for towels and other related bathroom articles should be located in the bathroom.[35]

HANDBASIN

Maximize Contrast

- The faucets should have contrasting colours to indicate hot and cold.[15]

Ease of Operation and Manipulation

- Basins with an adjacent work surface (in a contrasting colour) are preferred for personal accessories.[53]
- Tap handles should be lever or capstan type with a quarter-turn operation for water delivery.[54]
- Drawers with D-type or lever handles are preferred because they provide easier access to storage than a cupboard.[53]

Safety

- Edges on work surfaces, especially those in the bathroom, should be rounded to protect an individual from accidental injury.[15]

MEDICINE CABINET

Safety

- Medicine cabinet doors should sliding, not hinged.[55]

WATER CLOSET

Maximize Contrast

- The toilet seat should be a contrasting colour to the adjacent surfaces.[56]
- The flush control should be a contrasting colour to the adjacent surfaces.[57]

BATH AND SHOWER

Maximize Contrast

- The rim of the tub there should be a contrasting colour.[58]
- The faucets should have contrasting colours to indicate hot and cold.[15]

Ease of Operation and Manipulation

- Controls should be accessible from inside the tub and from beside the tub.[19]
- A hand-held shower placed on an vertical, adjustable bar should be provided. The hand-held shower should be easy to operate while sitting or standing in the tub. An on/off water control on the shower head may be advantageous.[19]

Safety

- An additional lighting source should be placed above the tub.[6]
- The tub should have a non-slip surface. This non-slip surface may be provided by an inherently non-slip tub surface or by using a non-slip mat (contrasting colour). The non-slip mat is a second choice because they are difficult to clean, are prone to mold and mildew, and they sometimes slip.[19]

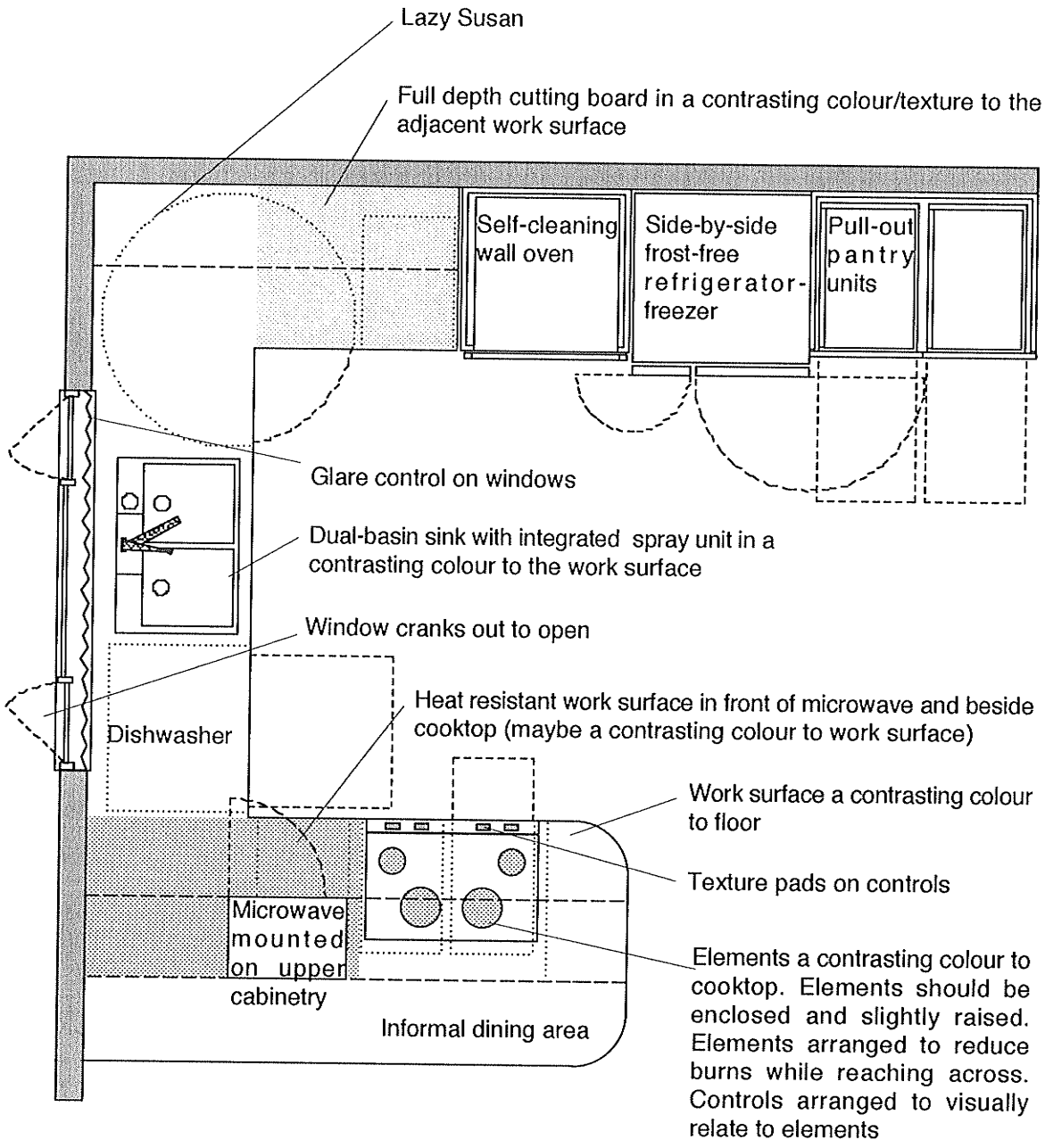


Figure 3.4: Low Vision Kitchen Plan, Design Suggestions

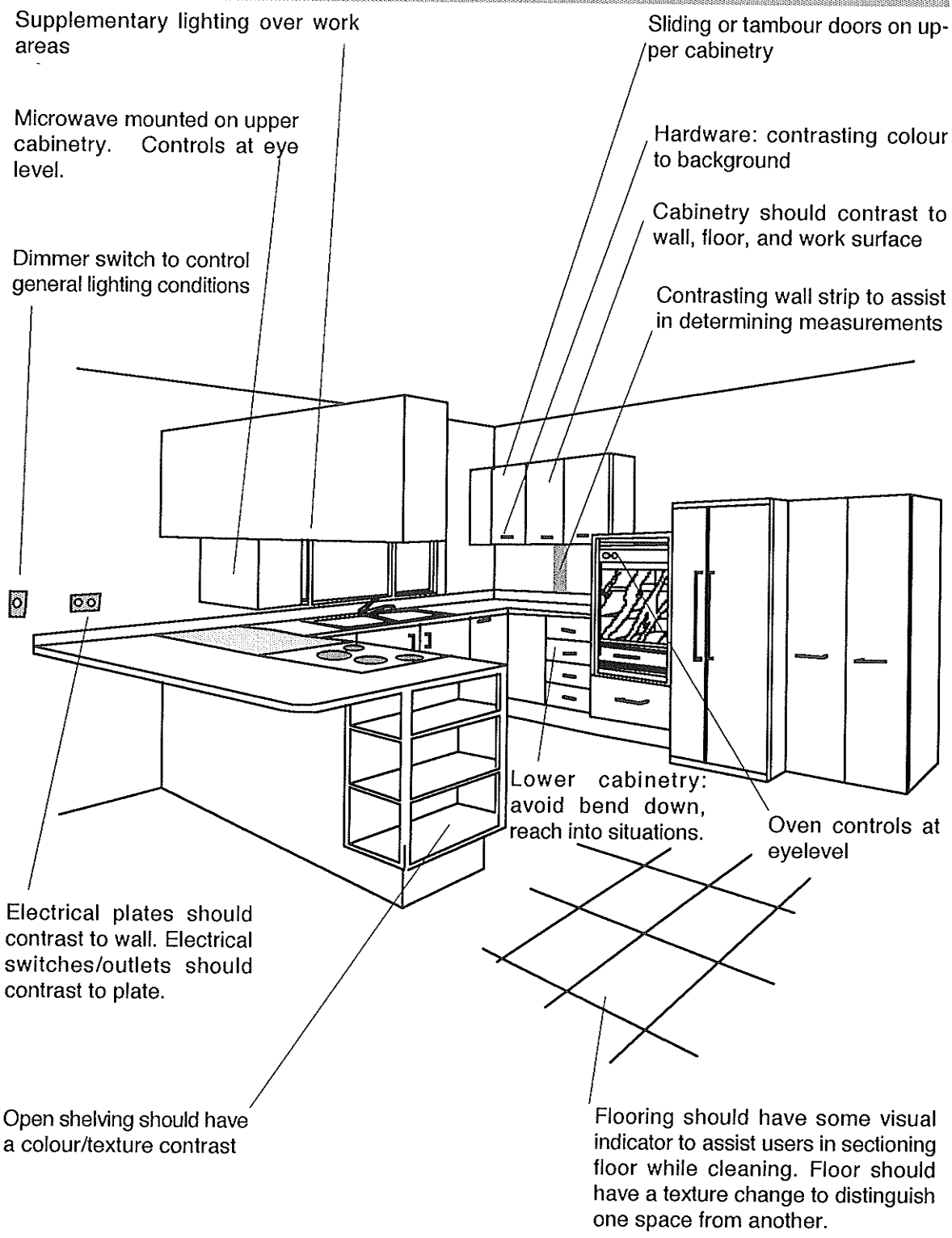


Figure 3.5: Low Vision Kitchen, Design Suggestions

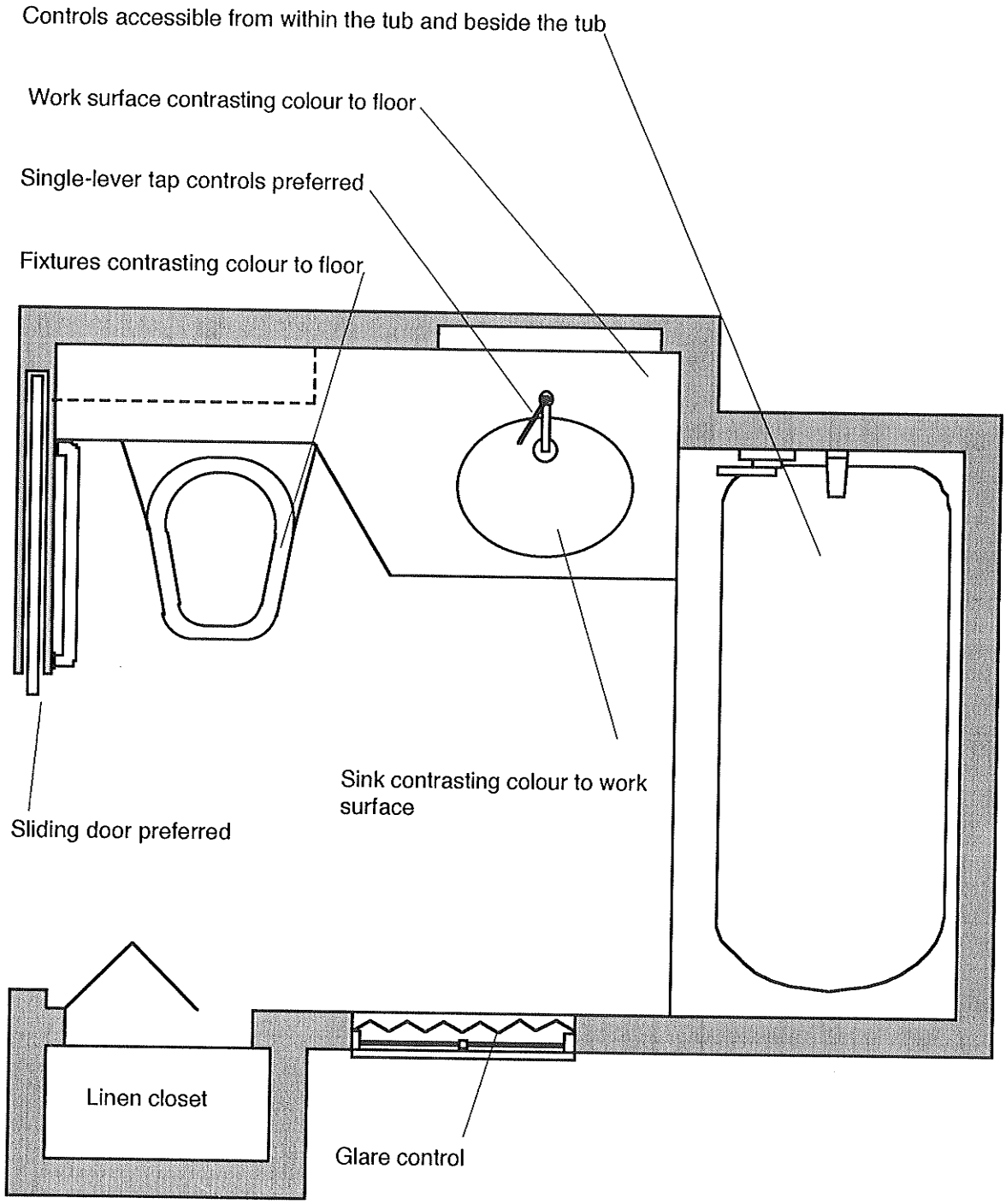


Figure 3.6: Low Vision Bathroom Plan, Design Suggestions

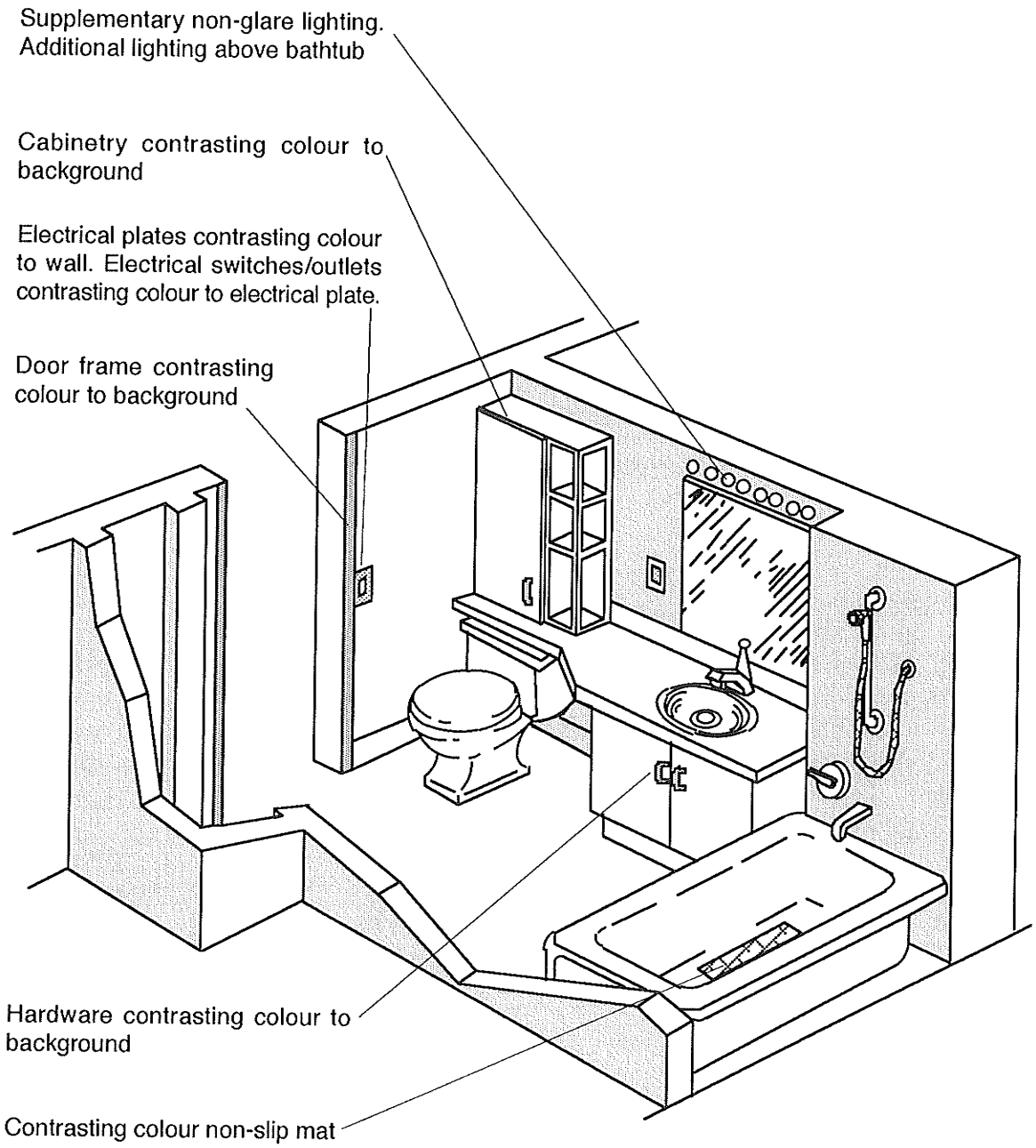


Figure 3.7: Low Vision Bathroom, Design Suggestions

[1] Richesin, et al. 1987, ix.
[2] Ibid, 38.
[3] Dickman 1983, 17-19.
[4] Ibid, 25.
[5] Haitt 1987, 363.
[6] Lynn Mayor, March, 1992.
[7] Dickman 1983, 9.
[8] Cluff 1991, 18.
[9] Koncelik 1987, 396.
[10] Richesin, et al. 1987, 39
[11] Kelly 1987, 95.
[12] From a one-page handout produced by the CNIB in Winnipeg entitled, "Principles of Assisting a Blind/Visually Impaired Person".
[13] CMHC 1988b, 8.
[14] Moos, Lemke, and David 1987, 198.
[15] Pynoos, Cohen, Davis, and Bernhardt 1987, 299.
[16] Richesin, et al. 1987, 76.
[17] Dickman 1983, 26.
[18] ANSI 1980, 66.
[19] Donna Collins, May, 1992.
[20] Wagner 1989, 98-9; Nesmith 1987, 63.
[21] Null 1988, 243.
[22] Null 1988, 242-3.
[23] Dickman 1983, 19.
[24] Richesin, et al. 1987, G-2.
[25] Richesin, et al. 1987, G-2 and G-3.
[26] Richesin, et al. 1987, G-3.
[27] Christiansen and Baum 1991, 723.
[28] Christiansen and Baum 1991, 719.
[29] Richesin, et al. 1987, 78.
[30] Aitkens and Finan 1987, Chapter 3, page 77.
[31] Salmon 1964.
[32] Dickman 1983, 21.
[33] Greer 1987, 71.
[34] Department of Education and Science 1981.
[35] Whiting 1986, 25.
[36] Aitkens and Finan 1987, Chapter 3, page 68.
[37] FitzGerald 1985, 9.
[38] Dickman 1983, 31.
[39] Dickman 1983, 30.
[40] Independent Living Centre, N.S.W. 1987a, 2.
[41] Null 1988, 244.
[42] IIT 1976, 428.
[43] Lau 1984.
[44] Null 1988, 242.
[45] Aitkens and Finan 1987, Chapter 3, page 70.
[46] Cochrane and Wilshere 1987.
[47] Pynoos, Cohen, Davis, and Bernhardt 1987, 298-9.
[48] Christiansen and Baum 1991, 731.
[49] Christiansen and Baum 1991, 730.
[50] Independent Living Centre, N.S.W. 1987a, 12.
[51] Independent Living Centre, N.S.W. 1987a, 14.

[52] Dickman 1983, 50.
[53] Independent Living Centre, N.S.W. 1987b, 12.
[54] Independent Living Centre, N.S.W. 1987b, 13.
[55] Dickman 1983, 55.
[56] Dickman 1983, 56.
[57] Christiansen and Baum 1991, 736.
[58] Christiansen and Baum 1991, 738.

DISABILITY DEFINITION AND LIMITATION

The "blind individuals" design group is defined in this paper as people with no sight.

Some Characteristic problems of blind individuals are:

- They have a tendency to drop objects because they misjudge distances.[1]
- They have a tendency to knock objects from a surface.[1]
- They have a tendency to bump into things.[2]

Related disability groups include:

BLIND INDIVIDUALS WITH COGNITIVE DISABILITIES

Designing for a blind individual with a cognitive disabilities it is important to maintain uniformity and standardization. Where possible specify features which match the user's "familiar" environment: i.e., the user's "familiar" work surface height, the user's "familiar" control location, etc.[1]

CANE USERS

There are two main techniques of use:

- Touch technique: cane arcs from side-to-side tapping the ground at points outside both shoulders.[3]
- Diagonal technique: cane is held in a stationary position diagonally across the body with the cane tip touching a point outside the left shoulder and the handle of the grip extending to a point outside the right shoulder. This technique is used in limited, controlled, and familiar environments.[3]

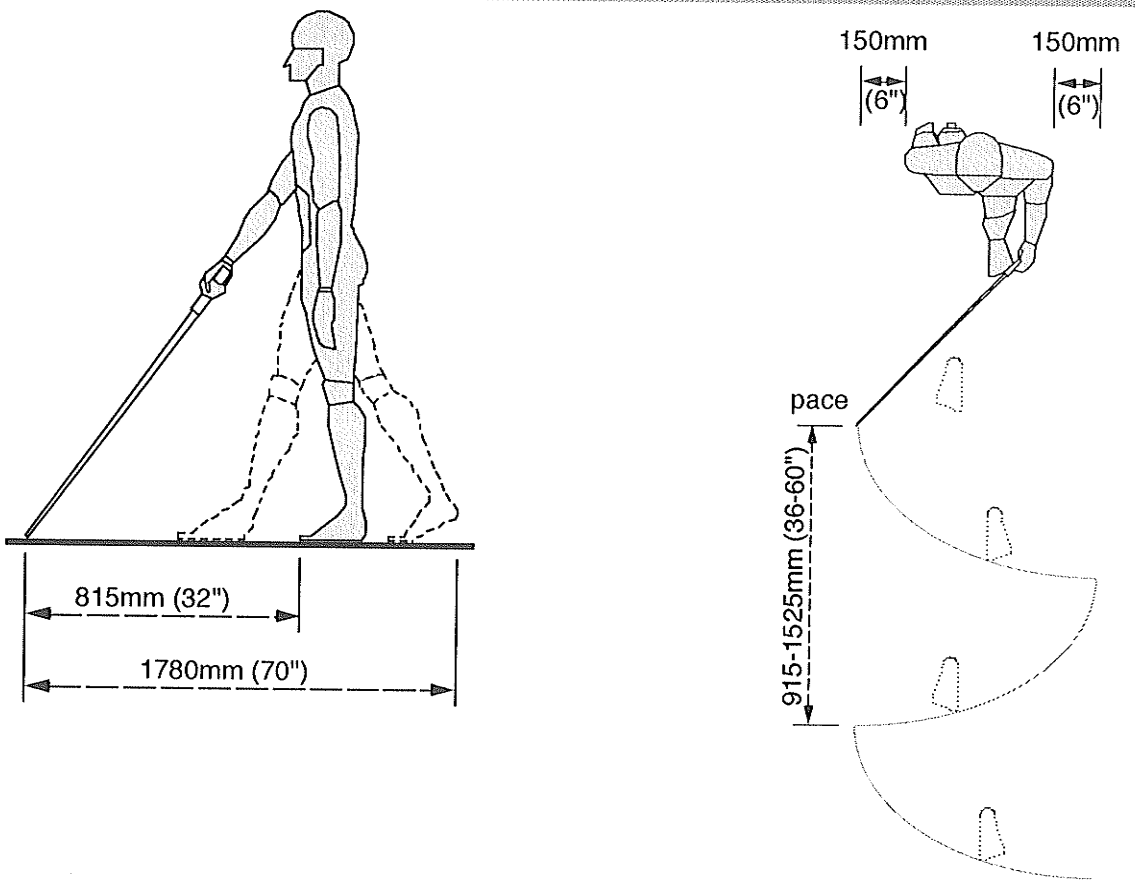


Figure 4.1: Critical Cane Dimensions (touch technique)

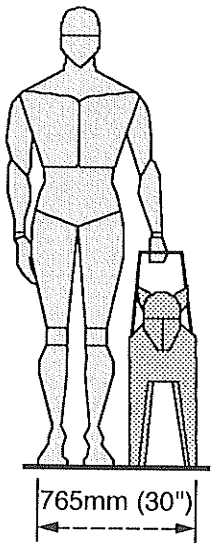


Figure 4.2: Guide Dog

GUIDE DOG

Guide dog users must be in good physical condition with a well developed sense of balance and direction. The user must also have a severe enough impairment to place trust in the dog and not try to guide the dog.[3]

DESIGN PRINCIPLES FOR

PLANNING ACCESSIBLE ENVIRONMENTS FOR BLIND INDIVIDUALS

ORIENTATION

- A good building design is one that is easily understood by blind individuals. It focuses on distinctive and simple planning with sufficient accessible information regarding the environment. Various techniques are recommended to achieve the desired design: well defined tactile cues and, most importantly, consistency and uniformity.[4] In familiar environments blind individuals may rely on a mental image of the space. This mental image is sometimes referred to as a cognitive map. Initially the mental image consists of direct and simple information; such as the shape of a route and landmarks along the route. As individuals are further exposed to a specific space, they gain a greater understanding of more complex interrelationships of objects and points.[5]
- To assist in orientation contrast features or surfaces that need to be differentiated. Contrast may be achieved through the use of texture, sound, material, and size variation.[6]
- Use contrast such as objects, and size variations to communicate important environmental information.[6]
  - ◊ Novelty items tend to be most useful for way-finding.[6]
  - ◊ Size changes when they create different ambiance in air movement or sound may convey importance.[6]
- Use textural contrasts to communicate important environmental information.[7]
  - ◊ Texture changes are useful cues for blind individuals. However, repetitious textures can be monotonous.[7]
  - ◊ The most obvious form of textural communication is braille, which can be used to mark controls.[7]
  - ◊ Other textural markers may include raised numbering and lettering, changes in the floor or wall surface, or shape coding (notches or grooves cut into a surface to identify a location).[7]

CONSISTENCY, UNIFORMITY, AND ORGANIZATION

- Consistency, uniformity, and organization assist a blind individual develop a cognitive map of their environment. The blind individual thus knows what to expect and knows where to locate something that is needed in their environment.[8]
- Consistency should be reflected in the overall design of the dwelling unit: its floor plan, furnishings and fixtures.[8]
- Uniformity among housing units should exist. Where possible specific "standard" features. Non-standard features tend to cause accidents.[1]
- Organization (a place for everything and everything in its place) in the placement of objects is necessary. Locations where items are stored should be organized and non-cluttered, since memory is used to locate items.[9] There should also be a sense of order to belongings and placement of items, i.e.: things used together should be kept together.[10]

MINIMIZE TRAVEL THROUGH RESIDENCE

- Storage: Create storage facilities near areas of use, eg.: large pots and pan storage by cooking area, towel storage in bathroom, etc.[1]
- Services: Duplicate services when possible, e.g.: more than one telephone in the house, an informal dining area in the kitchen, etc.[1]
- As a rule-of-thumb minimize distances between two navigation points to three steps in the kitchen and bathroom. A navigation point is a permanently located fixture or texture which assists in way-finding.[1]

EASE OF OPERATION AND MANIPULATION

- Provide features which are easy to access, operate, and control, eg.: large rocker-type switches, easy-to-use controls, etc.
- Everything should be operable with one hand.[11]

MINIMIZE MAINTENANCE

- Provide features which promote simple maintenance, i.e.: easy-to-clean flooring, self-cleaning ovens, etc.

SAFETY

- Residential environments should include basic safety features.
  - ◊ Individuals with disabilities and elderly persons have a strong preference for features that increase their safety, i.e.: smoke detectors, nonslip surfaces in the bathroom, no sharp edges to reduce injuries due to falls, etc.[12]
  - ◊ One decision facing designers is how far to take the effort to ensure personal safety in light of existing monetary constraints. Features that offer protection from fires, prevent falls and permit summoning help quickly in case of need are probably cost effective in the long run.[12]
- Safety features in the home should be readily available but unobtrusive and nontherapeutic looking. People do not wish to be identified as impaired and will be resistant to design that is institutional in appearance.[13]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS COMMON TO KITCHENS AND BATHROOMS

DOORS AND DOORWAYS

Orientation

- The door opening device may be textured to indicate that the door leads to a potentially dangerous situation, eg.: stairs.[14]

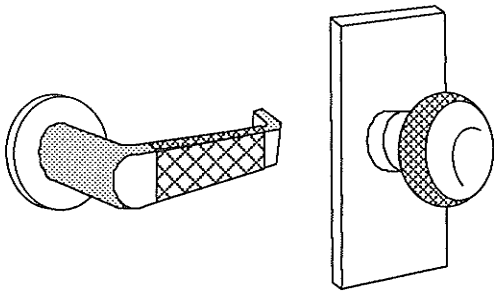


Figure 4.3: Door Opening Devices with Texture Warnings

Consistency, Uniformity, and Organization

- Maintain the same door opening device type (knob, lever) and height above floor throughout the house.[1]

Safety

- Doors should be kept either fully open or fully closed to keep a blind individual from accidently walking into it. It may be advantageous to provide a door closer on doors.[1]
- Sliding doors are a practical option to minimize people from walking into doors.[2]
- The door frame should be made of a soft material (wood, rubber). Many injuries occur when an individual walks into the door frame.[1]
- Thresholds should be avoided. If a threshold must exist it should be no more than 15mm (5/8") high.[15]

FLOORING

Orientation

- A change in flooring (texture and/or hardness) may act as a location cue indicating a change in planning function. Each room may be given a unique flooring surface to define it.[16]
- Cane users tap rather than sweep surfaces. Materials which rely on sound and resilient cues are more detectable than materials which rely on textural cues, although once a cane user detects a change in surface, they tend to sweep their canes making texture a secondary cue.[17]
- Texture strips may be placed in front of dangerous areas, eg.: in front of cooktop or before level changes.[14]

Minimize Maintenance

- Flooring should have some textural indicator to assist blind individuals in sectioning the floor while cleaning.[1]

Safety

- Choose slip-resistant flooring.[1]
- Floor mats and throw rugs should be avoided where possible. If they must exist, they should be securely attached to the floor and not be able to bunch up under one's feet.[2]

HARDWARE AND ELECTRICAL

Ease of Operation and Manipulation

- Control devices should have easy-to-grip handles. Most control devices can be fitted with braille/tactile overlays.[1]

WALLS

Orientation

- A room which has one wall textured and the remaining walls smooth may help orient a blind individual.[9]

Safety

- Walls should not have an extremely rough, abrasive, or uneven surface which could be uncomfortable to touch.[18]
- Avoid wall projections greater than 100mm (4") within a range of 685-1800mm (27-72") above the floor.[19]

WINDOWS

Orientation

- The sound transmitted through a window may help orient a blind individual.[1]

Consistency, Uniformity, and Organization

- Blind people may forget that the drapes are open. In rooms where privacy is necessary, such as in the bathroom or bedroom, provide half-curtains.[1]

Safety

- Avoid hinged windows which project into space when open.[20]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS SPECIFIC TO KITCHENS

GENERAL PLANNING AND ORGANIZATION

Consistency, Uniformity, and Organization

- Provide storage space in or near the kitchen to offer an accessible storage option supplementing the conventional upper and lower cabinets.[21]

Minimize Travel Through Residence

- U-shaped and galley kitchens are preferred by blind individuals because they generally minimize the need for travel. L-shaped kitchens should be avoided.[1]
- Create storage opportunities near areas of use, i.e.: storage for dishes and cutlery near the sink, storage for large posts and pans near the cooking area.[1]
- A telephone jack should be located in the kitchen.[22]
- An informal dining area should be located in the kitchen.[22]

Safety

- If food has to be carried some distance from kitchen to dining area, a storage trolley may be desirable. It can serve as a good "bumper" and carrier if the user becomes misdirected while transferring the food over a distance.[1]

WORK SURFACES (COUNTERTOP)

Orientation

- The work surface should have areas of contrasting texture to provide opportunities for orientation.[23] These contrasting texture areas should extend the full depth of the work surface, front edge to backsplash, to assist in way-finding.[1]

Consistency, Uniformity, and Organization

- All work surfaces should be at the same level because this reduces the amount of information a blind individual needs to know in order to familiarize oneself with the environment.[24]

Minimize Travel Through Residence

- Avoid long stretches of uninterrupted work surface, 1830mm (72") maximum.[1]

Ease of Operation and Manipulation

- Blind individuals find it easier to slide goods and utensils along the work surface than try and walk with them, therefore work surfaces should be all at the same level.[24]

SINK

Ease of Operation and Manipulation

- Single-lever faucet controls are preferred.[25]
- Faucets with a spray attachment so pans can be filled without placing them in the sink are preferred.[25]

CABINETRY

Orientation

- Varied shaped or textured handles should be used for ease of identification.[26]
- There should be a surface texture change to indicate one is inside a cabinet.[1]

Consistency, Uniformity, and Organization

- Provide built-in features which create predictability to make it easier for blind individuals to find things, i.e.: knife racks, dish racks, drawer dividers, storage insets, different shape storage containers.[27]

Ease of Operation and Manipulation

- Provide D-shaped or lever handles on cabinets.[28]
- Maximize storage accessibility by providing pull-out racks, pull-out shelving, flexible shelving, lazy-Susan corner cabinets, hanging pull-down storage, etc.[28]

Minimize Maintenance

- Enclosed cabinetry is preferred to open shelving because it is easier to maintain.[28]

Safety

- Edges on work surfaces should be rounded to protect an individual from accidental injury.[13]
- Swing out doors are a potential hazard because blind individuals tend to run into them if left open. Upper cabinetry doors should be either lift up flap, a roll-down shutter (tambour), or a roller blind.[23]
- Under-work surface storage should be drawers or pull-out devices. Avoid conditions where the user will have to bend down and reach inside an enclosed space.[1]

COOKING FACILITIES

Orientation

- Controls should be marked so they can be read by touch.[23]

Ease of Operation and Manipulation

- A heat-resistant work surface should be located next to all cooking facilities.[29]
- Controls should be large and easy to operate. A positive click or sensation should occur upon return to the "off" position.[30]

- Cooktop:
  - ◊ The cooking elements should be slightly higher than the adjacent surface. This enables the user to centre the pot on the cooking element quickly.[1]
  - ◊ Avoid ceramic cooktops. Blind users have a tendency to misjudge distances, a heavily placed pot may damage the ceramic surface.[1]
- Wall Oven:
  - ◊ Wall ovens are preferred to free-standing ranges.[31] The wall oven should be placed such that the most often used oven shelf is level with the surface of the work surface.[32]
  - ◊ Controls should be located at the top of the wall oven.[1]
- Microwave:
  - ◊ Provide space in front of the microwave on the work surface so that items may be set down. The work surface in front of the microwave should be heat-resistant. If no work surface space is available in front of the microwave a pull-out board in front of the microwave is advised. The pull-out board, however, may prove dangerous if the blind individual accidently bumps into it.[1]
  - ◊ A touchpad control with a textural indicator is the preferred control method, a dial control with textural markings is a secondary choice.[1]

Minimize Maintenance

- Cooktop:
  - ◊ Sealed cooking elements are preferred because they are easier to clean.[1]
- Wall Oven:
  - ◊ Self-cleaning ovens are preferred.[31]

Safety

- Electric cooking devices are preferred to gas operated cooking devices.[33]

- A countertop cooktop and a wall oven are preferred to a range. Using a wall oven one need not bend down while reaching inside the oven, this reduces the risk of burns from contact with the upper element.[1]
- Cooktop:
  - ◊ Cooking elements should be arranged in a half-moon or staggered layout to eliminate the risk of burning while reaching across the front element to a rear one.[32]

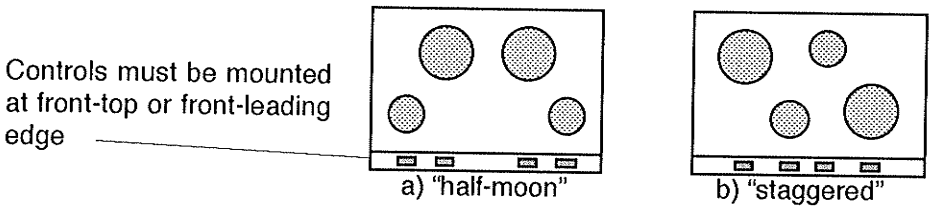


Figure 4.4: Recommended Cooktop Element Arrangements

  - ◊ Controls should be located at the front of the cooktop because they eliminate the risk of burning while reaching across the cooking elements.[33] Controls located at the side of the cooktop should be avoided because they may cause spills when an operator slides pots along the work surface.[1]
  - ◊ The control layout should relate to the heating element layout.[34]
- Wall Oven:
  - ◊ A wall oven with a side-opening door and heat-resistant, pull-out shelf below often is more accessible than a drop-down door wall oven. But, side-opening door wall ovens tend not to be as well insulated as drop-down door wall ovens and individuals may burn themselves on the side-opening oven door. Also, self-cleaning side-opening ovens are not commonly attainable and individuals may become injured while cleaning the oven. In an emergency a drop-down door wall oven allows a surface to place hot items on. When choosing a wall oven one may need to look at the trade-offs for each wall oven type.[15]

REFRIGERATOR

Consistency, Uniformity, and Organization

- A large refrigerator is preferred so that food can be organized easier.[1]
- Side-by-side refrigerator/freezers are preferred because generally items are easier to organize within them (more storage baskets and compartments than a standard up-right refrigerator).[1]

Ease of Operation and Manipulation

- A work surface should be located near the refrigerator.[1]
- The temperature control dial should be large, have textural markings, and be easy to manipulate.[15]
- Crisper drawers should open at least three quarter the way open and the drawer should have back stops.[15]
- Shelves should be adjustable, pull-out, and non tipping.[35]

Minimize Maintenance

- Frost-free refrigerators are preferred.[35]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS SPECIFIC TO BATHROOMS

GENERAL PLANNING AND ORGANIZATION

Minimize Travel Through Residence

- A storage closet for towels and other related bathroom articles should be located in the bathroom.[21]

HANDBASIN

Ease of Operation and Manipulation

- Basins with an adjacent work surface are preferred for personal accessories.[36]
- Tap handles should be lever or capstan type with a quarter-turn operation for water delivery.[37]
- Drawers with D-type or lever handles are preferred because they provide easier access to storage than a cupboard.[36]

Safety

- Edges on work surfaces, especially those in the bathroom, should be rounded to protect an individual from accidental injury.[13]

MEDICINE CABINET

Safety

- Medicine cabinet doors should sliding, not hinged.[38]

BATH AND SHOWER

Ease of Operation and Manipulation

- Controls should be accessible from inside the tub and from beside the tub.[15]
- A hand-held shower placed on a vertical, adjustable bar should be provided. The hand-held shower should be easy to operate while sitting or standing in the tub. An on/off water control on the shower head may be advantageous.[15]

Safety

- The tub should have a non-slip surface. This non-slip surface may be provided by an inherently non-slip tub surface or by using a non-slip mat (contrasting colour). The non-slip mat is a second choice because they are difficult to clean, are prone to mold and mildew, and they sometimes slip.[15]

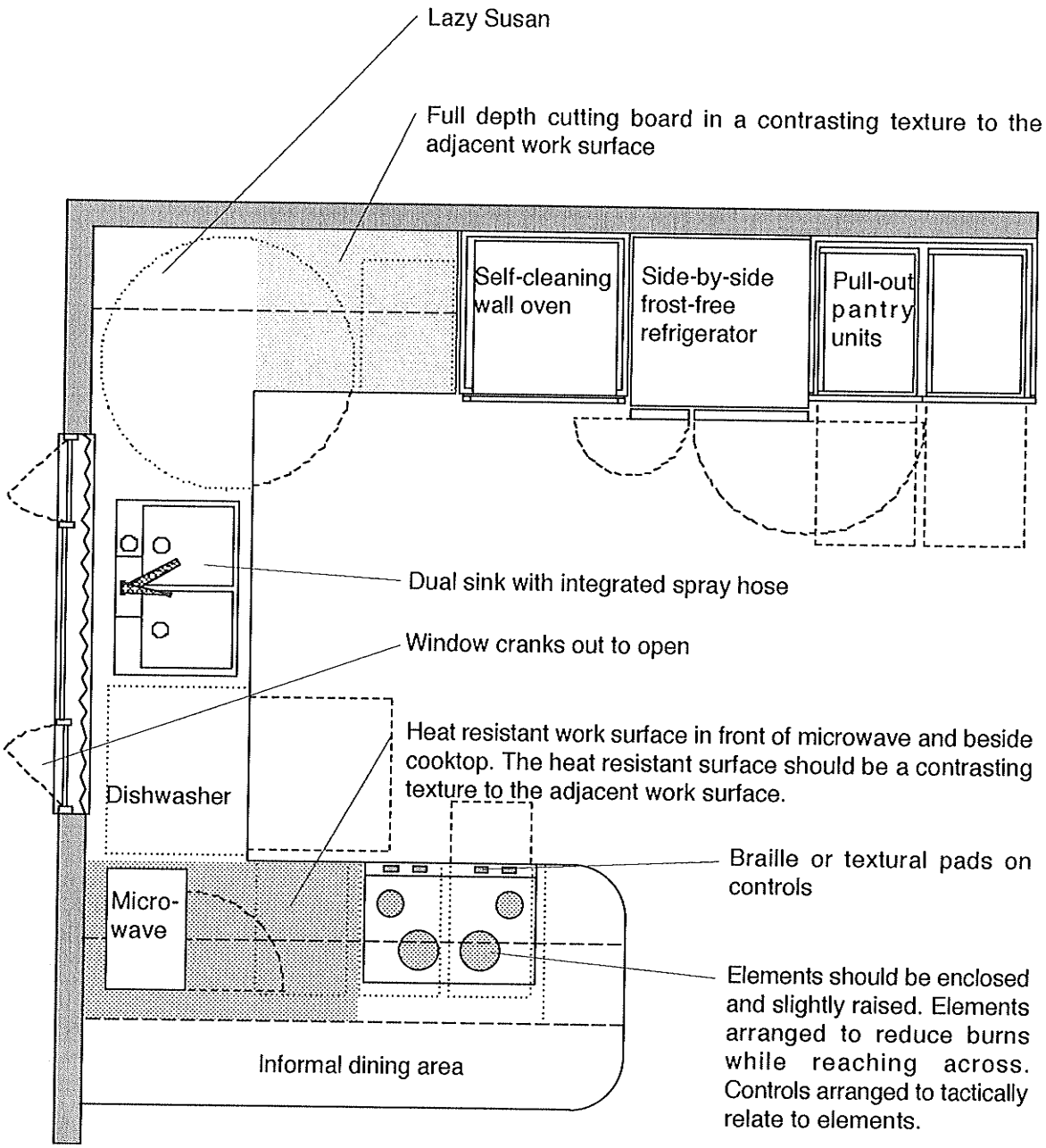


Figure 4.5: Blind Kitchen Plan, Design Suggestions

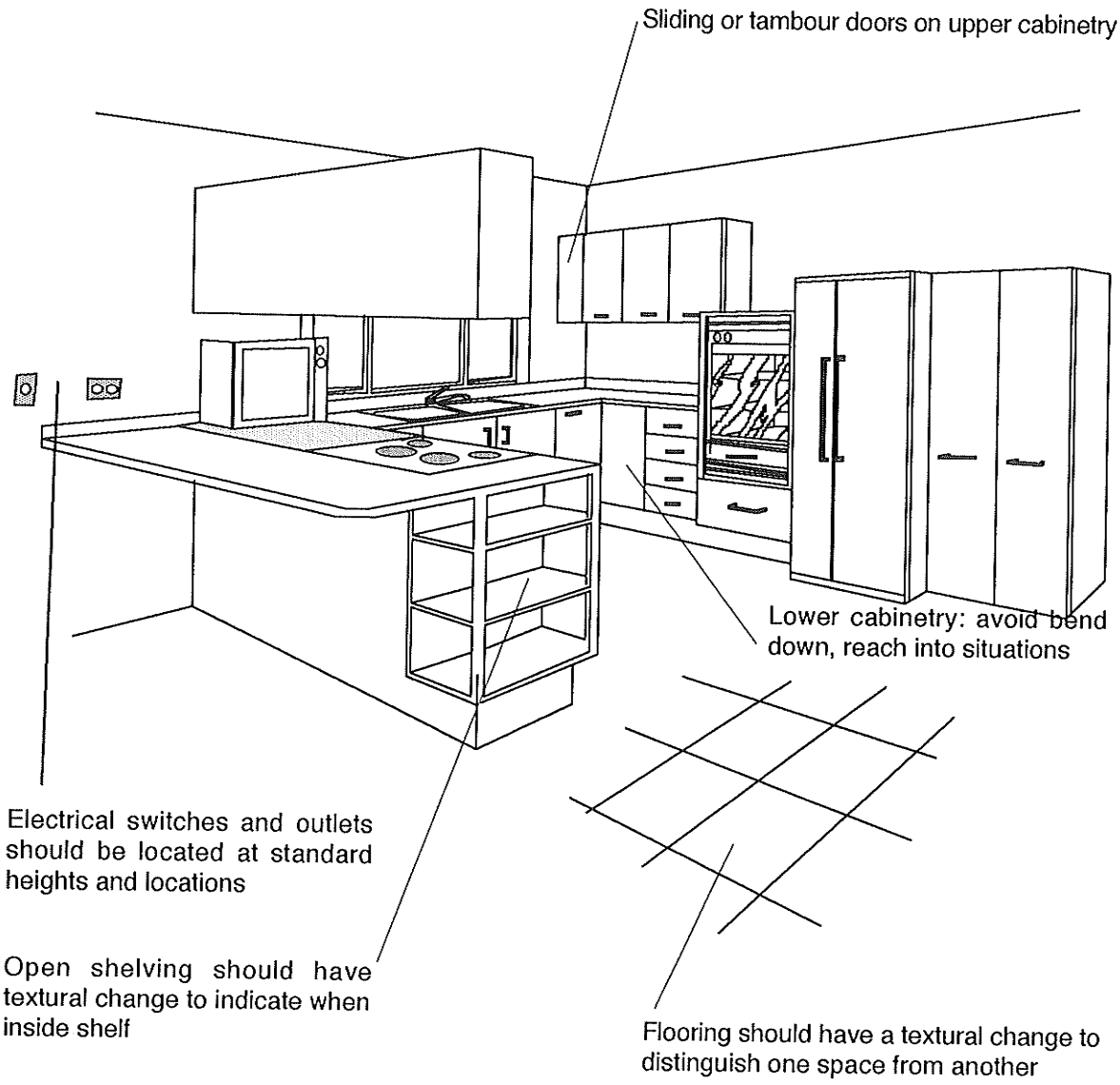


Figure 4.6: Blind Kitchen, Design Suggestions

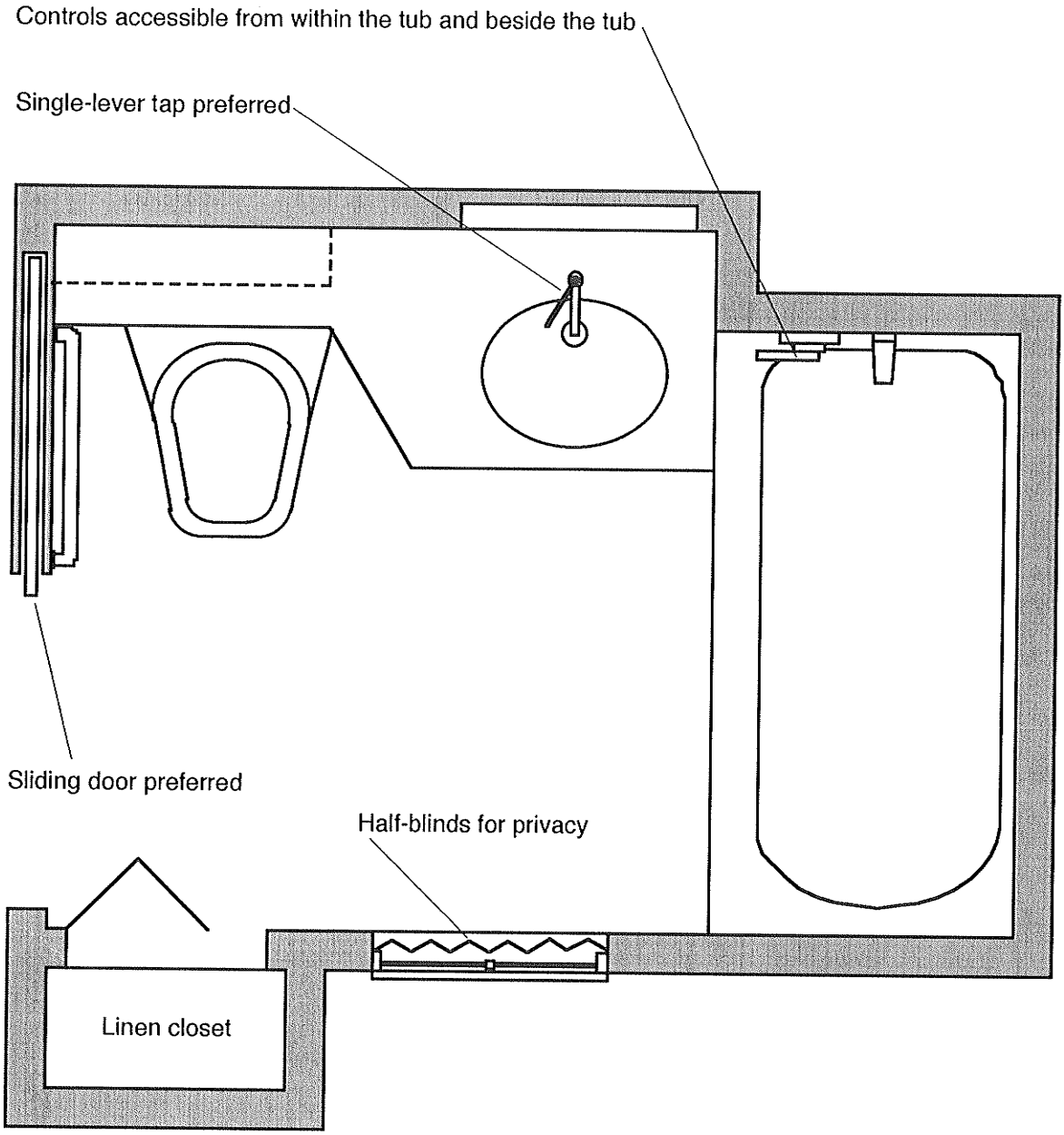


Figure 4.7: Blind Bathroom Plan, Design Suggestions

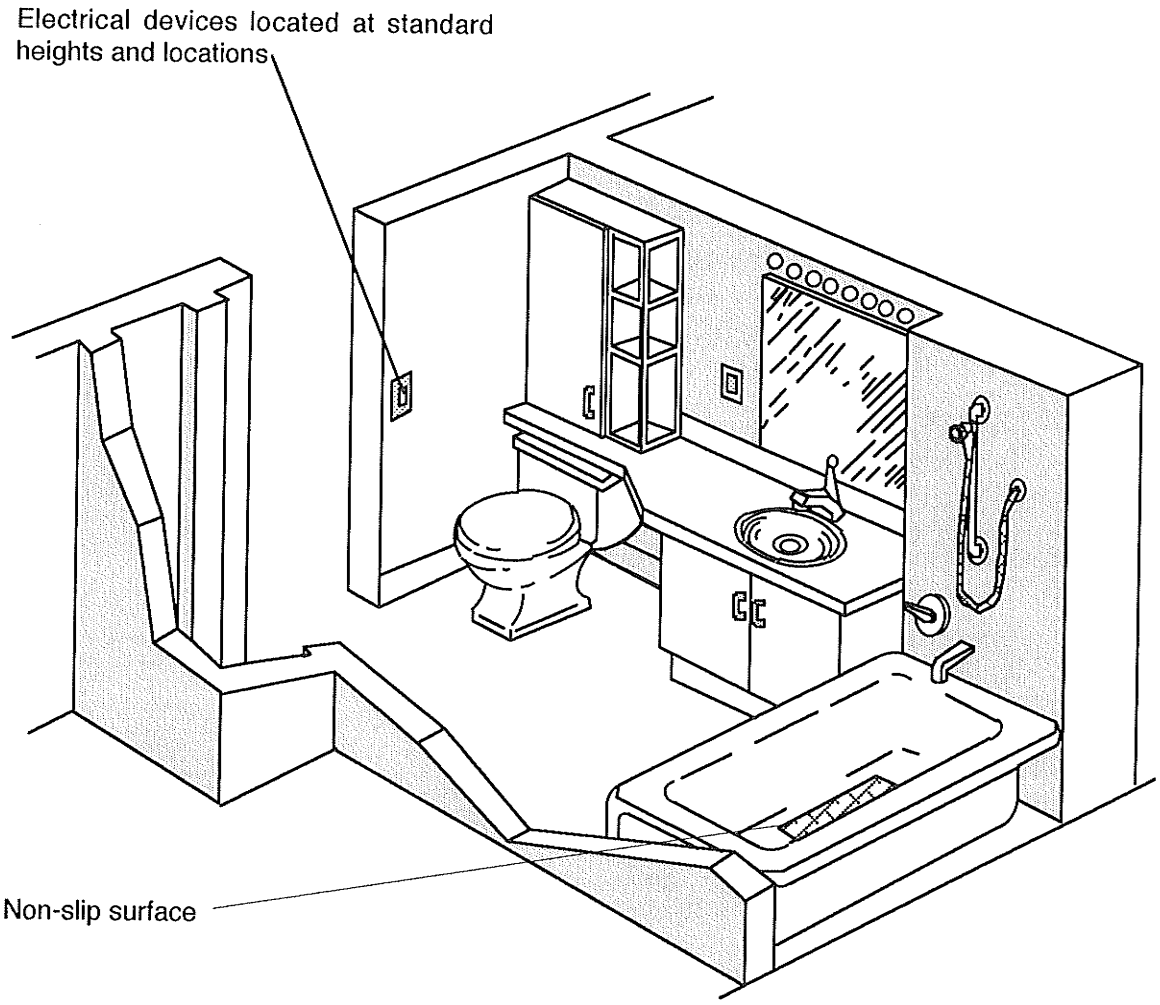


Figure 4.8: Blind Bathroom, Design Suggestions

[1] Lynn Mayor, March, 1992.
[2] Dickman 1983, 9.
[3] Hunter 1981.
[4] Richesin, et al. 1987, ix.
[5] Ibid, 38.
[6] Haitt 1987, 363.
[7] Koncelik 1987, 396.
[8] Richesin, et al. 1987, 39
[9] Kelly 1987, 95.
[10] From a one-page handout produced by the CNIB in Winnipeg entitled, "Principles of Assisting a Blind/Visually Impaired Person".
[11] CMHC 1988b, 8.
[12] Moos, Lemke, and David 1987, 198.
[13] Pynoos, Cohen, Davis, and Bernhardt 1987, 299.
[14] ANSI 1980, 66.
[15] Donna Collins, June, 1992.
[16] Wagner 1989, 98-9; Nesmith 1987, 63.
[17] Cabel Childress Architects 1985, 96-9.
[18] Richesin, et al. 1987, 78.
[19] Aitkens and Finan 1987, Chapter 3, page 77.
[20] Department of Education and Science 1981.
[21] Whiting 1986, 25.
[22] Aitkens and Finan 1987, Chapter 3, page 68.
[23] FitzGerald 1985, 9.
[24] Independent Living Centre, N.S.W. 1987a, 2.
[25] Null 1988, 244.
[26] IIT 1976, 428.
[27] Lau 1984.
[28] Null 1988, 242.
[29] Aitkens and Finan 1987, Chapter 3, page 70.
[30] Cochrane and Wilshere 1987.
[31] Pynoos, Cohen, Davis, and Bernhardt 1987, 298-9.
[32] Christiansen and Baum 1991, 731.
[33] Christiansen and Baum 1991, 730.
[34] Independent Living Centre, N.S.W. 1987a, 12.
[35] Independent Living Centre, N.S.W. 1987a, 14.
[36] Independent Living Centre, N.S.W. 1987b, 12.
[37] Independent Living Centre, N.S.W. 1987b, 13.
[38] Dickman 1983, 55.

HARD of HEARING INDIVIDUALS

DISABILITY DEFINITION AND LIMITATIONS

The "hard of hearing individuals" group is defined in this paper as people who use hearing aids and people with partial hearing who obtain some information on the environment using visual cues, this may include lip reading.

Special considerations to assist this group interpret the environment are:

- Illumination: Hard of hearing individuals require proper lighting in order to read lips.[1] The rule-of-thumb is to provide gently modulated and controllable overall light levels, combined with glarefree task lighting for close work and accent lighting for space defining contrast, avoid glare, spottiness, shadows, back-lighting an individual communicating in sign, and lighting with a strong vertical component.[2]
- Sound: Auditory environments, perhaps more than visual ones, are capable of contributing to stress. Noise is also a greater problem when an individual cannot see its source or predict its occurrence.[3] Generally, an individual may hear some frequencies better than others.[4] Some individuals with hearing disorders are less capable of perceiving high pitched tones.[3]
  - ◊ Two types of noise are important to control; background noise (especially low sound as produced by mechanical equipment) and sudden, intense, and uncontrollable noise.[3]
- Sound amplification systems: These systems are rarely used in the residential environment and are presented for informative purposes only.
  - ◊ Induction Loop: An induction loop is a wire which runs around an area, room or house and is connected to an electrical apparatus such as a radio or television. The loop sets up a magnetic field so that a person using a hearing aid with a special pick-up coil (T-switch) can hear the radio anywhere within the loop. This avoids having to raise the sound level, and at the same time ensures that the hard of hearing person only hears the sounds from the electronic source and is not troubled by background noise. Metal structure buildings may ground the magnetic field leaving the system inoperative.[5]

- ◊ FM system: The FM system consists of a transmitter and one or more personal receivers. There are two types of transmitters available; a portable transmitter which is used by an individual, and a local transmitter which is used in large rooms or auditoriums. The portable transmitter and personal receiver resemble a deck of playing cards in size. A similar, but less effective system is also available in AM.[5]
- ◊ Infrared system: The infrared system consists of one or more transmitters and receivers. A transmitter sends a signal using invisible infrared rays into a room. The receiver converts the light back into sound and directs the sound to the ear. There must be a direct line with no obstructions between the transmitter and receiver for this system to operate.[5]

Some characteristic problems of hard of hearing individuals are:

- They have balance problems, especially in dimly lit and dark spaces.[6]
- They cannot identify the location of a sound.[7]
- They may not hear alarms, water running, a kettle boiling, etc.[7]
- Hearing aids are rendered ineffective by background noise and electrical interference.[8]

DESIGN PRINCIPLES FOR PLANNING

ACCESSIBLE ENVIRONMENTS FOR HARD OF HEARING INDIVIDUALS

CONTROL SOUND BY ARCHITECTURAL MEANS

- Eliminate constant sources of noise to improve speech intelligibility.[3] Isolate air handling equipment and other noisy machines, i.e: dishwashing machines.[9]
- Ambient background sounds in rooms should be dampened and reduced.[10] Provide sound absorption to control airborne and structure-borne sound (i.e.: massive construction, insulation, fibrous-porous materials on room surfaces), and minimize surfaces which reflect sound readily (i.e.: large windows and hard, smooth surfaces).[11]
- Reduce noise from exterior sources. Locate residences away from railways, airports, and major vehicular roads. Provide sound buffers through landscaping, i.e.: berms, trees.[12]
- Closed planning (each room is surrounded by full-height walls and its doors can and will be normally closed) provides greater acoustical control than open planning (rooms separated from each other by anything less than full-height partitions).[12]

MINIMIZE SOUND INTERFERENCE

- Control background noise to improve speech intelligibility because hearing aids amplify background noise as well as speech.[4]
- Electrical devices should be properly shielded to prevent interference with hearing aids.[13]
- Antistatic treatment to materials and increased humidity will help reduce static electrical interference which affects hearing aid users.[5]

MINIMIZE AND CONTROL GLARE

- Glare is produced by the sun or light reflecting off surfaces or fixtures. It can also be aggravated by exposed lighting devices; shiny, lustrous floor; and metal, plastic, or veneer furnishings. Use nonreflective surfaces and materials to minimize glare.[14]

AVOID VISUAL CONTRAST

- Hard of hearing individuals require proper lighting in order to read lips and communicate in sign language. Lighting levels should be controllable. Avoid dramatic differences in lighting levels between rooms/spaces.[1] Avoid back-lighting an individual communicating in sign language.[6]

MAXIMIZE COINCIDENT AUDITORY AND VISUAL CUES

- Safety equipment, appliances, and fixtures should have auditory and visual features to communicate important information simultaneously. Auditory cues may be provided loud buzzers, bells, or tones. Visual cues may be provided by a light indicator (flashing, light to indicate on or off, colour of light to indicate information) or by movement.[6]

SAFETY

- Residential environments should include basic safety features.
  - ◊ Individuals with disabilities and elderly persons have a strong preference for features that increase their safety, i.e.: smoke detectors, nonslip surfaces in the bathroom, no sharp edges to reduce injuries due to falls, etc.[15]
  - ◊ One decision facing designers is how far to take the effort to ensure personal safety in light of existing monetary constraints. Features that offer protection from fires, prevent falls and permit summoning help quickly in case of need are probably cost effective in the long run.[15]
- Safety features in the home should be readily available but unobtrusive and nontherapeutic looking. People do not wish to be identified as impaired and will be resistant to design that is institutional in appearance.[16]

DESIGN RECOMMENDATIONS FOR

BUILDING COMPONENTS COMMON TO KITCHENS AND BATHROOMS

CEILING

Control Sound by Architectural Means

- Ceiling treatments alone have typically been unsatisfactory methods for controlling noise associated with conversation unless the area is small and ceiling is quite low.[3]

DOORS AND DOORWAYS

Safety

- Place doors so they do not open into areas where people normally walk or stand because hard of hearing individuals may not hear the twist of the door knob or the door opening.[17]
- Doors in heavy traffic areas should have glass panels or windows since hard of hearing persons need to know that someone is approaching from the other side.[18]

FLOORING

Control Sound By Architectural Means

- Carpeting absorbs airborne and structure-borne sound and reduces the seriousness of accidental falls.[19]

Minimize Sound Interference

- Carpets should have grounding characteristics to minimize problems resulting from static electricity for hearing aid users.[5]

Safety

- Floor mats and throw rugs should be avoided where possible. If they must exist, they should be securely attached to the floor and not be able to bunch up under one's feet.[20]

HARDWARE AND ELECTRICAL

Minimize Sound Interference

- Maximum suppression of interference from mechanical equipment should be provided.[18]
- Heating and ventilation systems should be noiseless. Fan convection heating should be avoided.[18]

Maximize Coincident Auditory and Visual Cues

- Sound emitting signals should be outfitted with a redundant visual warning device, such as a flashing light.[3]

Safety

- Important sounds like emergency signals or security systems should be of a low frequency with strong reverberations.[3]

LIGHTING DEVICES

Minimize Sound Interference

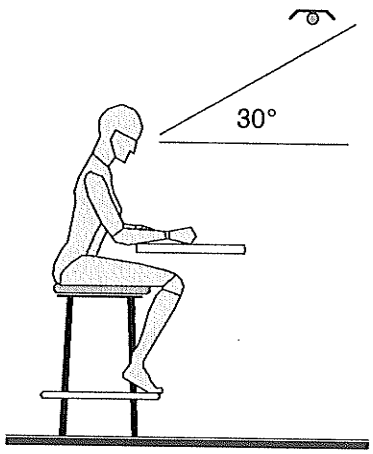
- Ballasts for fluorescent lighting should be of the type that do not cause interference with hearing aids.[21]
- Rheostats (dimmer switches) should be shielded so as not to cause interference with hearing aids.[13]

Minimize and Control Glare

- Fluorescent light characteristically provides little contrast because it is even lighting and casts only soft shadows. This makes fluorescent lighting ideal for general lighting.[2] However, fluorescent lighting is normally harsh because it is in the blue end of the spectrum (natural light fluorescent tubes are available and are preferred by hard of

hearing individuals), and the inherent flicker of this type of light presents problems for some people. It is possible to reduce the flicker effect by linking two fluorescent tubes so that they operate in phase opposition. Alternatively the addition of diffusers (lattice type coverings) or translucent shades around fluorescent fixtures also reduces the flicker effect. Another effective strategy is to mount the lights on a wall behind valances which would require the light to bounce off the ceilings and walls.[22]

- Incandescent light, compared to fluorescent light, is generally more directional, more continuous, more easily varied, and more of a point source. This makes incandescent light generally better for near-work tasks, such as reading, especially when the reader can adjust the focus and intensity of the light. Incandescent light is in the yellow portion of the spectrum. Incandescent light provides heavy contrast because it casts a strong shadow. Incandescent lights in some fixtures, such as those with an uncovered bulb, can cause pinpoint glare and pools of light within relative darkness. The solutions to these problems involve the use of shades and diffusers to prevent the light from directly entering the eye.[22]
- In order to prevent visual hot-spots or glare, a number of less bright lights are better than a single bright light.[22]



- To keep glare to a minimum the angle between the horizontal line of sight and a line from the eye to the light source must be more than 30 degrees.[23]

Figure 5.1: Lighting Device - Factor Effecting Glare

Avoid Visual Contrasts

- Provide rheostats for incandescent lighting to control lighting level.[24]
- In a room provide lighting from various lighting types (incandescent, fluorescent, etc.) which can be controlled by the user to establish the lighting level which they prefer.[2]

WALLS

Control Sound by Architectural Means

- Minimize surfaces which reflect sound readily.[6]
- Fibrous-porous wall materials such as firetreated carpeting, acoustical panels, dense fabrics, or textured woods may be used absorb sound, reducing sound reverberation and sound reflection.[3]

Avoid Visual Contrasts

- Avoid using bold patterns or textures on wall surfaces. They may confuse individuals using manual communication or speechreading.[7]

WINDOWS

Control Sound by Architectural Means

- Glass absorbs little sound. Large window walls may produce acoustical problems unless heavily draped or covered with acoustical vertical blinds. Lower, more effectively placed windows may actually improve communication and reduce glare.[3]

Minimize and Control Glare

- Glare control is best obtained by exterior protection. These may include blinds, louvers, screens, trellises, fences, and arbors.[25]

- Interior glare control methods include curtains, draperies, blinds, tinted window glass, polarized window glass, prismatic window glass, and lighting the room to a similar level of brightness as exists outside. (Polarized window glass reduces glare with little loss of light or change or tint. Prismatic window glass diffuses outside light, eliminates shadow and makes lighting more even throughout.)[22]
- Rooms which face north are beneficial because harsh conditions created by sunlight are eliminated.[27] North facing rooms usually require additional lighting during the day.[20]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS SPECIFIC TO KITCHENS

GENERAL PLANNING AND ORGANIZATION

Maximize Coincident Auditory and Visual Cues

- A small desk area for a TDD/TTY (telephone device for the deaf/teletypewriter) and other aids may be located in or near the kitchen.[6]
- Choose appliances which has coincident auditory and visual cues.[6]
- Hard of hearing users often confront problems with water. It would be beneficial if a technical device could inform a hard of hearing individual of a dripping faucet, running water, or a sink which about to overflow.[7]

SINK

Minimize Sound Interference

- Choose a dishwasher which makes a minimal amount of noise when operating.[9]

Maximize Coincident Auditory and Visual Cues

- An auditory and visual cue should inform a person if the dishwasher is operating, what stage of the washing cycle the machine is performing, and if the machine is not operating properly.[6]

Safety

- The kitchen sink should have an overflow drain.[20]

COOKING FACILITIES

Maximize Coincident Auditory and Visual Cues

- Cooking timer: a light should flash and a sound should sound to indicate that the set time has elapsed.[6]
- Microwave: a light should indicate if the microwave is operating, and a light and buzzer should indicate when the set time has elapsed.[6]
- A light should indicate when the cooktop or the oven is operating.[6]
- A light should indicate when the exhaust fan is operating.[7]

REFRIGERATOR

Maximize Coincident Auditory and Visual Cues

- A light should indicate if the refrigerator is operating.[6]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS SPECIFIC TO BATHROOMS

GENERAL PLANNING AND ORGANIZATION

Maximize Coincident Auditory and Visual Cues

- Hard of hearing users often confront problems with water. It would be beneficial if a technical device could inform a hard of hearing individual of a dripping faucet, running water, or a sink which about to overflow.[6]
- The light switch for the bathroom should be located outside the bathroom. By flashing the light one can inform a hard of hearing person in the bathroom that their presence is required elsewhere.[6]
- The exhaust fan switch should have a light to indicate when the fan is operating.[6]

Safety

- A bathroom for the hard of hearing should be designed as if for deaf people because hearing aid users remove the hearing aid to shower/bath.[6]

HANDBASIN

Safety

- The handbasin should have a overflow drain.[20]

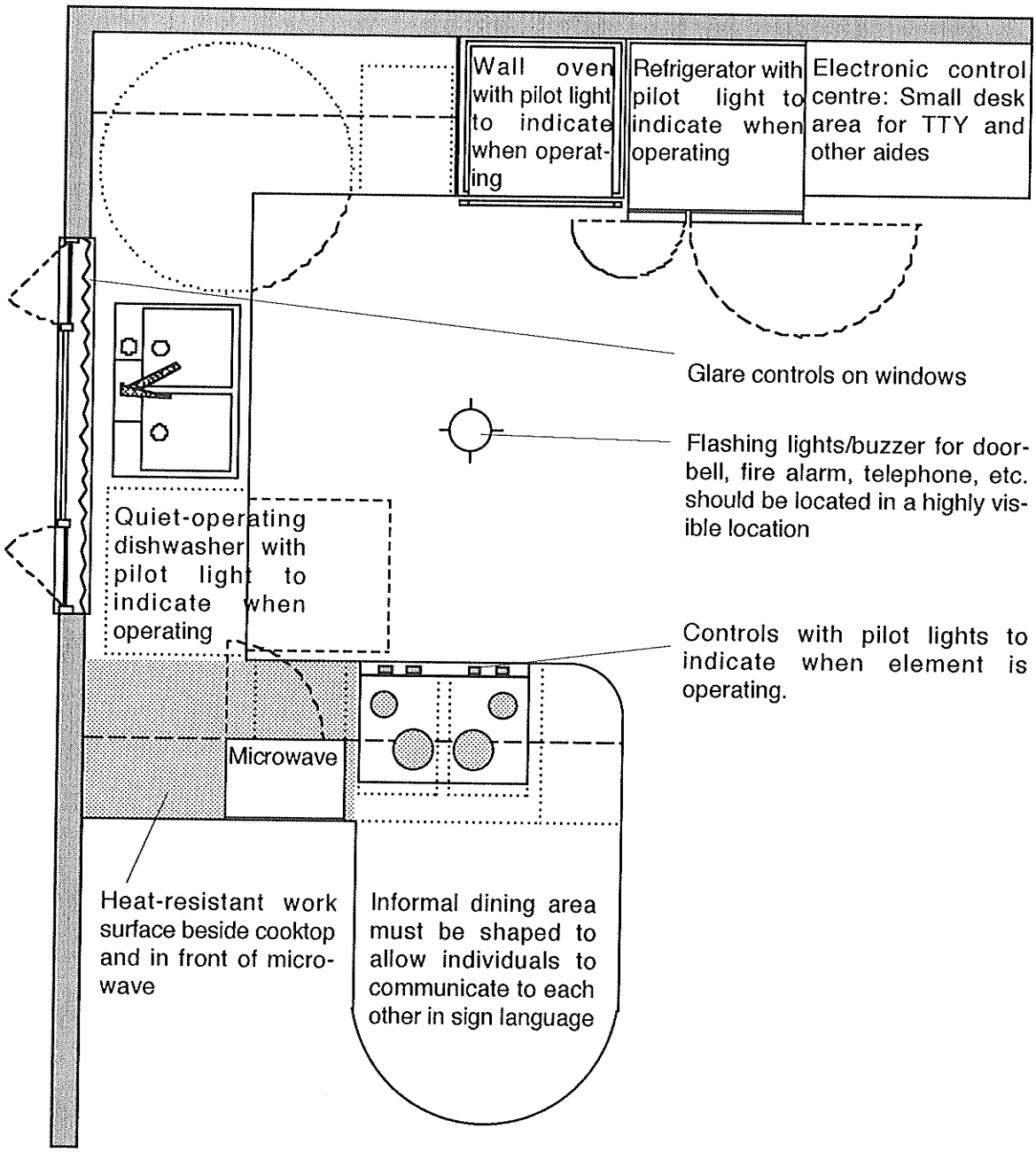


Figure 5.2: Hard of Hearing Kitchen Plan, Design Suggestions

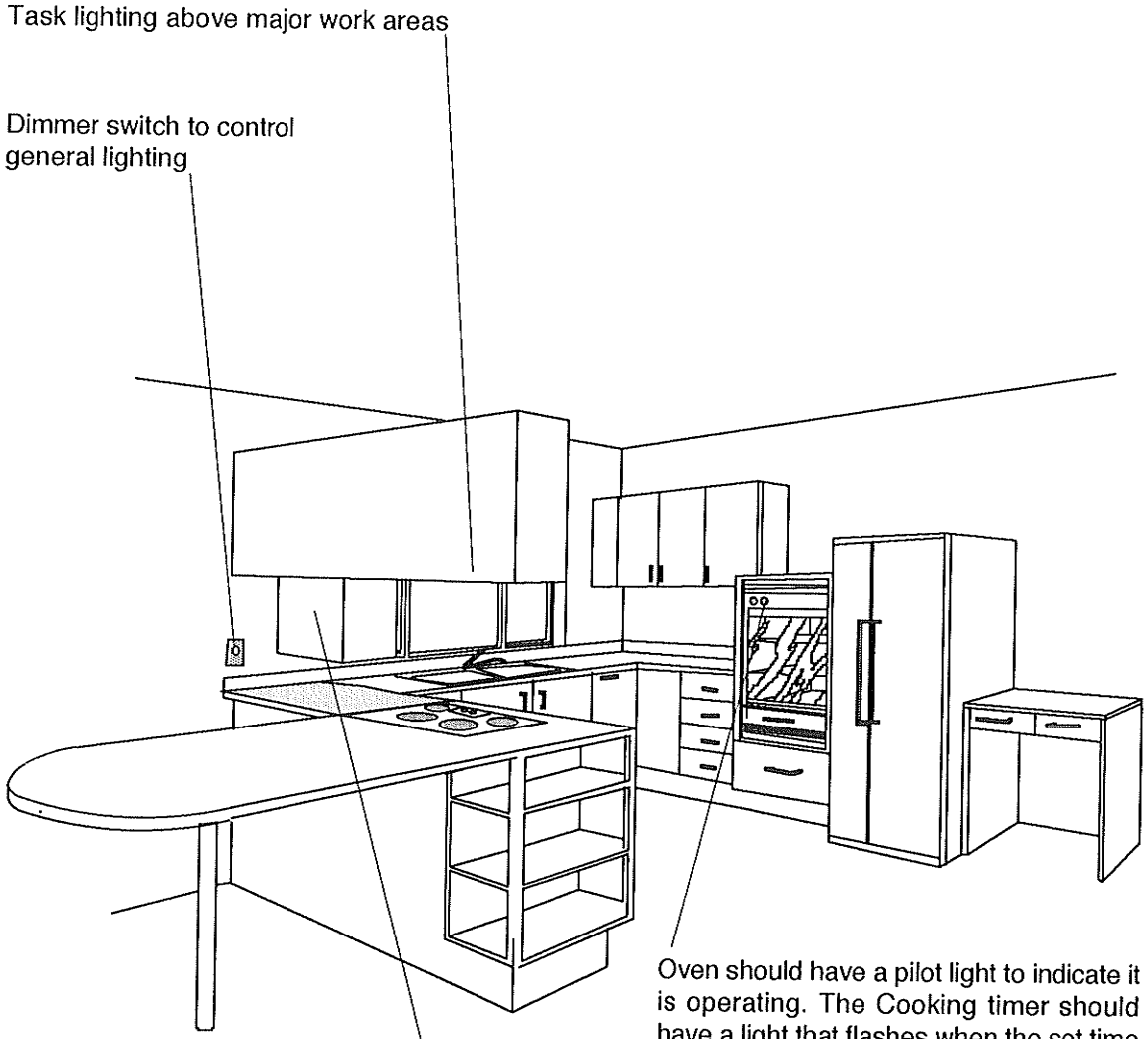


Figure 5.3: Hard of Hearing Kitchen, Design Suggestions

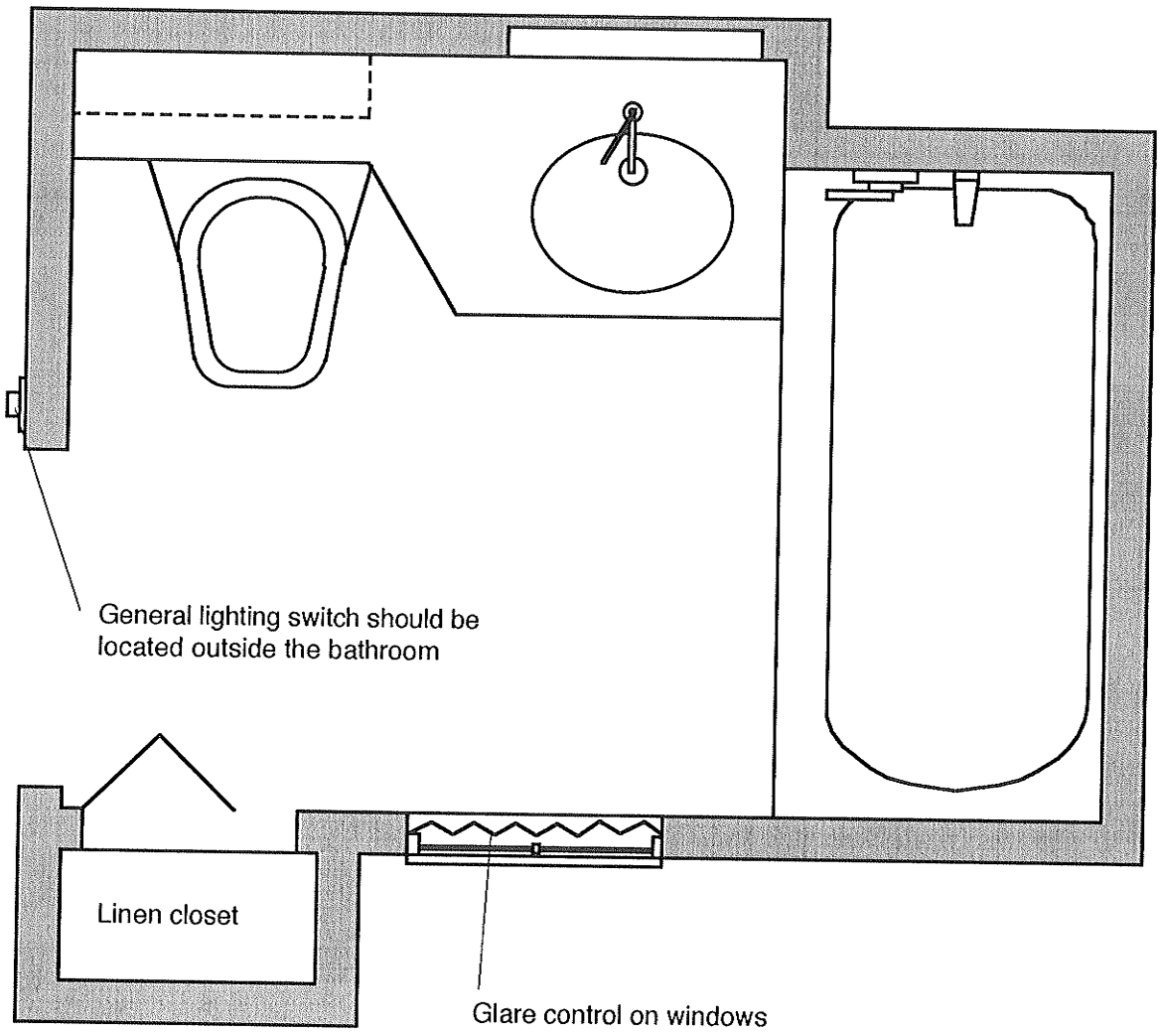


Figure 5.4: Hard of Hearing Bathroom Plan, Design Suggestions

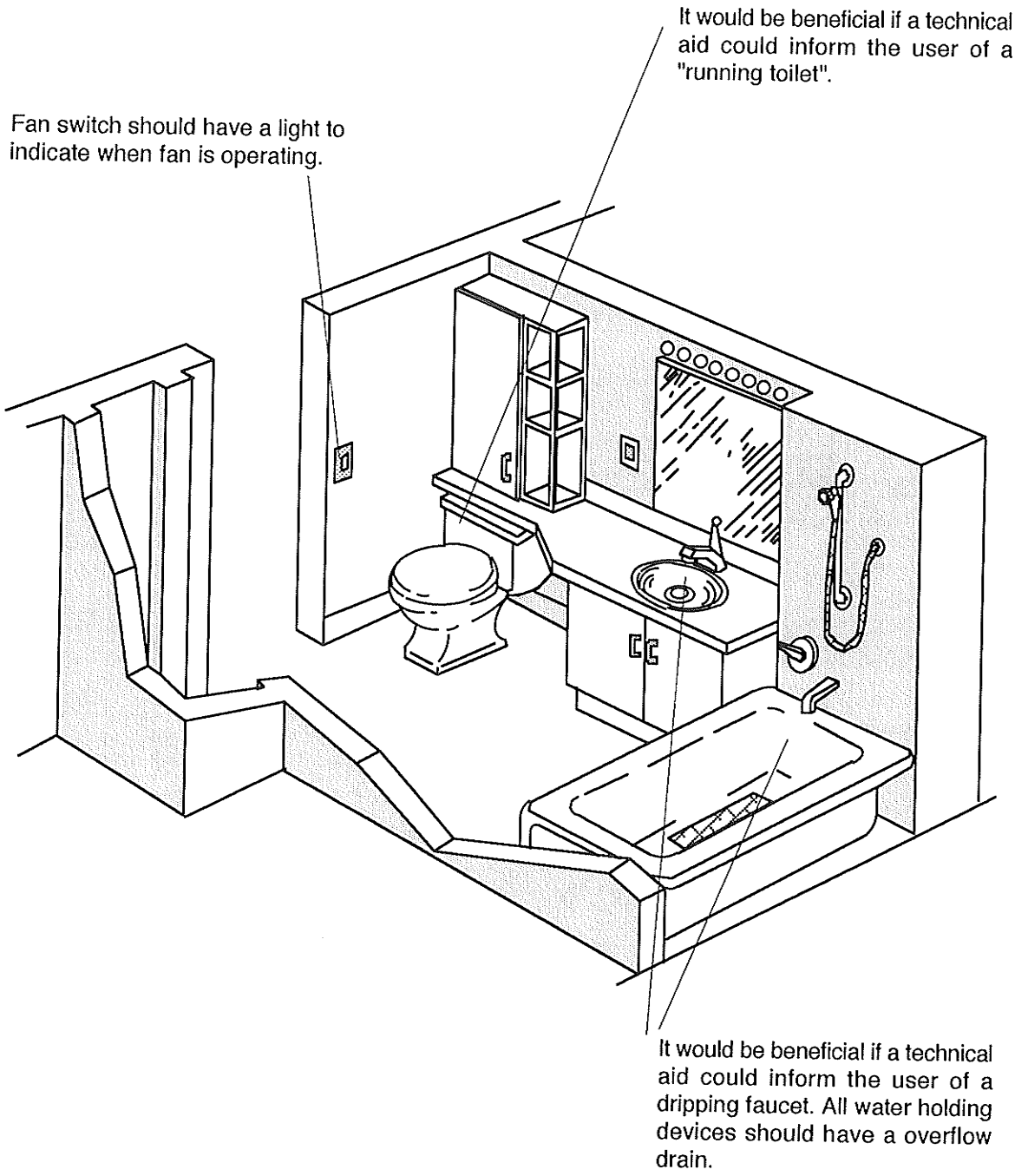


Figure 5.5: Hard of Hearing Bathroom, Design Suggestions

1 Department of Education and Science 1981.
2 Dickman 1983, 17-19.
3 Hiatt 1987, 366-367.
4 Kelly 1987, 90.
5 Canadian Hearing Society, no date, 32.
6 Bruce Koskie, May, 1992.
7 Catherine Shearer, June, 1992.
8 John Lane, October, 1992.
9 Gaskie 1988, 98-107.
10 Koncelik 1987, 394.
11 Blight 1985, 13-14.
12 Blight 1985, 23-27.
13 Aitkens and Finan 1987, chapter 3, 76.
14 Haitt 1987, 363.
15 Moos, Lemke, and David 1987, 198.
16 Pynoos, Cohen, Davis, and Bernhardt 1987, 299.
17 Blight 1985, 17.
18 Ontario Ministry of Community and Social Services 1987.
19 Pynoos, Cohen, Davis, and Bernhardt 1987, 301.
20 Donna Collins, May, 1992.
21 Aitkens and Finan 1987, Chapter 3, 77.
22 Richesin et al. 1987, G-2 and G-3.
23 Christiansen and Baum 1991, 723.
24 Null 1988, 243.
25 Salmon 1964.
26 Dickman 1983, 21.
27 Greer 1987, 71.

DISABILITY DEFINITION AND LIMITATIONS

The "deaf individuals" group is defined in this paper as people with no hearing.

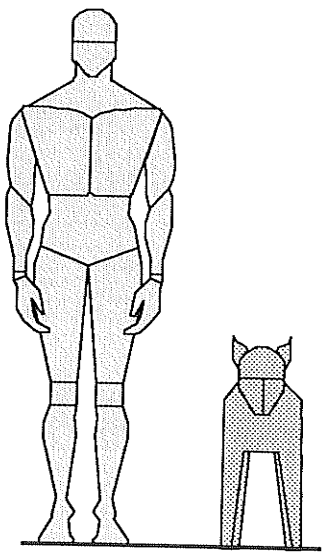
Special considerations to assist this group interpret the environment are:

- Illumination: Deaf individuals require proper lighting in order to read lips and communicate in sign language.[1] The rule-of-thumb is to provide gently modulated and controllable overall light levels, combined with glarefree task lighting for close work and accent lighting for space defining contrast, avoid glare, spottiness, shadows, back-lighting an individual communicating in sign, and lighting with a strong vertical component.[2]
- Sound: Deaf people may feel structure-borne and very low sounds.[3]

Some characteristic problems of deaf individuals are:

- They have balance problems, especially in dimly lit and dark spaces.[4]
- They can not hear alarms, water running, a kettle boiling, etc.[3]

Related disability groups include:



GUIDE DOG

Guide dogs are now being trained to assist deaf users.[3]

Figure 6.1: Guide Dog

DESIGN PRINCIPLES FOR
PLANNING ACCESSIBLE ENVIRONMENTS FOR DEAF INDIVIDUALS

MINIMIZE AND CONTROL GLARE

- Glare is produced by the sun or light reflecting off surfaces or fixtures. It can also be aggravated by exposed lighting devices; shiny, lustrous floor; and metal, plastic, or veneer furnishings. Use nonreflective surfaces and materials to minimize glare.[5]

AVOID VISUAL CONTRAST

- Hard of hearing individuals require proper lighting in order to read lips and communicate in sign language. Lighting levels should be controllable. Avoid dramatic differences in lighting levels between rooms/spaces.[1] Avoid back-lighting an individual communicating in sign language.[4]

MAXIMIZE COINCIDENT AUDITORY AND VISUAL CUES

- Safety equipment, appliances, and fixtures should have auditory and visual features to communicate important information simultaneously. Visual cues may be provided by a light indicator (flashing, light to indicate on or off, colour of light to indicate information) or by movement.[4] Auditory cues are important because many technical aids need sounds in order activate visual warning cues.[6]

SAFETY

- Residential environments should include basic safety features.
  - ◊ Individuals with disabilities and elderly persons have a strong preference for features that increase their safety, i.e.: smoke detectors, nonslip surfaces in the bathroom, no sharp edges to reduce injuries due to falls, etc.[7]

- ◊ One decision facing designers is how far to take the effort to ensure personal safety in light of existing monetary constraints. Features that offer protection from fires, prevent falls and permit summoning help quickly in case of need are probably cost effective in the long run.[7]

- Safety features in the home should be readily available but unobtrusive and nontherapeutic looking. People do not wish to be identified as impaired and will be resistant to design that is institutional in appearance.[8]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS COMMON TO KITCHENS AND BATHROOMS

DOORS AND DOORWAYS

Safety

- Place doors so they do not open into areas where people normally walk or stand because deaf individuals can not hear the twist of the door knob or the door opening.[9]
- Doors in heavy traffic areas should have glass panels or windows since deaf persons need to know that someone is approaching from the other side.[10]

FLOORING

Safety

- Floor mats and throw rugs should be avoided where possible. If they must exist, they should be securely attached to the floor and not be able to bunch up under one's feet.[11]

HARDWARE AND ELECTRICAL

Maximize Coincident Auditory and Visual Cues

- Safety equipment, appliances, and fixtures should have auditory and visual features to communicate important information simultaneously. Visual cues may be provided by a light indicator (flashing, light to indicate on or off, colour of light to indicate information) or by movement.[4] Auditory cues are important because many technical aids need sounds in order activate visual warning cues.[6]

LIGHTING DEVICES

Minimize and Control Glare

- Fluorescent light characteristically provides little contrast because it is even lighting and casts only soft shadows. This makes fluorescent lighting ideal for general lighting.[2]

However, fluorescent lighting is normally harsh because it is in the blue end of the spectrum (natural light fluorescent tubes are available and are preferred by deaf individuals), and the inherent flicker of this type of light presents problems for some people. It is possible to reduce the flicker effect by linking two fluorescent tubes so that they operate in phase opposition. Alternatively the addition of diffusers (lattice type coverings) or translucent shades around fluorescent fixtures also reduces the flicker effect. Another effective strategy is to mount the lights on a wall behind valances which would require the light to bounce off the ceilings and walls.[12]

- Incandescent light, compared to fluorescent light, is generally more directional, more continuous, more easily varied, and more of a point source. This makes incandescent light generally better for near-work tasks, such as reading, especially when the reader can adjust the focus and intensity of the light. Incandescent light is in the yellow portion of the spectrum. Incandescent light provides heavy contrast because it casts a strong shadow. Incandescent lights in some fixtures, such as those with an uncovered bulb, can cause pinpoint glare and pools of light within relative darkness. The solutions to these problems involve the use of shades and diffusers to prevent the light from directly entering the eye.[12]
- In order to prevent visual hot-spots or glare, a number of less bright lights are better than a single bright light.[12]
- To keep glare to a minimum the angle between the horizontal line of sight and a line from the eye to the light source must be more than 30 degrees.[13]

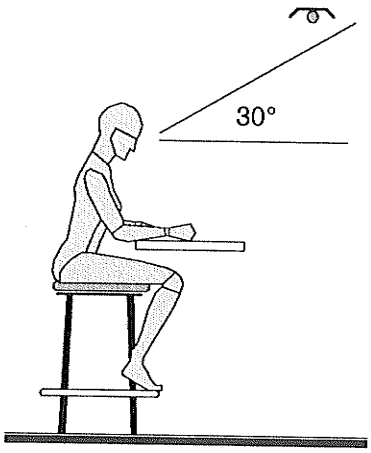


Figure 6.2: Lighting Device - Factor Effecting Glare

Avoid Visual Contrasts

- Provide rheostats for incandescent lighting to control lighting level.[14]
- In a room, provide lighting from various lighting types (incandescent, fluorescent, etc.) which can be controlled by the user to establish the lighting level which they prefer.[2]

Maximize Coincident Auditory and Visual Cues

- Provide wiring for flashing lights.[11]

WALLS

Avoid Visual Contrasts

- Avoid using bold patterns or textures on wall surfaces. They may confuse individuals using manual communication or speechreading.[3]

WINDOWS

Minimize and Control Glare

- Glare control is best obtained by exterior protection. These may include awnings, louvers, screens, trellises, fences, and arbors.[15]
- Interior glare control methods include curtains, draperies, blinds, tinted window glass, polarized window glass, prismatic window glass, and lighting the room to a similar level of brightness as exists outside. (Polarized window glass reduces glare with little loss of light or change or tint. Prismatic window glass diffuses outside light, eliminates shadow and makes lighting more even throughout.)[12]
- Rooms which face north are beneficial because harsh conditions created by sunlight are eliminated.[16] North facing rooms usually require additional lighting during the day.[11]

DESIGN RECOMMENDATIONS FOR PLANNING CONDITIONS SPECIFIC TO KITCHENS

GENERAL PLANNING AND ORGANIZATION

Maximize Coincident Auditory and Visual Cues

- A small desk area for a TDD/TTY (telephone device for the deaf/teletypewriter) and other aids may be located in or near the kitchen.[4]
- Choose appliances which has coincident auditory and visual cues.[4]
- Deaf users often confront problems with water. It would be beneficial if a technical device could inform a deaf individual of a dripping faucet, running water, or a sink is which about to overflow.[3]

SINK

Maximize Coincident Auditory and Visual Cues

- A visual cue should inform a person if the dishwasher is operating, what stage of the washing cycle the machine is performing, and if the machine is not operating properly.[4]

Safety

- The kitchen sink should have an overflow drain.[11]

COOKING FACILITIES

Maximize Coincident Auditory and Visual Cues

- Cooking timer: a light should flash and a sound should sound to indicate that the set time has elapsed.[4]
- Microwave: a light should indicate if the microwave is operating, and a light and buzzer should indicate when the set time has elapsed.[4]
- A light should indicate when the cooktop or the oven is operating.[4]

- A light should indicate when the exhaust fan is operating.[3]

REFRIGERATOR

Maximize Coincident Auditory and Visual Cues

- A light should indicate if the refrigerator is operating.[4]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS SPECIFIC TO BATHROOMS

GENERAL PLANNING AND ORGANIZATION

Maximize Coincident Auditory and Visual Cues

- Deaf users often confront problems with water. It would be beneficial if a technical device could inform a deaf individual of a dripping faucet, running water, or a sink which about to overflow.[4]
- The light switch for the bathroom should be located outside the bathroom. By flashing the light on and off one can inform a deaf person in the bathroom that their presence is required elsewhere.[4]
- The exhaust fan switch should have a light to indicate when the fan is operating.[4]

HANDBASIN

Safety

- The handbasin should have a overflow drain.[11]

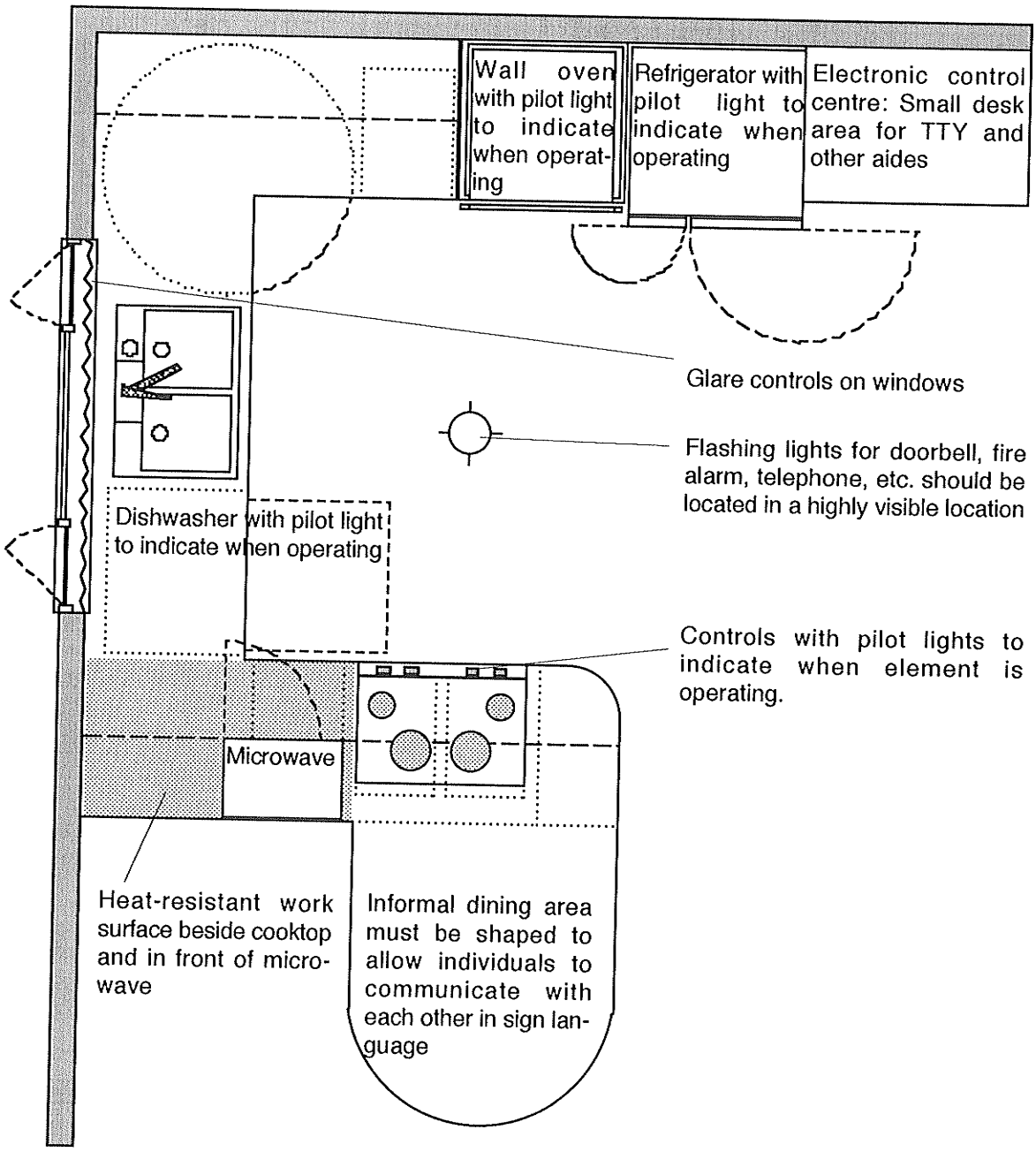


Figure 6.3: Deaf Kitchen Plan, Design Suggestions

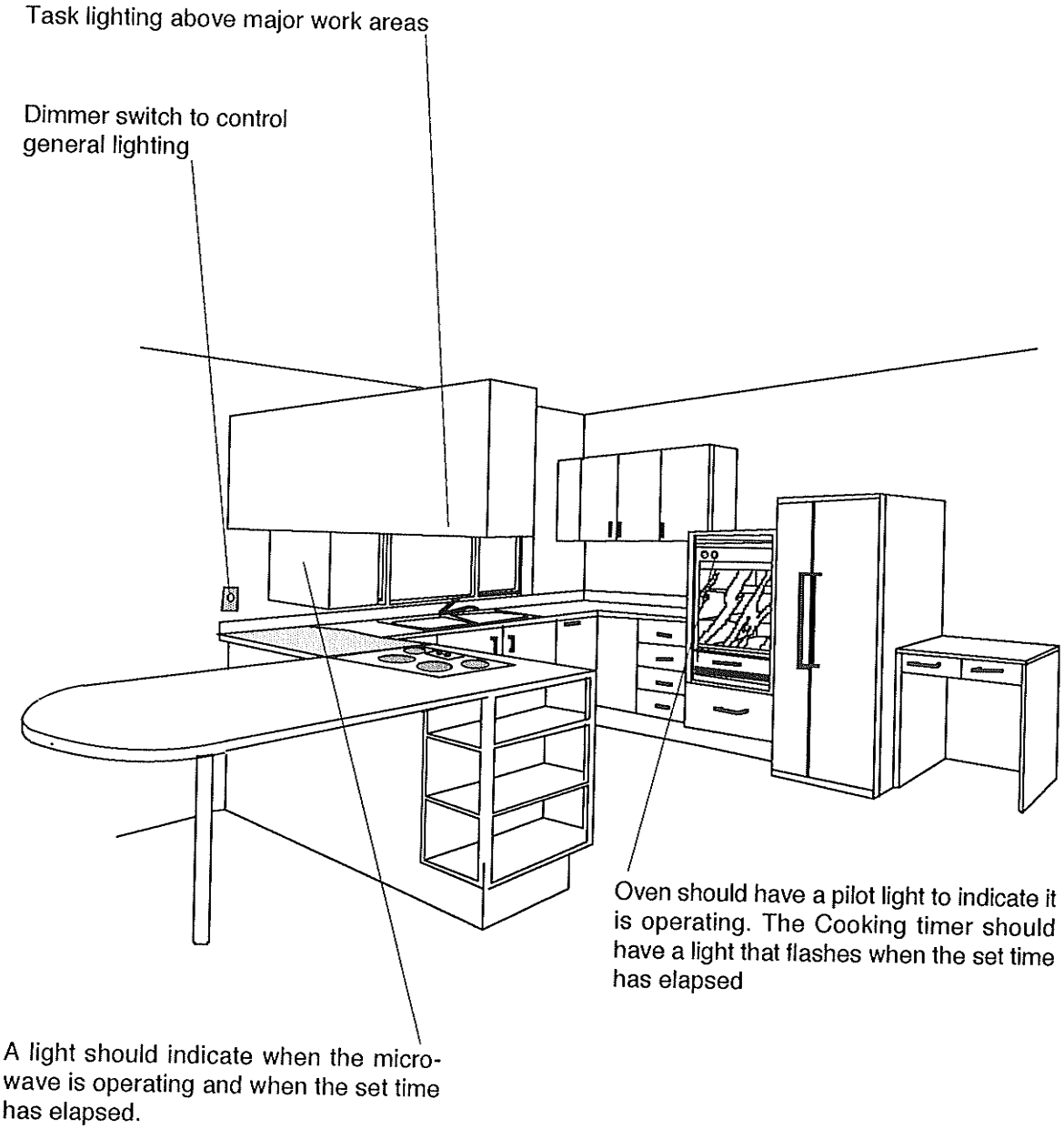


Figure 6.4: Deaf Kitchen, Design Suggestions

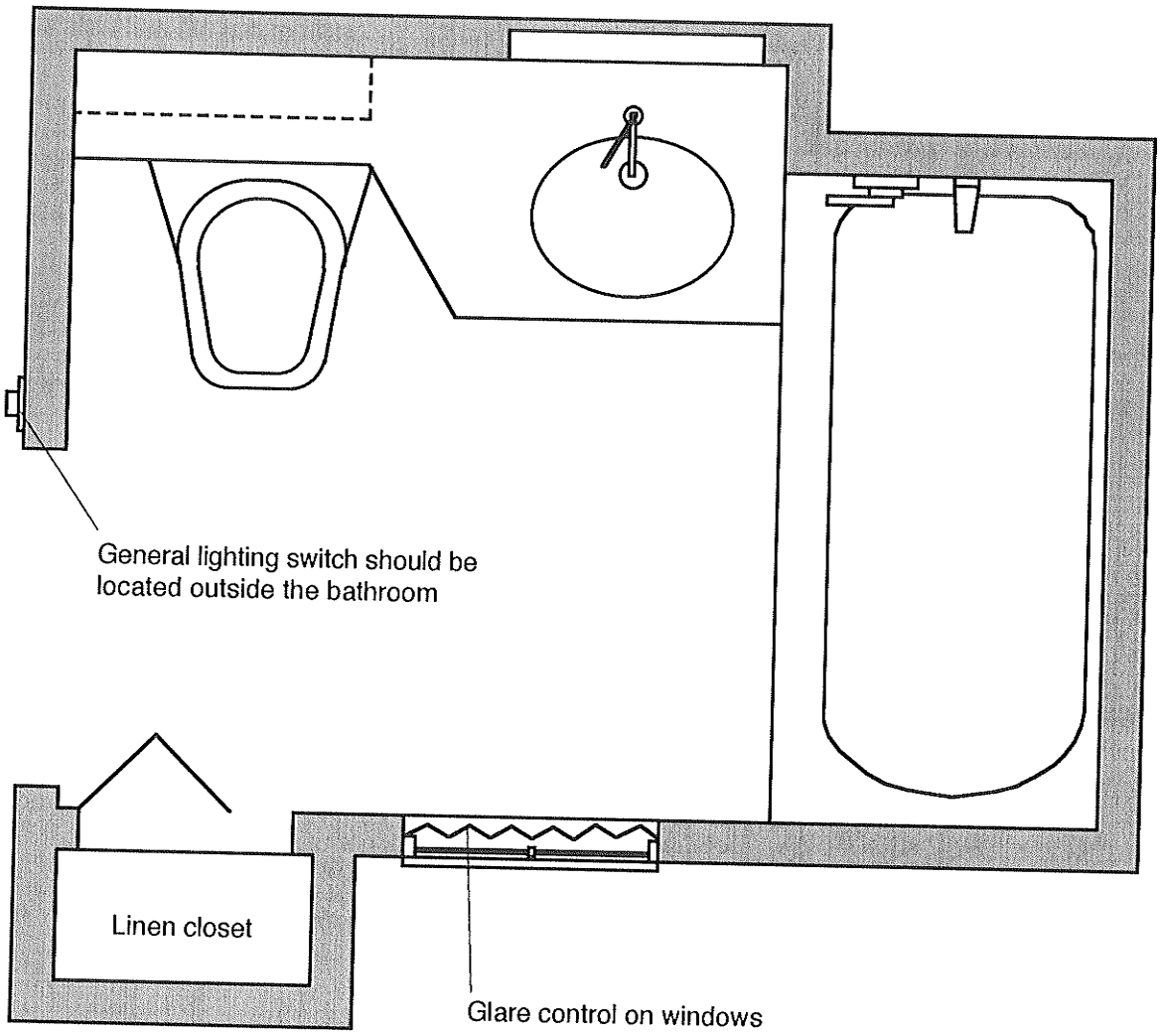


Figure 6.5: Deaf Bathroom Plan, Design Suggestions

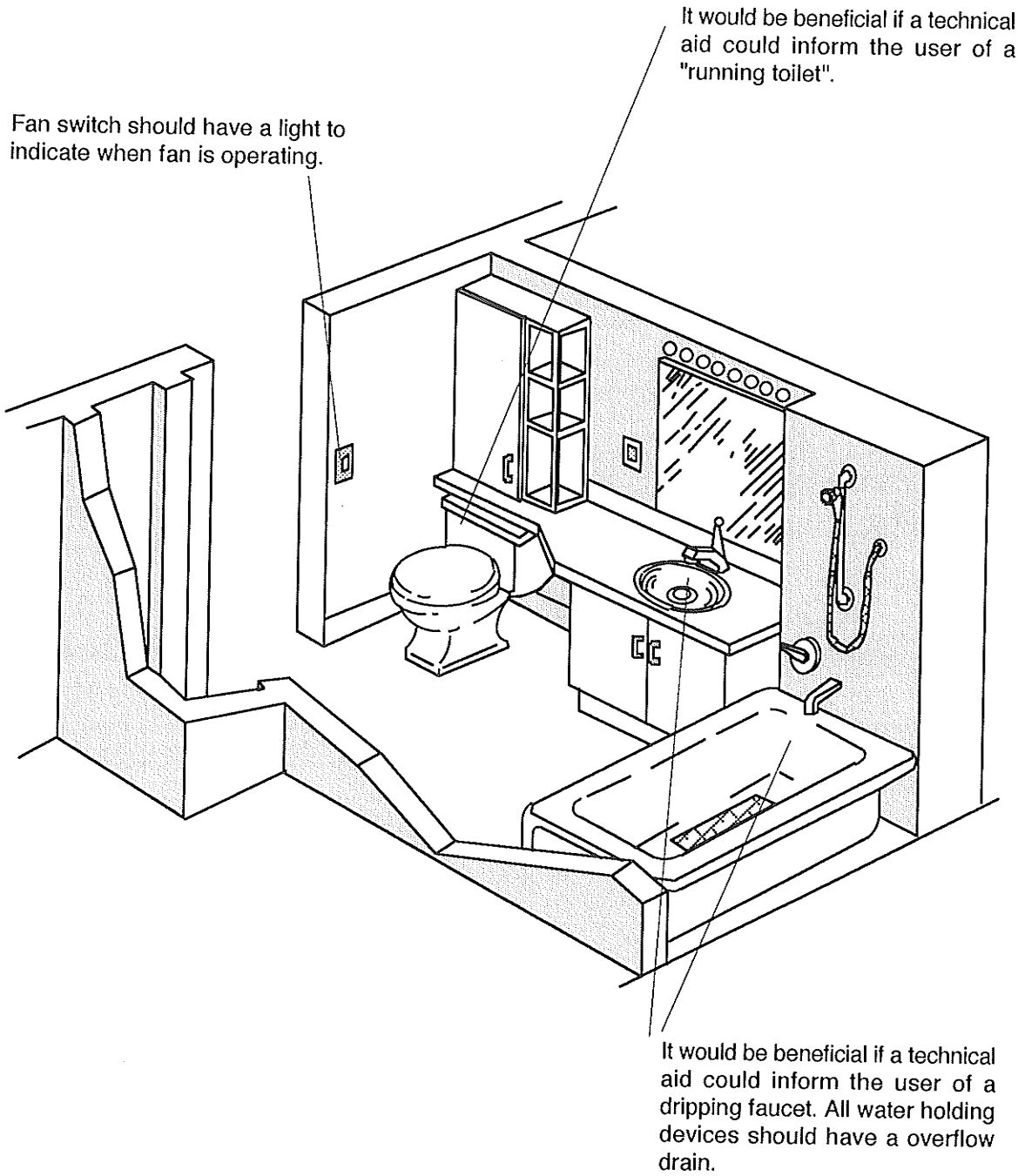


Figure 6.6: Deaf Bathroom, Design Suggestions

1 Department of Education and Science 1981.
2 Dickman 1983, 17-19.
3 Catherine Shearer, June, 1992.
4 Bruce Koskie, May, 1992.
5 Haitt 1987, 363.
6 Lynn Mayor, April, 1992.
7 Moos, Lemke, and David 1987, 198.
8 Pynoos, Cohen, Davis, and Bernhardt 1987, 299.
9 Blight 1985, 17.
10 Ontario Ministry of Community and Social Services 1987.
11 Donna Collins, May, 1992.
12 Richesin et al. 1987, G-2 and G-3.
13 Christiansen and Baum 1991, 723.
14 Null 1988, 243.
15 Salmon 1964.
16 Greer 1987, 71.

MOBILITY AID USERS

DISABILITY DEFINITION AND LIMITATIONS

The "mobility aid users" design group is defined in this paper as people with weak lower limbs who have difficulty walking or standing and use walkers, crutches, or other mobility aids.

There are a number of special considerations which a designer should be aware of when designing for individuals who use mobility aids:

- Degenerative Conditions: Many mobility aid users who have a degenerative condition may eventually require a wheelchair. Some individuals will use a mobility aid at home and a wheelchair outside the home.[3]
- Elderly: Many elderly will require the use of a mobility aid.
- Mobility Aid Placement: The mobility aid frequently is set aside while an individual performs a task or activity. Often, the placement of the aid during this time is a problem. The environment should be designed so that an individual who uses a mobility aid may set aside and retrieve the mobility aid safely and easily.[1]
- Sit-to-work Opportunities: If an individual uses a mobility aid, they may need to sit in order to free up their hands to work.[2]The opportunity to sit-to-work should be provided at locations where common or lengthy tasks are performed, e.g.: sink and handbasin.[3]
- Mobility Aids: Typical dimensions of mobility aids commonly used by adults are:
  - ◊ Walker: The clearance required by an individual employing the aide of a walker is a minimum width of 710mm (28").[4]

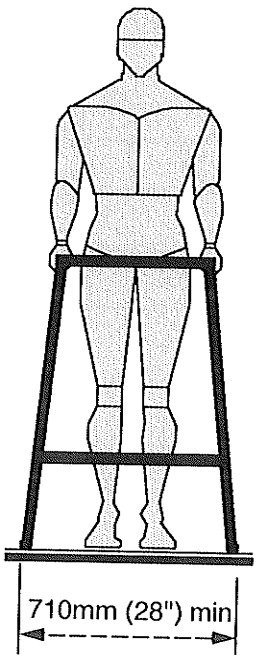


Figure 7.1: Walker, Clearance

◊ Crutches: The mode, gait, and speed of the user is impeded significantly by the use of crutches. The limited use of the user's lower extremities as well as manipulation and placement of crutches significantly limit the leverage that the user can develop, particularly as may be required in opening or closing doors and getting in and out of seats.[4]

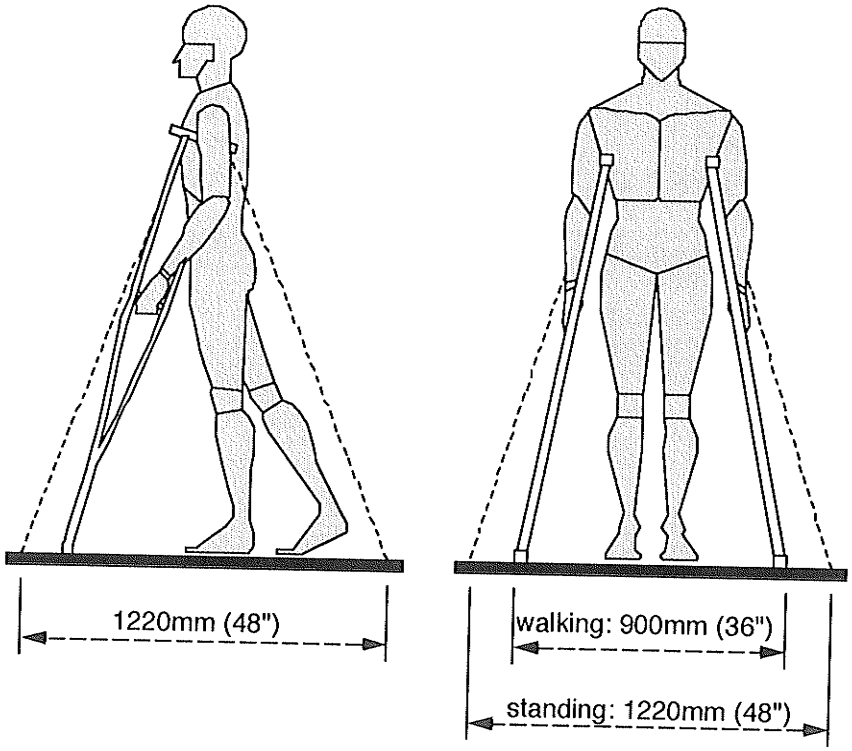


Figure 7.2: Crutches, Clearances

Some characteristic problems mobility aid users face are:

- People who use a mobility aid have difficulty performing any task while operating the mobility aid.[1]
- Mobility aid users have a tendency to fall.[3] Some falls occur because an individual uses their weaker hand to stabilize their body's position while their stronger hand is performing a task.[1]
- Mobility aid users frequently have limited reach, strength, and dexterity.[3]

DESIGN PRINCIPLES FOR
PLANNING ACCESSIBLE ENVIRONMENTS FOR MOBILITY AID USERS

ACCESSIBILITY

- Maneuvering Space (Clear Floor Space): Space must be provided for mobility aid users to maneuver close enough to doors, windows, cabinets, appliances, etc. to reach the knobs and controls which operate the devices.[5]
- Work Surfaces: Standard standing work surface height is 915mm (36"). A work surface height of 815mm (32") with a knee space below is more comfortable for seated people. Mobility aid users require both standing and sitting working surfaces.[6] Common solutions to resolve this complicated design problem include:
  - ◊ Work surfaces at a maximum height of 865mm (34") or lower, which will place the work surface accessible from a seated position but at a height that is uncomfortable and awkward for many standing people;[6]
  - ◊ Providing some work surfaces at standing height and some at sitting height;[6]
  - ◊ Installing a motor driven adjustable height work surface that can be raised or lowered instantly at the touch of a button;[6]
  - ◊ Providing standing height work surfaces with pull-out boards at sitting work heights.[7]

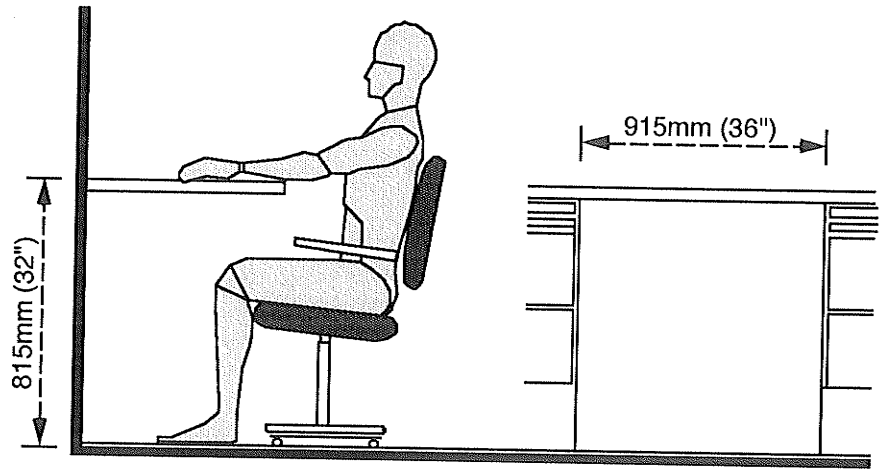


Figure 7.3: Preferred Sitting Work Surface and Knee Space Clearances

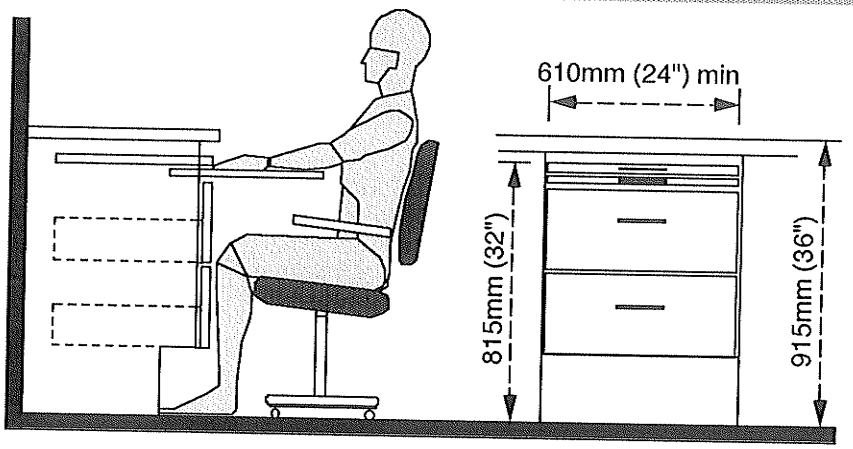
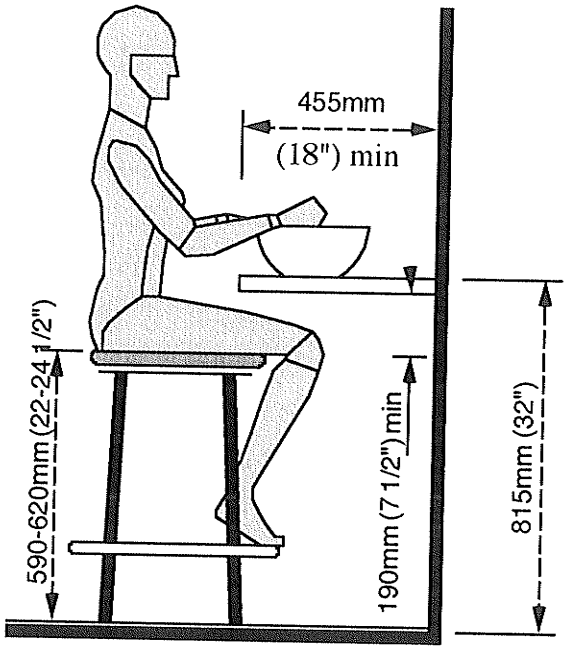


Figure 7.4: Standing Height Work Surface with Pull-out Board



The stool should be equipped with a foot rest.

Figure 7.5: Sitting Work Surface with Stool

- Transferring Surfaces and Aids (including grab bars):
  - ◊ Often a transfer surface or seat is necessary at locations where a mobility aid user is required to step over an obstruction, change from a standing to a reclining position, or change from a reclining to a standing position. This transfer surface provides a place for the individual to sit, maintain their balance, and prepare for the next task in the transfer.[8]

◊ Safety is greatly increased by the addition of grab bars at transfer points. The grab bar type varies with the level and type of disability of the individual user. Generally for an individual who uses a mobility aid, the grab bar should have a vertical or angular component for the user to help pull themselves up or let themselves down.[3] Grab bars should be slip-resistant; have a diameter of 30-40mm (1 1/8-1 1/2"), or a shape that provides an equivalent gripping surface; and, have a space of 35-45mm (1 3/8-1 3/4") between the wall and the grab bar where mounted adjacent to a wall.[9]

- Reach Ranges: Mobility aid users have a restricted reach range. Many individuals are able to reach at least the lower level shelves of conventional wall cabinets but, because of limited ability to bend over or stoop down, they may be unable to use low and rear portions of base cabinet storage. Another factor which often complicates use for individuals who use mobility aids is their need to use their arms and hands to maintain balance. As such, they may have difficulty reaching and lifting objects that are extremely low or high.[10]

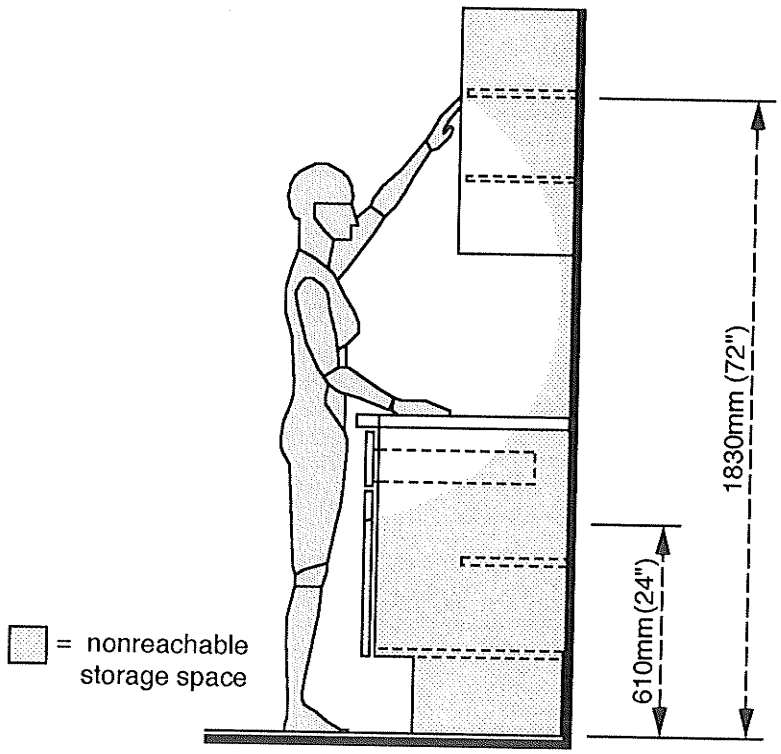


Figure 7.6: Maximum and Minimum Reach Heights for Mobility Aid Users

MINIMIZE TRAVEL THROUGH RESIDENCE

- Storage: Create storage facilities near areas of use, e.g.: large pots and pan storage by cooking area, towel storage in bathroom, etc.[11]
- Services: Duplicate services when possible, e.g.: more than one telephone in the house, an informal dining area in the kitchen, etc.[11]

MINIMIZE BARRIERS

- Open planning arrangements are preferred because the need to navigate the mobility aid through door openings and around barriers is reduced.[3]
- Floor surfaces should be firm, level and unbroken to facilitate the operation of the mobility aid.[3]
- Work surfaces should be level to allow an individual to slide items on the work surface to reduce the need for lifting and the risk of spilling.[1]

EASE OF OPERATION AND MANIPULATION

- The opportunity to sit-to work should be provided at locations where common or lengthy tasks are performed, e.g.: sink and handbasin.[3]
- Provide features which are easy to access, operate, and control, e.g..: large rocker-type switches, easy-to-use controls, etc.[1]
- Provide opportunities for the user to reduce the job into tasks, e.g..: double sink with drying rack—wash dishes in first sink and place them in the second sink to rinse; move; take dishes from the rinse sink and place dishes on drying rack.[3]
- Provide features within the immediate reaching area, directly in front or beside, the user, e.g.: pull-out storage, pull-out boards, controls at the front of an appliance, etc.[3]
- Everything should be operable with one hand.[12]

MINIMIZE MAINTENANCE

- Provide features which promote simple maintenance, e.g.: easy-to-clean flooring, self-cleaning ovens, etc.
- Provide features which protect against damage by the mobility aid, e.g.: corner molding, kick plates on doors, etc.

SAFETY

- Residential environments should include basic safety features.
  - ◊ Individuals with disabilities and elderly people have a strong preference for features that increase their safety, i.e.: smoke detectors, nonslip surfaces in the bathroom, no sharp edges to reduce injuries due to falls, etc.[13]
  - ◊ One decision facing designers is how far to take the effort to ensure personal safety in light of monetary constraints. Features that offer protection from fires, prevent falls and permit summoning help quickly in case of need are probably cost effective in the long run.[13]
- Safety features in the home should be readily available but unobtrusive and nontherapeutic looking. People do not wish to be identified as impaired and will be resistant to design that is institutional in appearance.[11]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS COMMON TO KITCHENS AND BATHROOMS

DOORS AND DOORWAYS

Accessibility

- Doorways must be wide enough to allow a mobility aid through, the minimum clear opening of doorways should be 810mm (32") with a minimum door swing of 90°, measured between the face of the door and the stop.[19]
- Sufficient maneuvering space around the door is needed to open the door, pull the door open, and to pull the door closed once through the door. [15]

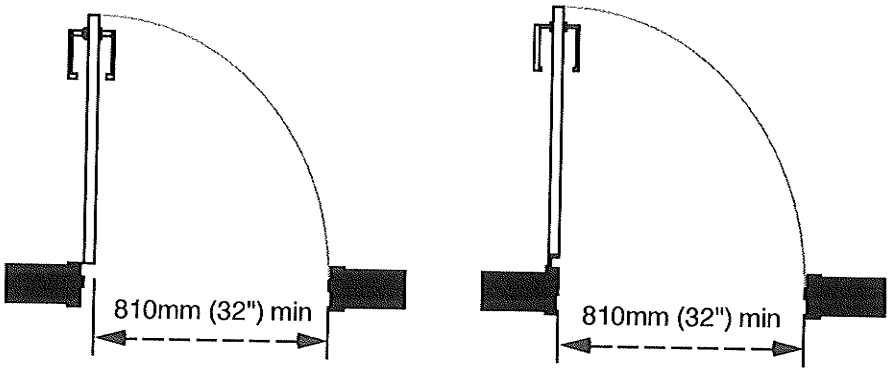


Figure 7.7: Clear Width of Doorway, Hinged Doors.

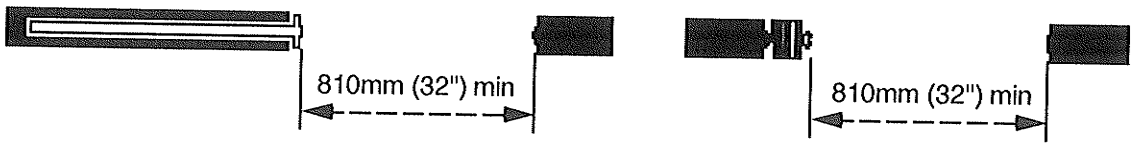


Figure 7.8: Clear Width of Doorway, Sliding and Folding Doors.

Minimize Barriers

- Door placement in the wall should be such that the door is able to swing completely open to at least 90 degrees without bumping into other structures. If the swing space of two doors intersects, the hinge side of one or both doors may be changed so there is no swing

space intersection. Doors should open in a direction that allows maximum movement space.[15]

- Thresholds should be avoided. If a threshold must exist it should be no more than 15mm (5/8") high.[1]

Ease of Operation and Manipulation

- Sliding doors are preferred to side-hinged doors where space is tight and where doors are infrequently closed.[3] Sliding door hardware should be easy to manipulate and reach and be exposed and operable from both sides of the door when the door is fully open.[16]
- To assist some individuals who use mobility aids, a 150mm (6") minimum D-shaped pull handle can be placed on a door 180-200mm (7-8") from the hinge at the same level as the door knob. The person passing through can pull on it instead of maneuvering to grasp the door knob.[15]
- Doors must have hardware that is easy to operate and which does not require fine grasp. Lever-type handles are preferred because they can be operated by a single, non-precise movement.[17] Lever-type door handles should have a curved or angled end to avoid snagging clothing.[3]
- Holding packages while attempting to open a door can be very difficult for any individual. Shelves or tables on which to place packages while opening or closing the door can be helpful in this situation. The table or shelf should not interfere with the maneuverability space at the door.[15]

FLOORING

Minimize Barriers

- Minimize changes in floor levels or ridges between floor surfaces. Very small level changes may be dangerous.[3]

Ease of Operation and Manipulation

- A resilient floor surface such as cork or linoleum has a backing material that gives it the ability to spring back after being pressed down. This type of floor is better than a hard floor for ambulatory individuals who are prone to falls. Additionally, the resiliency of such a floor may be preferable for individuals with lower extremity joint or back pain.[18]
- If carpet is used, it should have a level loop, textured loop, level cut pile, or level cut/uncut pile texture with a maximum pad and pile height of 13mm (1/2").[19]

Safety

- Floor surfaces should be firm and slip-resistant.[19]
- Floor mats and throw rugs/carpets should be avoided, if used, they should not bunch up under the mobility aid.[1]
- Slippery surfaces, including highly waxed and polished wooden and vinyl floors, are hazardous for most people and are particularly hazardous for persons using walkers, canes, or crutches.[15]

WALLS

Minimize Maintenance

- Provide features to protect against mobility aid damage, e.g.: corner moldings, tall base boards, etc.[7]

WINDOWS

Accessibility

- The ability to use a window is dependent upon its location and construction. A person using a mobility aid should be able to get close to the window, view out of the window, and operate the window.[20]

Ease of Operation and Manipulation

- The opening mechanisms should be easy to reach and operate for purposes of ventilation and temperature control. The curtains, drapes, or blinds should be easily manipulated in order to control lighting and privacy. Ease in cleaning also influences the use of the window. Window controls should be located with the range of 700-1050mm (28-42").[18]
- Horizontal sliding windows with an easy release lock are preferred. A crank-out window is also acceptable, but this type of window may be difficult to operate in the winter.[3]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS SPECIFIC TO KITCHENS

GENERAL PLANNING AND ORGANIZATION

Accessibility

- Maneuvering space: A clear floor space at least 750 x 1200mm (30 x 48") should be provided for side approach at all appliances in the kitchen, including the range or cooktop, oven, refrigerator/freezer, and dishwasher.[21]

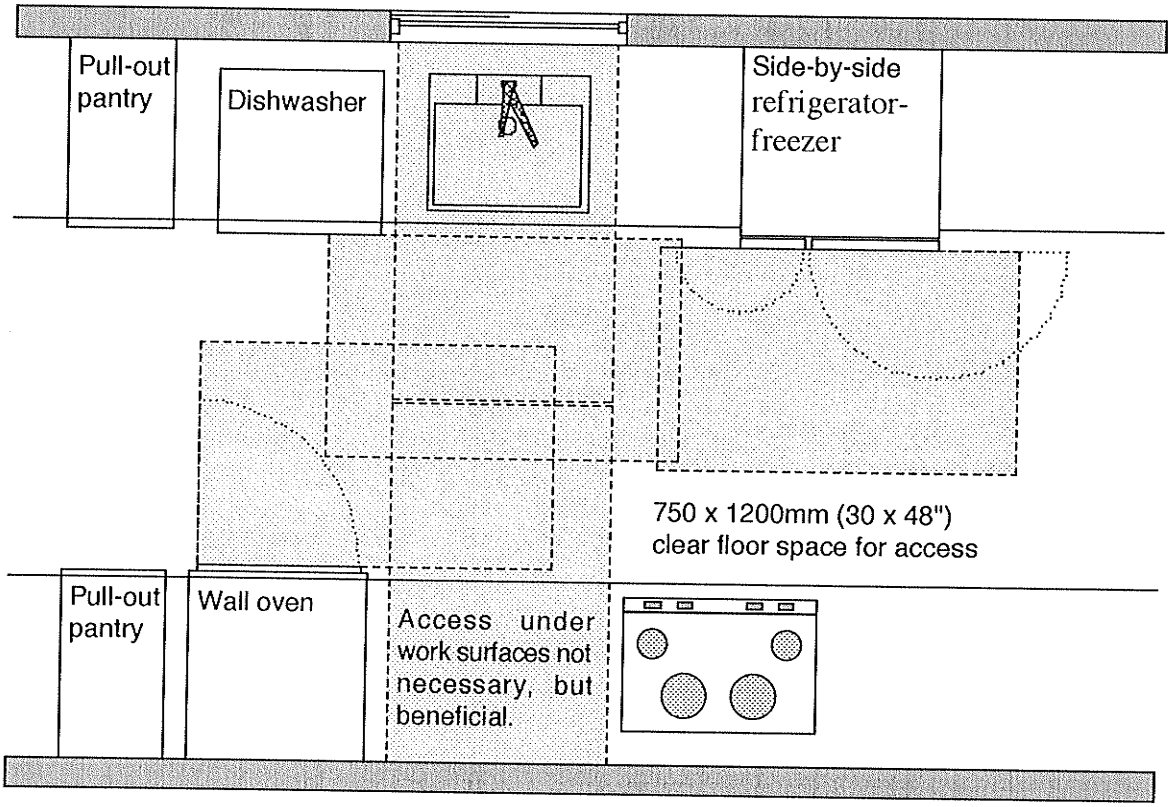


Figure 7.9: Minimum Kitchen Maneuvering Space.

- Kitchen layout: The amount and arrangement of space in a kitchen influences task organization, task time, and energy output. The number of movements one must make, the distance moved, and the amount of things to carry are all greatly affected by space and arrangement. This is an important consideration for mobility aid users.[22]

- ◊ A galley kitchen with a maximum width of 1200mm (48") is preferred by mobility aid users who can use the work surfaces for support .[3]
- ◊ A L-shaped or U-shaped kitchen is preferred by mobility aid users who have limited use of their arms and hands. These kitchen types provide a continuous work surface upon which a pots and pans may be slid.[31]

- Storage: (See also: Cabinetry) Storage spaces influence safety, task speed, amount of movement needed, and organization of meal preparation activities. Each work area should have a storage space.
  - ◊ Providing sufficient and accessible kitchen storage is often a problem because the reach range of a mobility aid user is limited. The design must maximize storage opportunities and consider storage alternatives such as pantries, islands, locating general storage space near the kitchen to act as a kitchen storage overflow, etc.[3]

Minimize Travel Through Residence

- Create storage opportunities near areas of use, e.g.: storage for dishes and cutlery near the sink, storage for large pots and pans near the cooking facilities, etc.[22]
- An informal dining area should be located in the kitchen.[23]
- A telephone should be located in the kitchen.[23]
- A storage trolley should be provided to allow a mobility aid user to cart heavy or hot items. The trolley may be designed so that it can be parked under a work surface then pulled out when that space is required for knee space.[24] The trolley often is used as a mobility aid.[1]

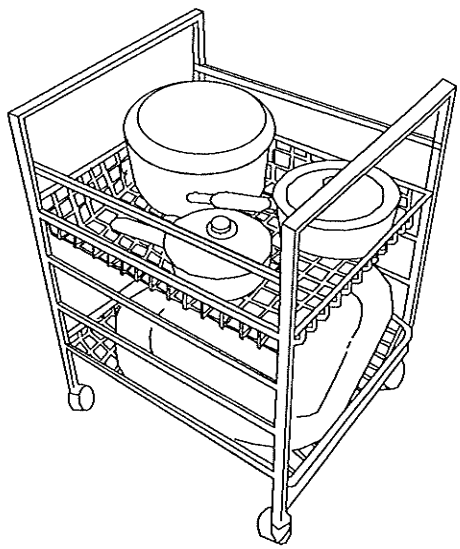


Figure 7.10: Storage Trolley

Ease of Operation and Manipulation

- Task lighting should be provided above all major work areas.[3]
- Furniture should be light and easy to move.[3]

Safety

- A person lying on the floor should be able to pull the phone to the floor in an emergency.[3]
- The kitchen towel bar should be able to bear the weight of a person supporting themselves on it.[1]

WORK SURFACES (COUNTERTOPS)

Accessibility

- The location and amount of work surfaces influences the organizational and time factors of mealtime activities. Work surface space should be designed so that minimal movement is required and so that a logical, efficient flow of tasks can be performed. Work space should be located near the cooking facilities, sink, and refrigerator. A minimal work space of 450mm (18") next to the opening side of the refrigerator door, 600mm (24") of heat-resistant surface to the left of the cooktop and in front of the microwave, and 900mm (36") to the right and 600mm (24") to the left of the sink is suggested. There should also be a place available to put dishes prior to serving meals.[22]
- Many kitchens lack an adequate amount of work space. Pull-out boards often provide sufficient workspace.[25] Provide at least one pull-out board at each work area.[7]

Minimize Barriers

- Work surfaces should be the same height for easy sliding of dishes and pans.[22]

Ease of Operation and Manipulation

- Pull-out boards are very effective for activities which require the user to bend over an object to get improved leverage, e.g.: cutting and mixing.[7] Pull-out boards may have apertures cut in them to help stabilize bowls.[26]

SINK

Accessibility

- An individual who uses a mobility aid may request a knee access be located under the sink to allow them to sit while working at the sink. If a knee space below the sink is necessary:
  - ◊ The sink drainage pipe should be located at the back of the sink. And, the hot water pipes and drain pipes under sinks should be insulated or otherwise covered.[22]
  - ◊ The depth of the sink bowl shall be no greater than 165mm (6 1/2"). Only one bowl of double- or triple-bowl sinks need meet this requirement.[27]
  - ◊ There should be no sharp or abrasive surfaces under the sink.[22]

Ease of Operation and Manipulation

- A double sink is preferred because the work of cleaning dishes may be reduced into tasks.[3]
- The faucet control levers should be easily operated with one hand. A faucet with single operation lever-type handles that control the water volume and temperature is recommended. The installation of a retractable hose with a faucet end can be helpful for filling pans away from the sink and rinsing large objects in the sink.[22]
- The faucet may be located at the side of one-bowl sinks for ease of access.[3]
- A dishwasher may be a helpful appliance for an individual who has difficulty washing and drying dishes.[22]
- People with coordination problems often find it difficult to operate the standard sink stopper.[3] A chain attached to a large flat rubber stopper is preferred.[1]

CABINETRY

Accessibility

- Shelves
  - ◊ Adjustable shelves are preferred because they allow the shelves to be placed at the optimal reaching zone of the user.[22]
  - ◊ Shelves should be narrow in depth. A depth of 100mm (4") for shelves allows items such as cans and boxes to be stored without having other items in front of them. This allows items to be easily located and facilitates reaching.[22]
  - ◊ Corner areas in kitchens can be wasted space. Shelves that are placed at a diagonal in the corner minimize reaching. Lazy Susans can make corner space more usable.[22]
  - ◊ Shelves with vertical partitions can be used to store wide items such as pans and mixing bowls. This allows the cook to reach one item at a time without lifting or moving other items out of the way. Interval grooves allow the partitions to be placed at a desired width.[22]
- Lower Cabinetry:
  - ◊ Lower cabinetry generally are not very accessible for mobility aid users. Provide pull-out and door-mounted storage which brings items forward to increase accessible space.[3]
  - ◊ Minimize situations where the user must reach under and into cabinetry.[3]
  - ◊ Drawers are preferred to lower cabinets because they reduce bending and reaching.[22]
  - ◊ Side-hinged doors should open fully 180 degrees. The hinges and hinge connections should be strong enough to bear the weight of a person supporting themselves on the door.[7]
- Other Storage Options:
  - ◊ Storage bins on work surfaces may be used to provide additional storage that is within the user's reach zone.[22]

- ◊ Wall racks and hanging hooks can be placed in most locations in the kitchen for additional storage of pans and utensils.[22]
- ◊ One- or two-tiered lazy Susans are convenient storage devices that help move small items closer to the user. They may be used on shelves or in cabinets, refrigerators, and bathrooms.[22]
- ◊ The storage trolley may be used for storage as well as transportation.[22]

Ease of Operation and Manipulation

- Provide D-shaped or lever handles on cabinetry.[3]
- Upper Cabinetry:
  - ◊ Doors on upper cabinetry may be difficult to open because the user can not get sufficient leverage to pull the door open. Place the handles on upper cabinetry near the bottom of the doors or use a push-release mechanism.[7]
- Lower Cabinetry:
  - ◊ Place handles on lower cabinetry near the top of the door/drawer to reduce bending and reaching.[28]
  - ◊ Drawers and pull-out devices should be on easy-gliding, full-extension glides. There should be an end stop to prevent the drawer or pull-out device from being accidentally pulled out.[1]

COOKING FACILITIES

Accessibility

- Stoves and ovens should be evaluated carefully as these appliances greatly affect safety, speed of preparation, quality of food, and amount of cleanup needed.[22]
- A cooktop/wall oven arrangement is preferred to a conventional range because the conventional range's controls are difficult and dangerous to reach.[29] Also, reaching into

a range's oven can be a safety hazard for individuals with poor balance or weakness.[22]

- Controls should be easily accessible. Cooktop controls may be located on or near the front of the cooktop to eliminate the need to reach over or between hot burners and steaming posts to adjust the temperature.[29] Controls located to the side of the cooktop are a secondary option because they may cause spills when pots are slide along the cooktop.[1] Controls for a wall oven should be easy to access and operate.[1]
- Oven:
  - ◊ Side-hinged oven doors are best for many people because they allow the user to get closer to the oven and thus require less reaching or bending while moving hot pans.[30]
  - ◊ A wall oven with a side-opening door and heat resistant, pull-out shelf below often is more accessible than a drop-down door wall oven. But, side-opening door wall ovens tend not to be as well insulated as drop-down door wall ovens and individuals may burn themselves on the side-opening oven door. Also, self-cleaning side-opening ovens are difficult to find. Individuals may become injured while cleaning conventional side-opening ovens. In an emergency a drop-down door wall oven allows a surface to place hot items. When choosing a wall oven one may need to look at the trade-offs for each wall type.[1]

Ease of Operation and Manipulation

- Controls should be large, easy to operate and reach. A positive "click" should occur upon return to the "off" position and each control should have a pilot light to indicate when "on". [24]
- A microwave oven can have many advantages for a person in a using a mobility aid.[24]
- Cooktop:
  - ◊ Cooktops and heating elements should be flush with adjacent work surfaces to assist in sliding objects.[24]

- Oven:
  - ◊ The oven should be placed so that the most often used shelf is located level with the adjacent work surface.[7]
  - ◊ Wall ovens with side-hinge doors should have a shelf or pull-out board below. The shelf should be approximately 250mm (10") wide and extend the full width of the oven or greater. This shelf can be used when needed for transferring hot pans.[30]
  - ◊ Oven shelves should be pull-out, non-tipping and have a stop.[1]

Minimize Maintenance

- Cooktop:
  - ◊ Sealed heating elements are preferred because they are easy to clean but present a raised profile which may be an obstacle and cause tipping.[24]
- Oven:
  - ◊ A self-cleaning oven is preferred.[22]

Safety

- It is generally considered safer to have an electric cooking device rather than a gas one because of the open flames of the gas cooking device.[22]
- Cooktop:
  - ◊ Heating elements should be arranged in a half-moon or staggered layout to avoid reaching over hot surfaces to access rear heating elements.[22]

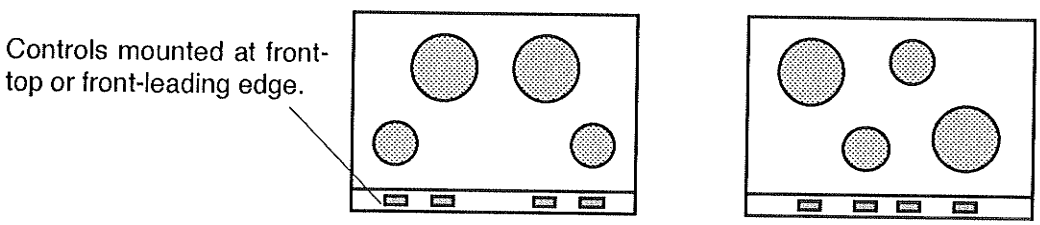


Figure 7.11: Recommended Cooktop Element Arrangement

REFRIGERATOR

Accessibility

- Refrigerator doors should open so that the door does not interfere with the pathway or movement of the users. The door should open away from the line of approach and, if possible, away form the sink, stove and work surface. The door should open so that the individual can remove objects from the refrigerator and easily place them on an adjacent work surface. [22]
- The refrigerator door should open 180 degrees.[22]
- Refrigerators should be located away from a corner or wall so the doors can be opened the full 180 degree.[31]
- Side-by-side refrigerator-freezers are preferred by mobility aid users, however, the doors open from the middle, which may cause approach and accessibility difficulties.[22]
- Both the light and the temperature controls should be at the front of the refrigerator for easy access.[22]

Ease of Operation and Manipulation

- The door handle should be one which is easy to grasp and open, a long D-shaped handle which allows the entire hand to be used in the opening is preferred.[22]
- Conveniences such as ice makers and external cold water spouts can be very helpful. Units with these attachments require a plumbing hook-up.[22]
- Shelves should be pull-out, non-tip. It may be helpful to place a lazy Susan on the shelves to minimize the need for reaching.[24]
- Door storage capacity is very important because items stored in the door are easy to access, however the deeper the door storage the further the user must reach into the refrigerator.[1]

Minimize Maintenance

- Frost-free and automatic de-frost refrigerators are a great advantage.[24]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS SPECIFIC TO BATHROOMS

GENERAL PLANNING AND ORGANIZATION

Accessibility

- The most important consideration in space planning of a minimal sized accessible bathroom is that the water closet must be located parallel and adjacent to an uninterrupted wall so that a grab bar of adequate length can be installed.[32]
- Side-hinged bathroom doors should open out so that if someone falls behind the door, one can still open the door. A side benefit of the out-swinging door is that space within the bathroom can be kept to a minimum, because less space is need on the push side of the door than the pull side, and the door swing will not interfere with bathroom fixtures.[33] If an out-swinging door is used, place the door so that it does not swing into areas where people normally walk or stand (see also page 194).[3]

Minimize Travel Through Residence

- A storage closet for towels and other related bathroom articles should be located in the bathroom.[3]

Ease of Operation and Manipulation

- Provide a heat source in the washroom.[3]

Safety

- A telephone jack should be provided in the bathroom.[34]
- The towel bar should be able to support the weight of a person.[1]
- Provide non-slip surfaces and handholds.[3]

HANDBASIN

Accessibility

- An individual who uses a mobility aid may request a knee access be located under or beside the handbasin to allow them to sit. If a knee space below the sink is necessary:
  - ◊ The sink drainage pipe should be located at the back of the sink. Hot water pipes and drain pipes under sinks should be insulated or otherwise covered.[22]
  - ◊ The depth of the hand basin shall be no greater than 165mm (6 1/2").[35]
- The handbasin must be mounted so that the minimum distance between the centreline of the fixture and the side wall is 460mm (18").[36]
- Lower cabinetry (see recommendations under kitchen cabinetry)

Ease of Operation and Manipulation

- Handbasins with an adjacent work surface are preferred for personal accessories.[37]
- Faucets must be able to operate without gripping or twisting. Tap handles of a lever or capstan type with a quarter-turn operation are preferred.[37]

MEDICINE CABINET

Accessibility

- Medicine cabinets in bathrooms are frequently place too high for use by individuals with limited reaching range. Cabinets should be installed so that the bottom edge of the cabinet is 50mm (2") above the handbasin.[38]
- The use of shelves, pegboards and hooks mounted to the wall near the handbasin can be an alternative to medicine cabinets. These open storage adaptations will be unacceptable for storage of medicines and potentially harmful items in households with family members who do not understand the danger of these products.[38]

WATER CLOSET

Accessibility

- Water closets for use by mobility aid users are best located in a corner where the wall behind and beside the fixture can be reinforced, and grab bars can be mounted if they are needed. To provide space for a person's shoulders 460mm (18") of clearance should be allowed between the centre line of the water closet and the side wall.[39]
- There should be ample clear floor space in front and beside the water closet fixture to allow a person using an mobility aid to maneuver, approach the seat, and safely sit.[39]

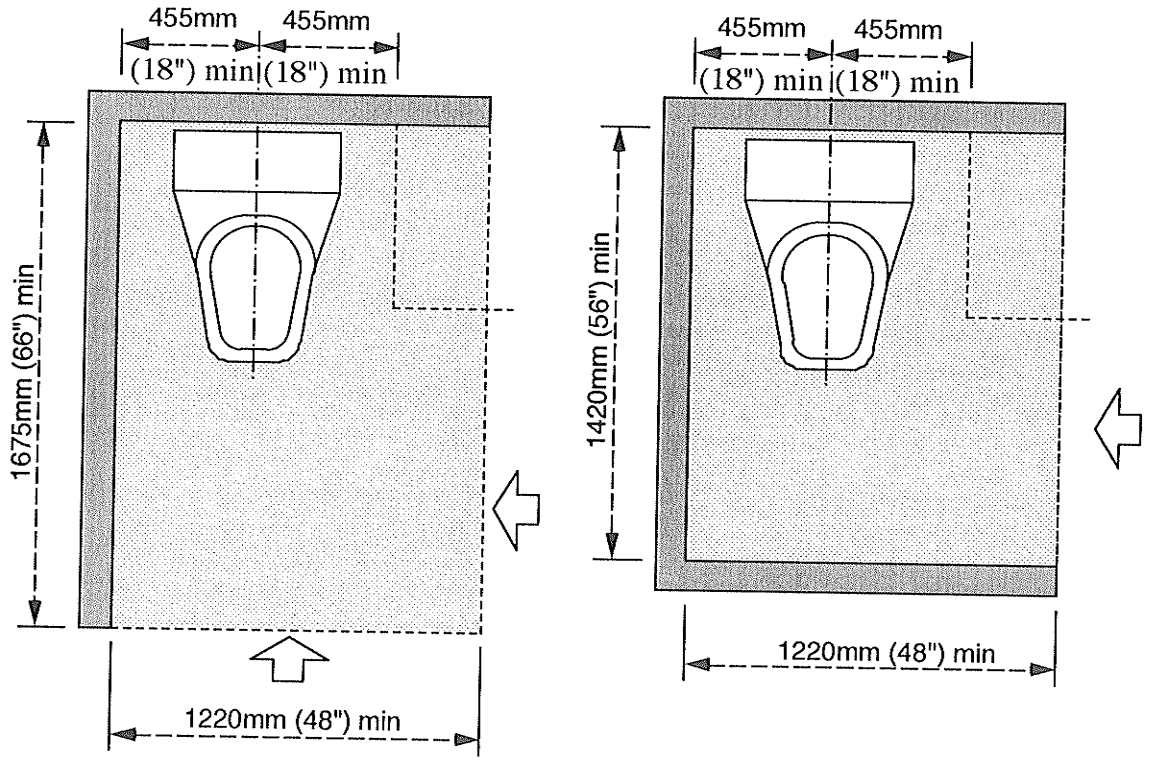


Figure 7.12a: Minimum Water Closet Maneuvering Space.

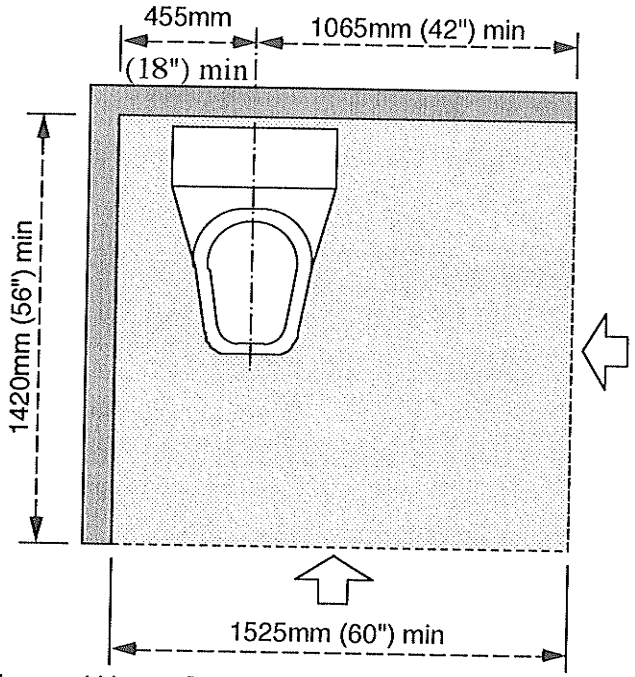


Figure 7.12b: Minimum Water Closet Maneuvering Space.

- The height of a water closet seat can radically affect the use of the toilet. Low seats are difficult for walking mobility impaired people who have trouble getting up on their feet. As a general rule, a water closet seat height of 455 (18") is good.[39] This dimension can be achieved by adding an attachment onto a normal height watercloset.[3]
- The toilet paper dispenser should be located below the grab bar in line with the front of the toilet seat not less than 600mm (24") from the floor.[36]
- Water closets should be equipped with a sloping or "lazy-L" grab bar to allow the user to pull themselves to their feet or slide themselves onto the water closet seat.[3]

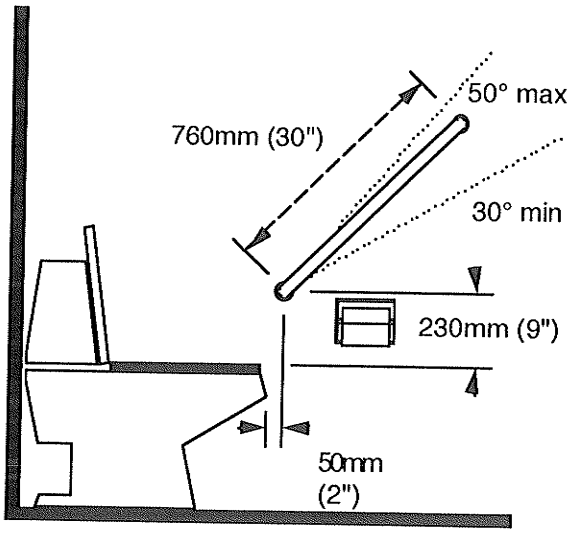


Figure 7.13: Sloping Grab Bar Clearances

- Some people who walk with difficulty and have problems sitting down and getting up again may benefit from seat-mounted grab bars that provide armrests on both sides of the seat.[39]

Ease of Operation and Manipulation

- The water closet flush control should be easy to operate.[3]

BATHTUB AND SHOWER

Accessibility

- Many people who have mobility impairments have difficulty using a conventional bathtub and must learn different ways to safely get in and out of the tub.[8]
- For people with strength and coordination problems a 380mm (15") seat at the head of the bathtub can facilitate transfers into the bathtub.[3]
- There must be sufficient maneuvering space adjacent to the bathtub and shower to allow for easy access.

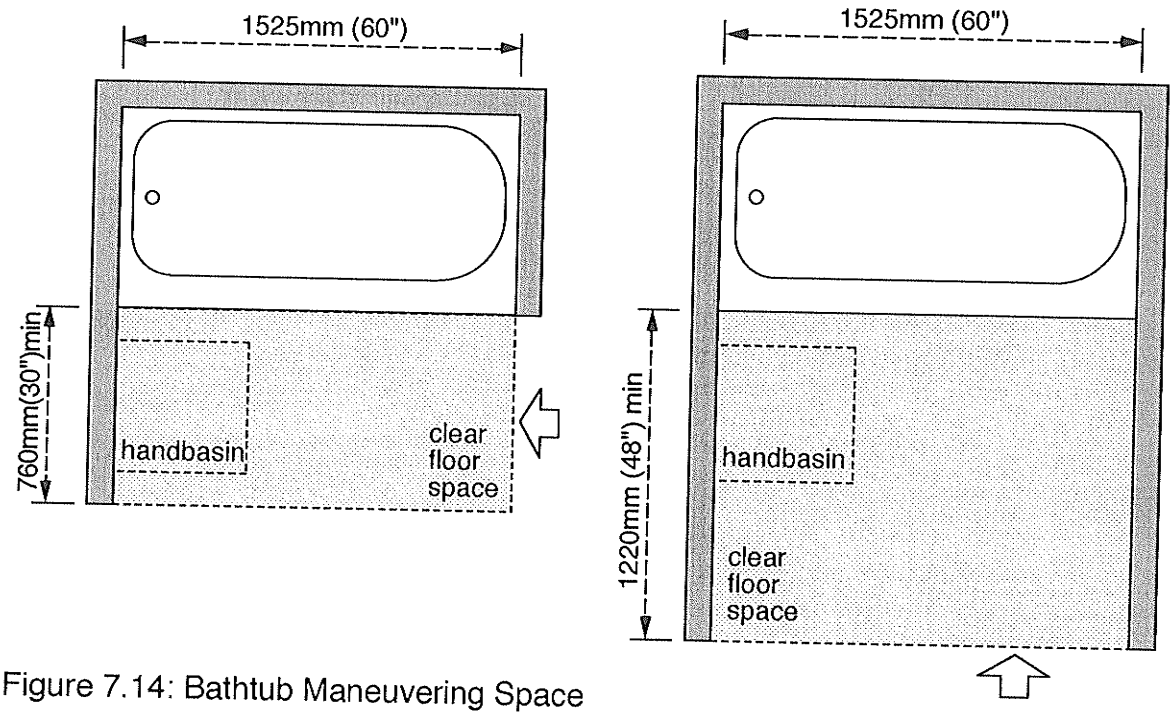


Figure 7.14: Bathtub Maneuvering Space

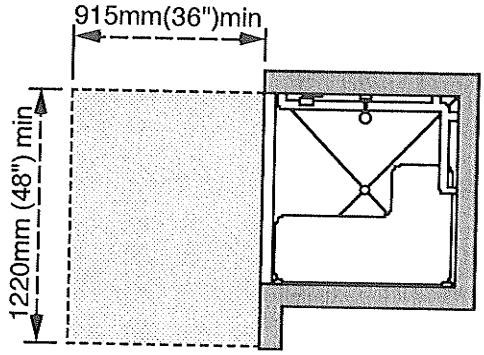


Figure 7.15: Shower Maneuvering Space

- Faucets should have single mixing control and be easy to use and access.[38] The faucet should have a pressure and temperature control device.[1]
  - ◊ Bathtub controls should: be located at the foot end of the bathtub between the centreline of the bathtub and the clear floor space; and, be not more than 450mm (18") from the bathtub rim. The controls should be accessible from outside the bathtub.[36]
  - ◊ For shower stalls with a seat, all controls, faucets, and the shower unit should be mounted on the wall opposite the seat not more than 1200mm (48") from the floor, and accessible from outside the stall.[36]

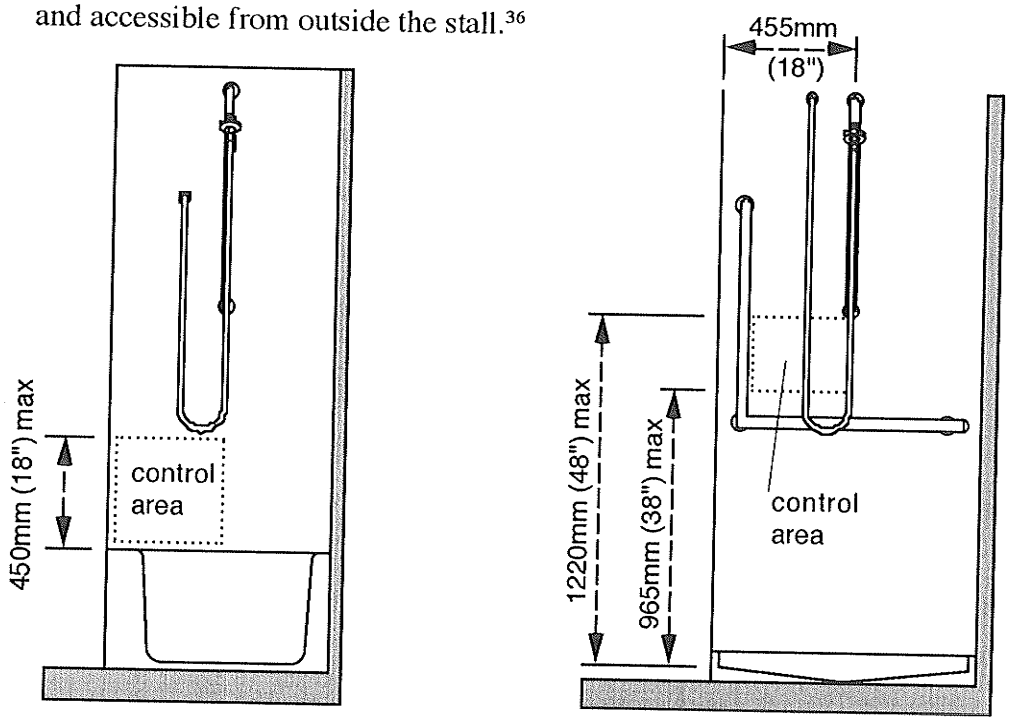


Figure 7.16: Bathtub and Shower Control Clearances

- Grab bars are needed on the side, front, and back tub and shower walls. [38]
  - ◊ Bathtub grab bars should: be at least 1200mm (48") long, located horizontally along the length of the bathtub, 180-280mm (7-11") above the bathtub rim; and, be at least 1200mm (48") long, located vertically at the foot end of the bathtub adjacent to the clear floor space, with the lower end between 180-280mm (7-11") above the bathtub rim. Care should be taken that the vertical grab bar does not interfere with the shower curtain.[36] A second, higher grab bar should also be located along the length of the bathtub to assist people transferring into the bathtub and those who stand to shower.[8]

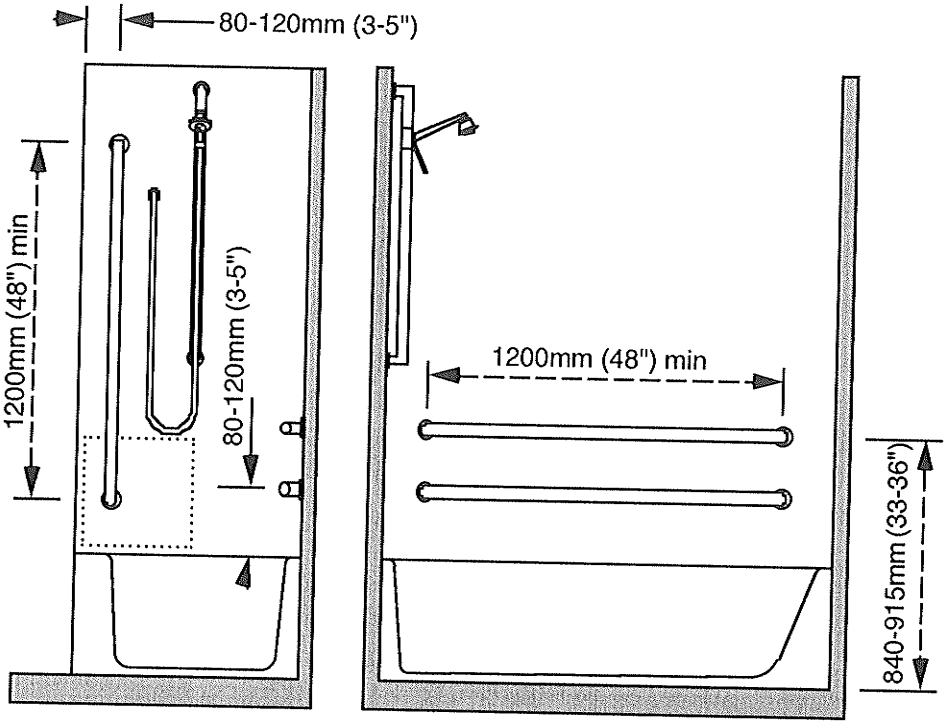


Figure 7.17: Bathtub Grab Bar Clearances

  - ◊ Grab bars in shower stalls with a seat should have one grab bar at least 750mm (30") long installed horizontally on the back wall between 700-800mm (28-31") from the shower floor, and have another grab bar at least 750mm (30") long installed vertically 80-120mm (3-5") from the front edge starting between 700-800mm (28-31") from the floor.[36]

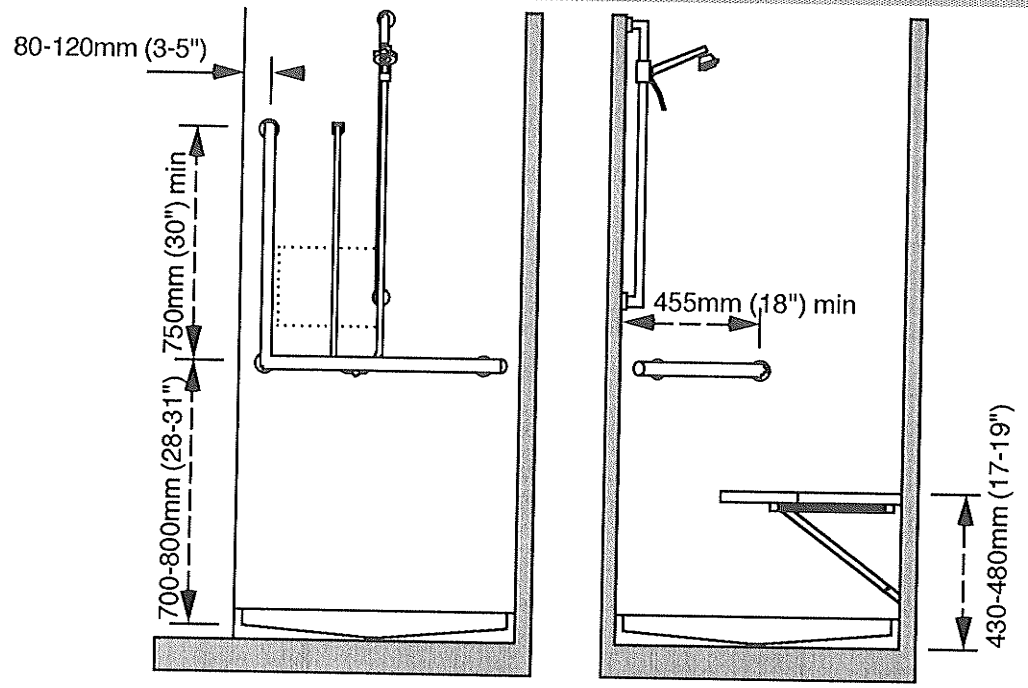


Figure 7.18: Shower Grab Bar Clearances

- A chair or seat should be provided to make mobility easier and safer in the bathtub and shower.[38]
  - ◊ In a shower stall the seat should be on the wall opposite the controls, be a minimum of 400mm (16") wide extending the full depth of the stall, and have its top 430-480mm (17-19") from the floor.[36]

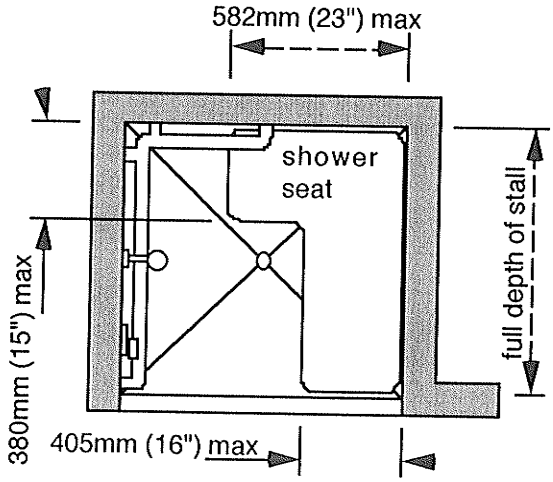


Figure 7.19: Shower Seat Preferred Design

- Bathtub enclosures should not obstruct the controls or interfere with a person stepping into the bathtub.[36]
  - ◊ Sliding doors should be removed as they block movement into the tub and since they are not very sturdy, may present a safety risk.[38]

Minimize Barriers

- Eliminating the curb in the shower makes transferring easier by allowing mobility aid users to get closer to the seat and even to step into the stall if it is equipped with a folding seat.[40]

Ease of Operation and Manipulation

- Flexible shower attachments which can be mounted on the wall at a desired height or held in the hand while sitting allow better control over water flow than traditional showers and bathtub faucets.[38] An on/off water control on the shower head is advantageous.[37]
- A built-in transfer surface or seat at the head (opposite the control end) of the tub may be necessary. This transfer surface provides a place for a mobility impaired person to sit for a moment during the process of entering the tub.[8]

Safety

- Nonskid surfaces should be provided to help prevent slipping in the tub or shower.[38]
- The soap holder should be recessed to prevent injuries.[37]
- Nonskid surfaces should be provided to help prevent slipping in the tub or shower.[38]

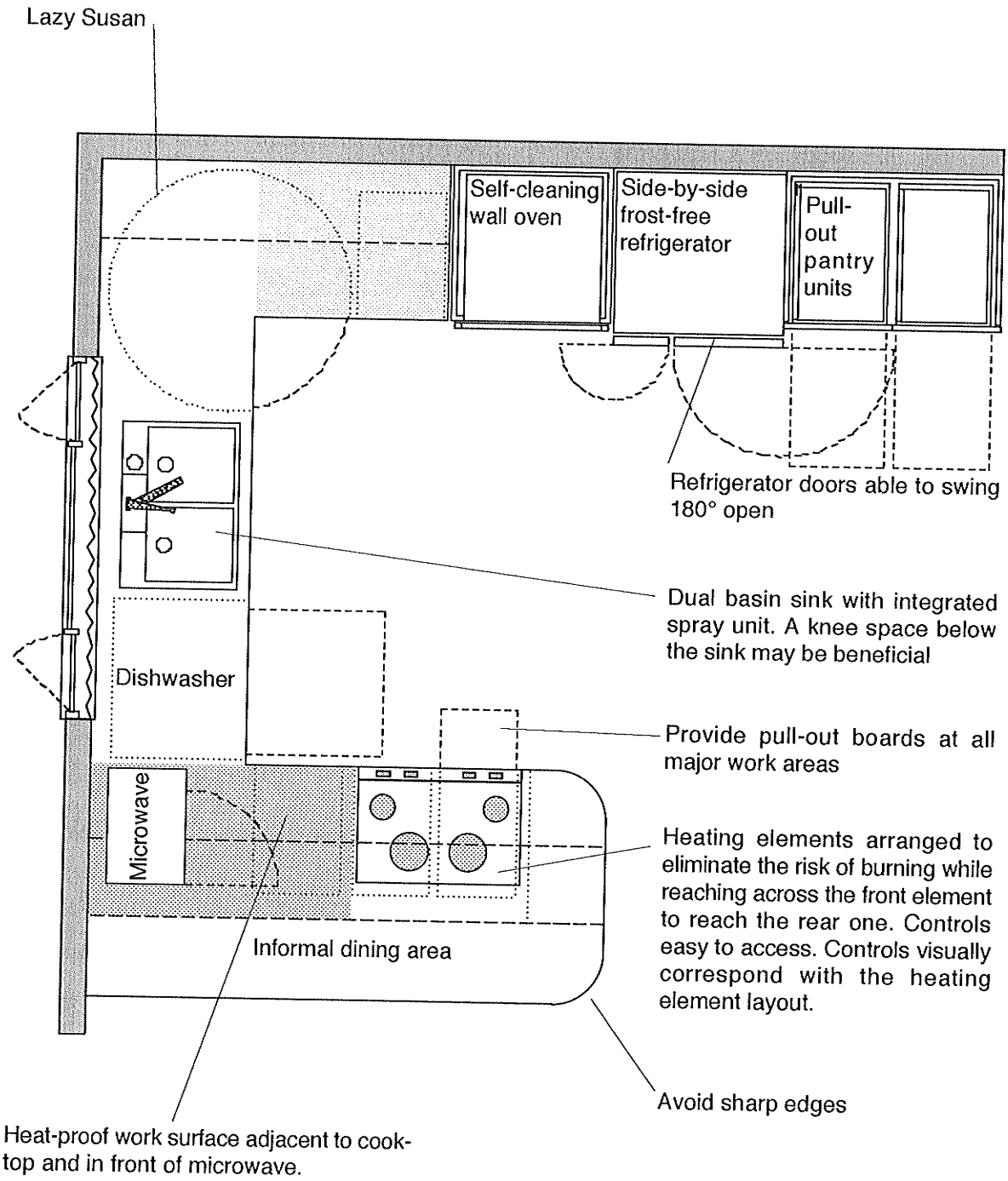


Figure 7.20: Mobility Aid Kitchen Plan, Design Suggestions

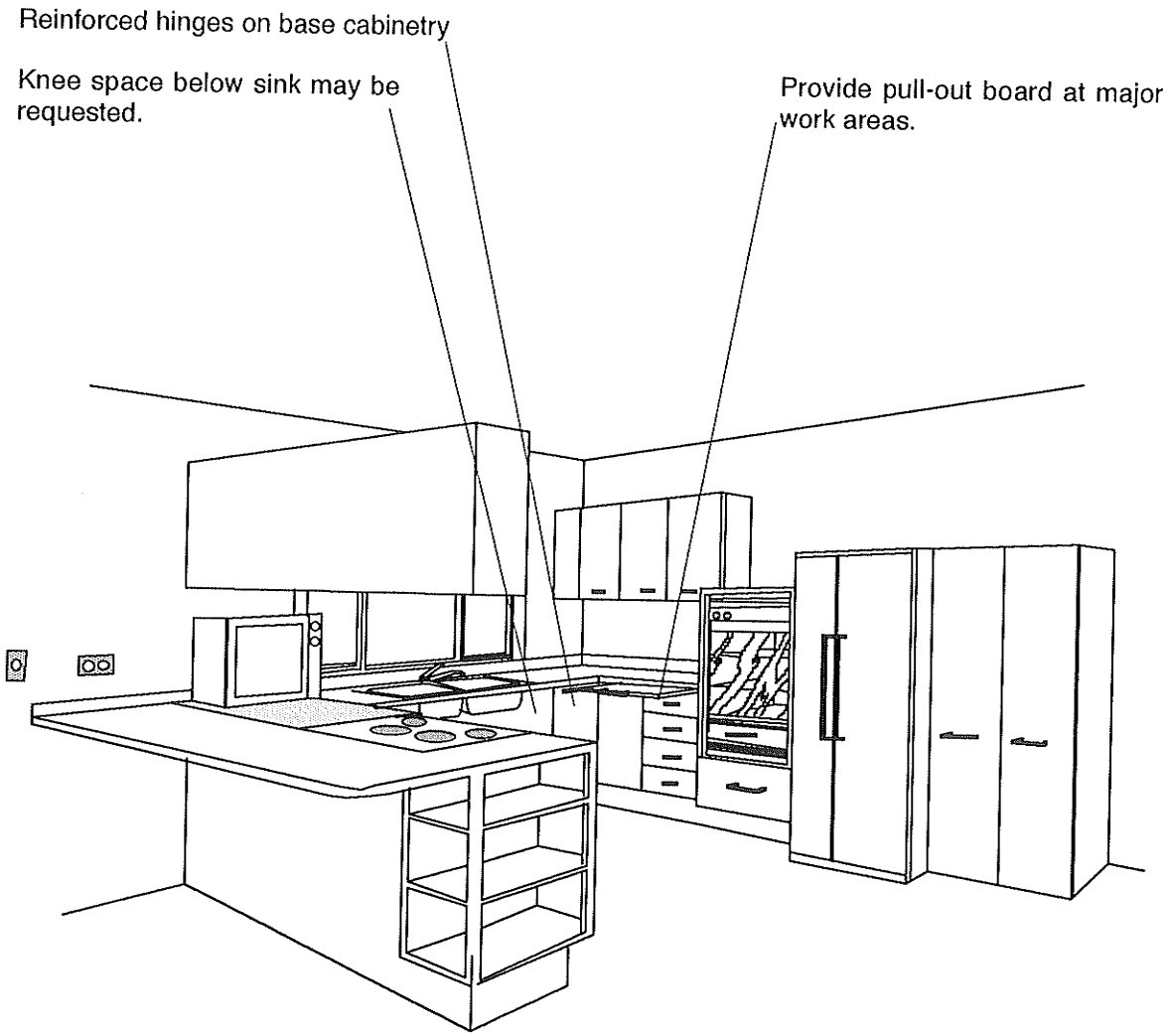


Figure 7.21: Mobility Aid Kitchen, Design Suggestions

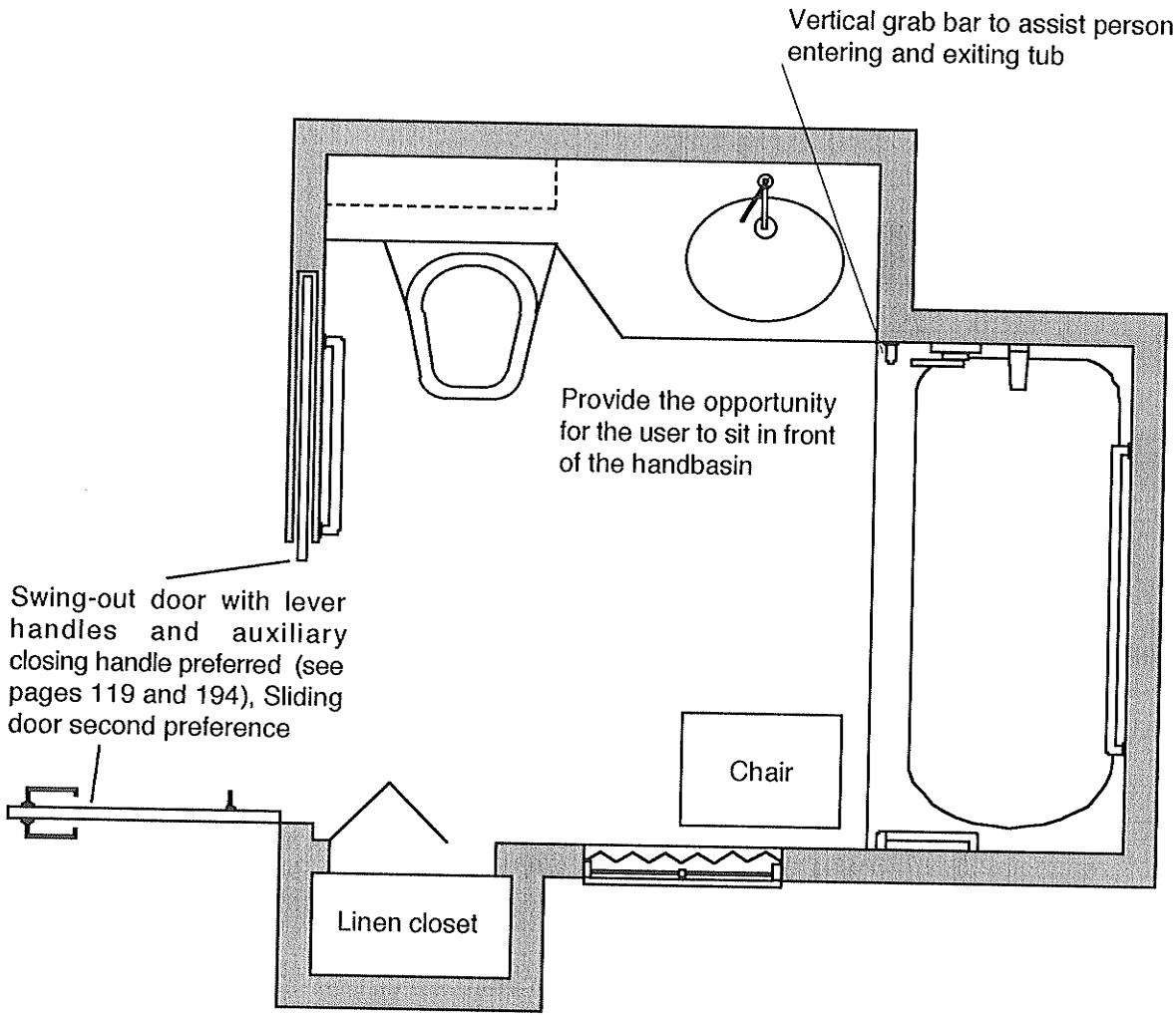


Figure 7.22: Mobility Aid Bathroom Plan, Design Suggestions

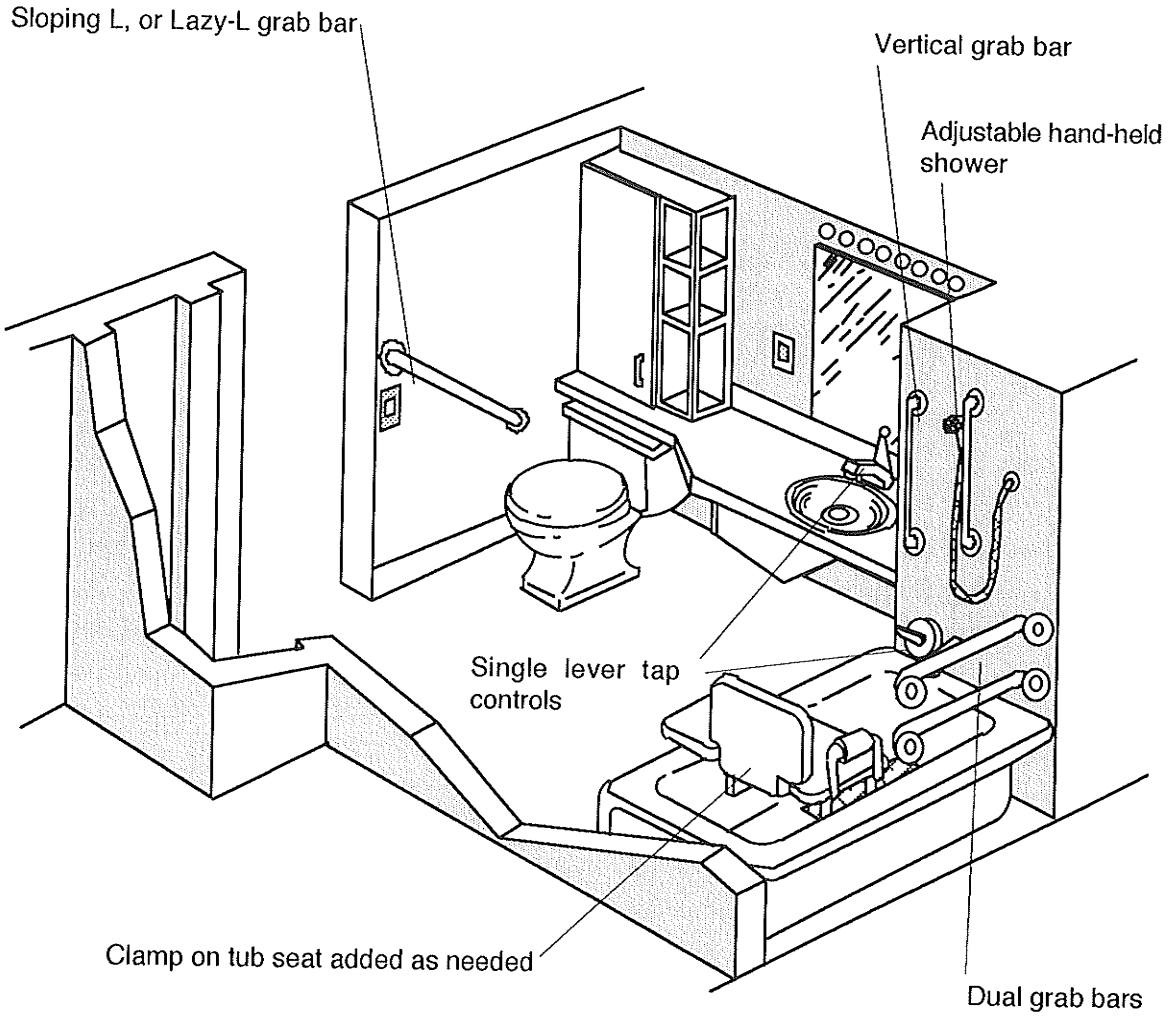


Figure 7.23: Mobility Aid Bathroom, Design Suggestions

[1] Donna Collins, May, 1992.
[2] Kelly 1987, 67.
[3] John Lane, April, 1992.
[4] Panero and Zelnik 1979.
[5] Mace 1991, 105.
[6] Mace 1991, 113 - 117.
[7] Don Ament, June, 1992.
[8] Mace 1991, 149 - 151.
[9] CSA 1990, 96.
[10] Mace 1991, 112.
[11] Pynoos et al. 1987, 299.
[12] CMHC 1988b, 32.
[13] Moos et al. 1987, 198.
[14] CSA 1990, 81 - 82.
[15] Christiansen and Baum 1991, 715 - 718.
[16] ANSI 1980, 32.
[17] Barrier-Free Environments 1980, 31.
[18] Christiansen and Baum 1991, 720 - 721.
[19] CSA 1990, 86.
[20] Kelly 1987, 77.
[21] CSA 1990, 97.
[22] Christiansen and Baum 1991, 723 - 731.
[23] Aitkens and Finan 1987, Chapter 3, Page 68 - 71.
[24] Independent Living Centre, N.S.W. 1987a, 11 - 14.
[25] Kelly 1987, 67 - 71.
[26] Independent Living Centre, N.S.W. 1987a, 6.
[27] ANSI 1980, 58.
[28] Mace 1991, 58.
[29] Mace 1991, 118.
[30] Mace 1991, 126.
[31] Mace 1991, 132 - 138.
[32] Steinfeld 1987, 321.
[33] Steinfeld 1987, 333.
[34] Aitkens and Finan 1987, Chapter 3, Page 66.
[35] CSA 1990, 106.
[36] CSA 1990, 89 - 95.
[37] Independent Living Centre, N.S.W. 1987b, 11 - 13.
[38] Christiansen and Baum 1991, 734 - 738.
[39] Mace 1991, 174 - 181.
[40] Mace 1991, 164.

DISABILITY DEFINITION AND LIMITATIONS

The "wheelchair users" design group is defined in this paper as persons who use wheelchairs. The recommendations in this paper refer mainly to manual wheelchairs.

Special considerations which a designer should know about wheelchair users are:

- Wheelchair types: Wheelchairs come in manual, electric, and scooter models.[1] Manual and electric wheelchairs have similar dimensions, but electric wheelchairs do not always have the same maneuverability/capacity as manual wheelchairs and are much heavier. Electric wheelchairs cannot be folded.[2] For more information on wheelchairs see CSA documents: CAN/CSA-Z323.4.2-M86, *Wheelchairs–Determination of Overall Dimensions, Mass and Turning Space.*

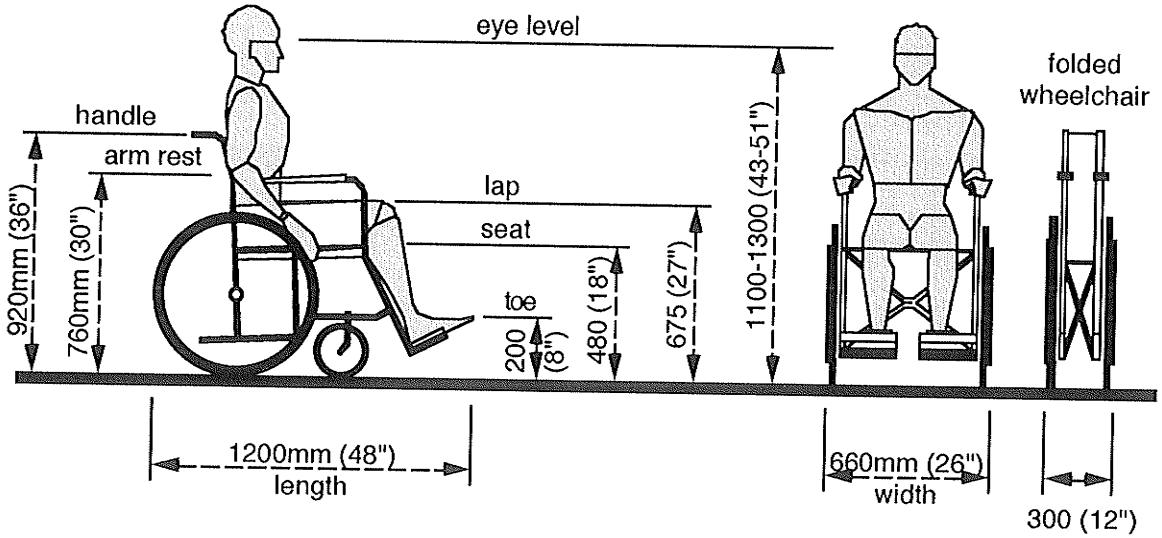


Figure 8.1: Typical Dimensions of Wheelchairs Commonly Used by Adults

- Frequently wheelchair users are compounded with an additional impairment, such as those discussed in other chapters of this paper.[3] Also, many wheelchair users are quadriplegic or paraplegic with impaired sensation (design solutions: insulated fixtures, set-back piping, etc.).[4]

Some characteristic problems wheelchair users face are:

- When manipulating objects, anything which falls tends to fall on the lap of the user.[4]
- Changes in floor levels or floor textures tend to act as barriers.[1]
- Often standard items and dimensions are too high or uncomfortable to use, e.g.: doorknobs, work surfaces, etc. Everything must be designed from the sitting position.[4]

Related disability groups include:

WHEELCHAIR USER AND ATTENDANT

When designing for a wheelchair user and an attendant it is important that the two individuals observe and interact with each other.[4] Specific design recommendations include:

- A larger bathroom may be required to facilitate in transferring the wheelchair user to the water closet and the shower/tub.[4]
- A mechanical lift may be required to transfer the wheelchair user in the bathroom. Two types of lifts are common, a fixed overhead tracking system and a portable tub-side mechanical lift. The overhead tracking system requires structural support in the bathroom ceiling. The tub-side lift may require a clear floor space below the tub for the lift to operate safely. A raised tub will make the attendant's job easier because the raised tub reduces the amount of bending required of the attendant compared to a standard tub, as long as the raised tub is not too deep.[1]

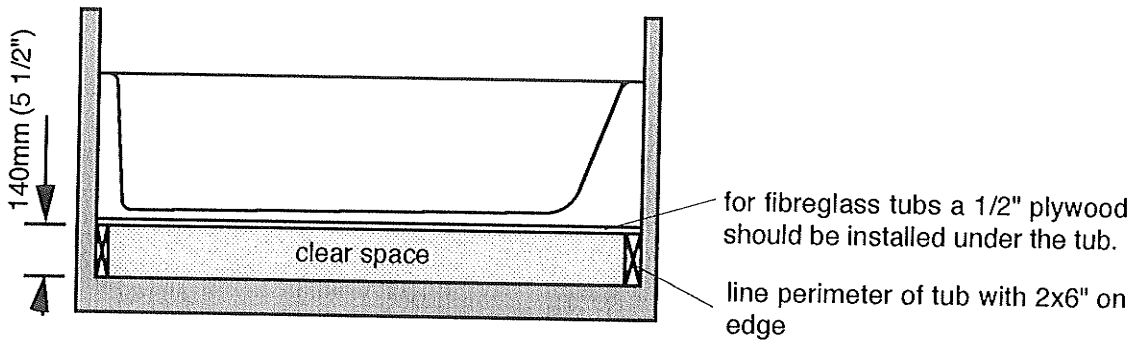


Figure 8.2: Raised Tub Clearances

- A kneespace below the bathroom handbasin is necessary. The handbasin in wheelchair user with attendant situations functions as an upperbody washing station.[4]
- Grab bars should be located according to the needs of the attendant.[5]

DESIGN PRINCIPLES FOR

PLANNING ACCESSIBLE ENVIRONMENTS FOR WHEELCHAIR USERS

ACCESSIBILITY

- Turnaround Space: One method of designing a wheelchair accessible environment is by providing turnaround space, that is, allowing enough space for a wheelchair to make a 180° turn. Two types of turnaround space will make such turns possible, i.e.: a 1500mm circular area for pivoting turns and a T-shaped area for making a T-turn. Each of these spaces allows a different type of turn to be made and each can drastically affect the design of a room.[6]
  - ◊ The 1500mm (60") diameter turning space provides enough area to complete 360° pivoting turn. For the average manual wheelchair user, the three-dimensional space required for this turn resembles a stepped circular pyramid. The portion of the space closet to the floor must be 1500mm in diameter. At approximately 300mm above the floor the diameter gets smaller and at 760mm it gets even smaller. This can be useful information for planning economical yet accessible spaces. The 300mm and 760mm high portions of the turning space can be provided under overhanging cabinets and tables or in knee spaces under cabinets.[6]

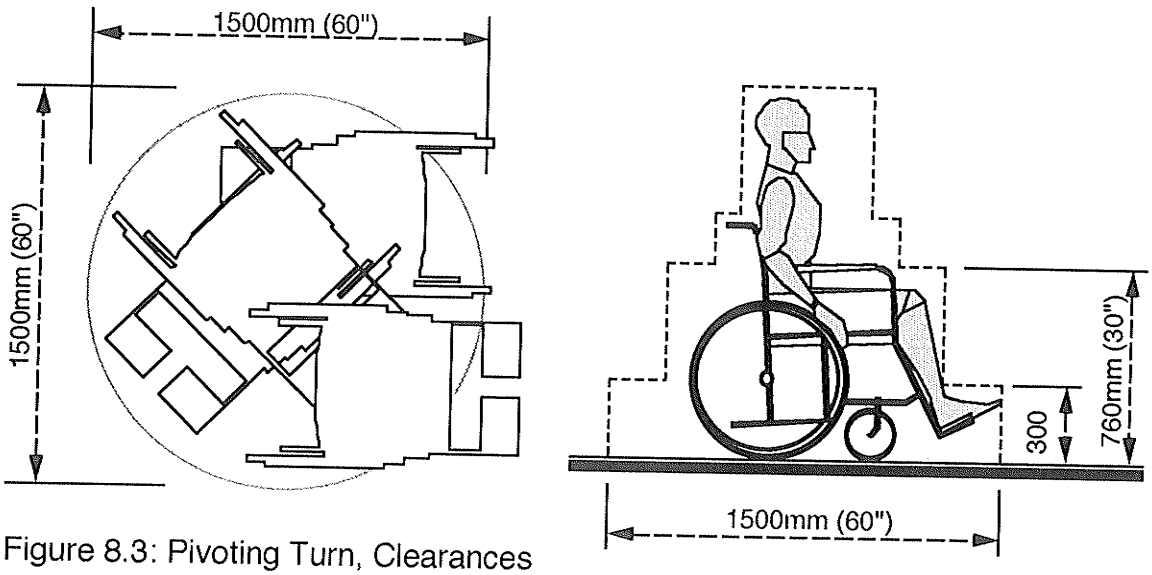


Figure 8.3: Pivoting Turn, Clearances

◊ Findings have demonstrated the 1500mm (60") diameter turning area used in many standards is inadequate for almost half of the wheelchair users. They need a space that is at least 1500mm (60") wide by 1980mm (78") deep.[7] This larger space is required because many wheelchair users can not make a smooth turn due to strength and coordination impairments or because the model of wheelchair they own can not pivot sharply.[4]

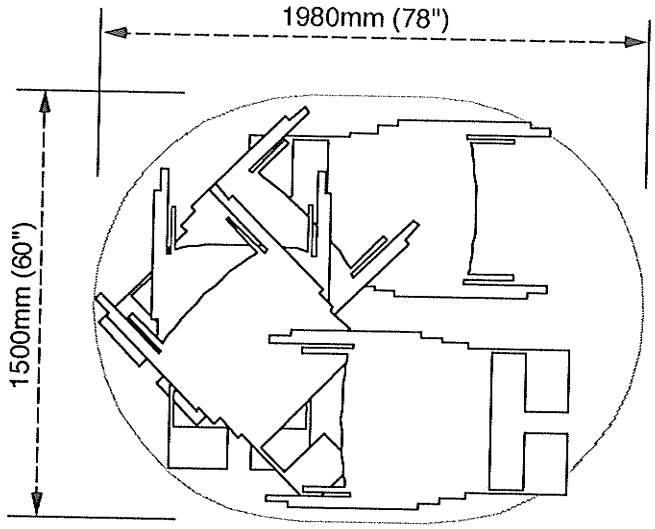


Figure 8.4: Pivoting Turn, Optimal Clearances

◊ Some accessibility codes require a 1500mm turning radius. Given adequate clearances, there is no need for a wheelchair user to make a 180° pivoting turn.[9]

◊ The T-shaped turning space allows a three point turn to be made by pulling into one leg of the "T" and backing out into the other. For planning economical yet accessible spaces the central arm of the "T" may be provided under overhanging cabinets and tables or in knee spaces under work surfaces.[6]

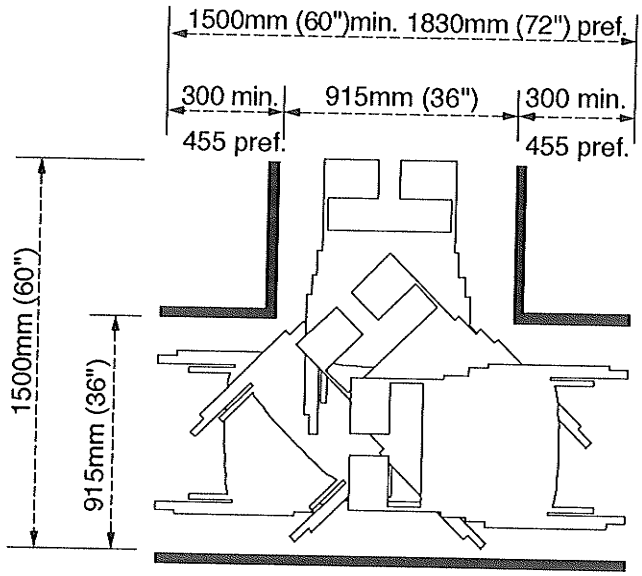


Figure 8.5: T-Turn, Clearances

- Maneuvering Space (Clear Floor Space): A second method of providing a wheelchair accessible environment is by providing sufficient wheelchair maneuvering space beside fixtures and appliances. Maneuvering spaces can overlap with each other to conserve space and, if carefully planned they need not necessarily increase the size of a kitchen or bathroom. The maneuvering spaces discussed in this paper are generally adequate for most people who use conventional manual or electric wheelchairs. It should be noted that these are minimum spaces which may not be convenient when more than one person is using the kitchen/bathroom at the same time.[10]
- Transferring Space and Surfaces (including grab bars): Wheelchair users have many different ways of safely transferring in and out of their wheelchair. Three factors generally influence how an individual may transfer: transferring method, transferring surface, and grab bars.
  - ◊ Transferring method: Some people can transfer to and from fixtures (wc, bath, or shower) from only one side. Others can complete right, left, or front transfers. The technique used depends on which approach is most familiar, easiest, and safest to complete.[11] To facilitate wheelchair transfers it is important to provide a usable amount of clear floor space on at least one side of the transferring surface.[12]
  - ◊ Transferring surface: The height of the transferring surface can radically affect its accessibility. Very low or very high transferring surfaces are not good.[13] For one-way transfers the optimal transfer condition exists when the transfer-on surface is about 25mm(1") lower than the transfer-off surface.[4] For two-way transfers the optimal transfer condition exists when the two transferring surfaces are at an equal level.[14] The transferring surface should be stable[5] and also be large enough for the individual to maintain their balance easily.[1] The height of a wheelchair seat is approximately 455mm (18").[13]

◊ Safety is greatly increased by the addition of grab bars at transfer points. The grab bar type varies with the level and type of disability of the individual user. Generally, wheelchair users require horizontal grab bars. If the wheelchair user transfers from the wheelchair by standing up and walking to the fixture, the grab bar should have a vertical or angular component for the user to help pull themselves up.[4] Grab bars should be slip-resistant; have a diameter of 30-40mm (1 1/8-1 1/2"), or a shape that provides an equivalent gripping surface; and, have a space of 35-45mm (1 3/8-1 3/4") between the wall and the grab bar where mounted adjacent to a wall.[49]

- Knee Space and Work Surface`: It is important to provide adequate knee space below work surfaces to make the work surface accessible and usable for a wheelchair user.

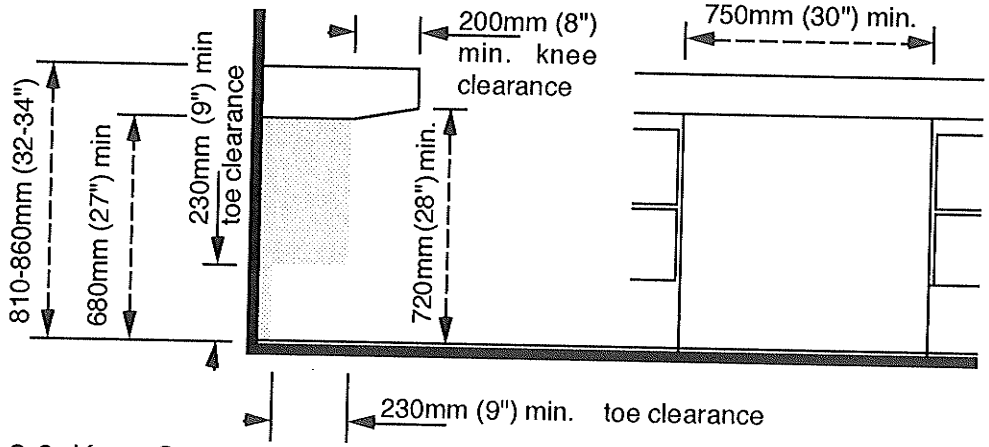


Figure 8.6: Knee Space, Minimal Clearances

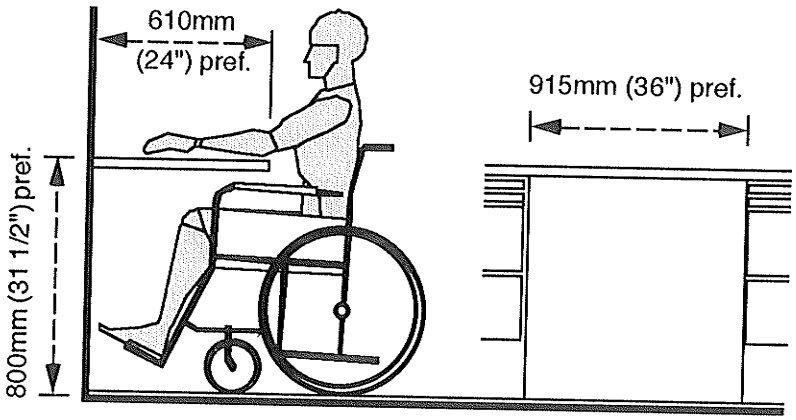


Figure 8.7: Knee Space, Preferred Clearances

- Toe Space: It is important to provide adequate toe space in order to make the toe space area accessible to a wheelchair user. The recommended size of the toe space differs among the sources: ANSI: 150 deep x 230 high; CSA: 230 x 230mm; Independent Living Centre, N.S.W.: 150 x 200.
  - ◊ A toe space may be used to minimize the distance between cabinetry if a pivoting turn clearance is being provided.

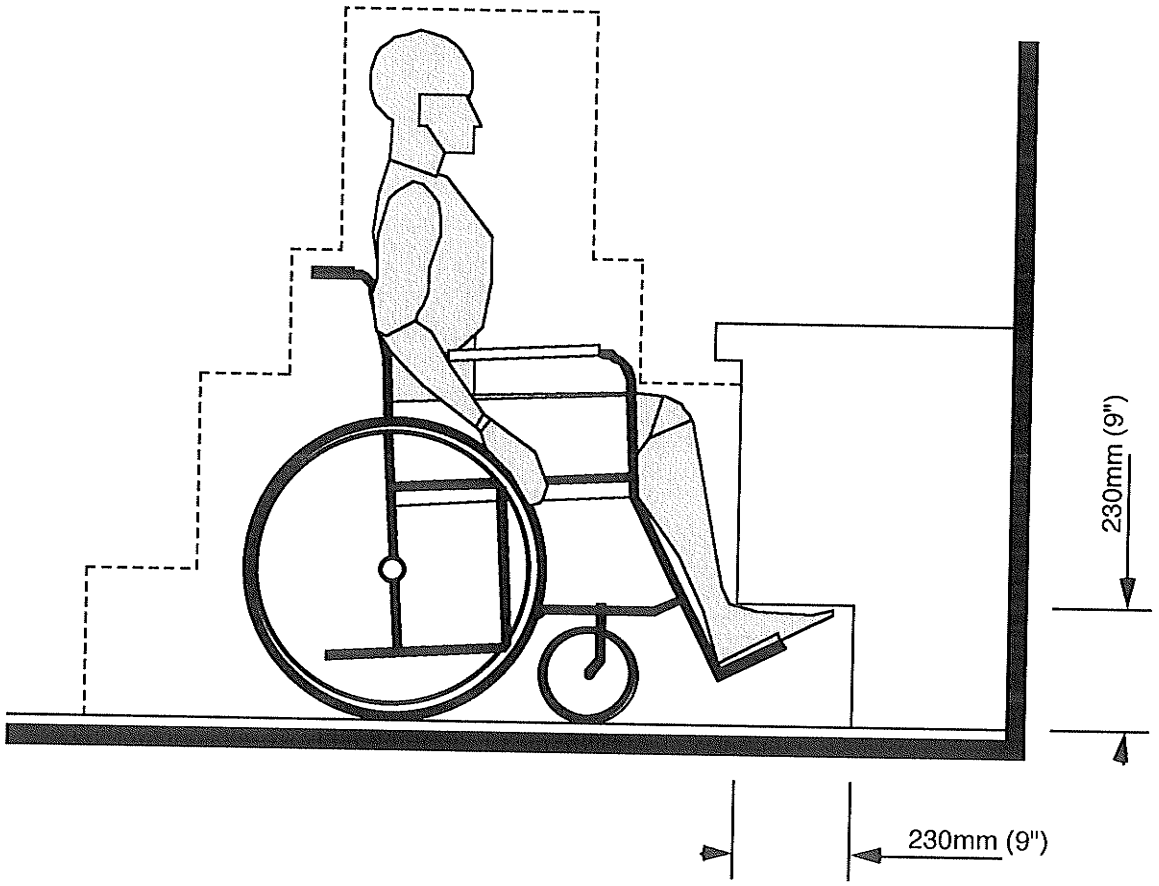


Figure 8.8: Toe Space, Clearance

- Reach Ranges: Wheelchair users have a limited reaching ability because they must sit down while performing tasks. Figures 8.9 and 8.10 illustrate the forward and side reach ranges for wheelchair users.

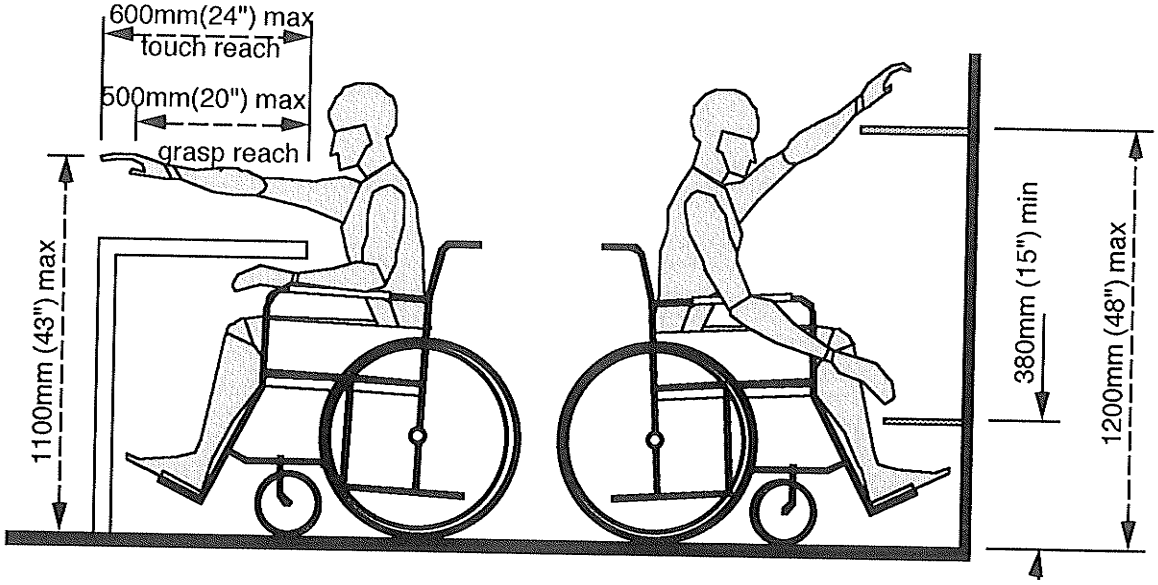


Figure 8.9: Forward Reach

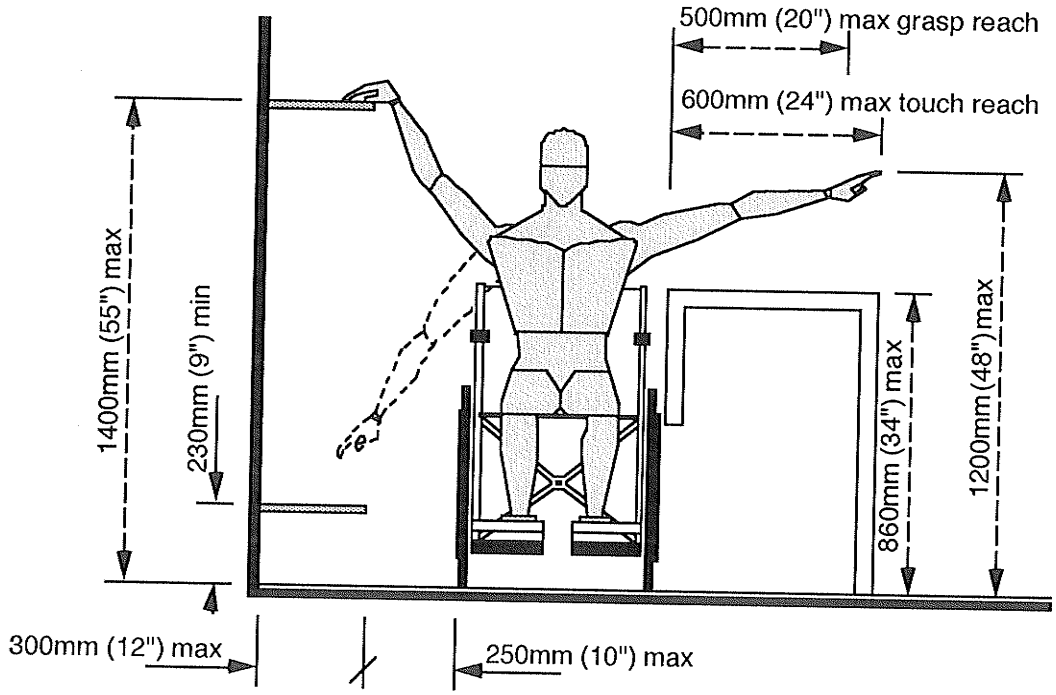


Figure 8.10: Side Reach

MINIMIZE TRAVEL THROUGH RESIDENCE

- Storage: Create storage facilities near areas of use, e.g.: large pots and pan storage by cooking area, towel storage in bathroom, etc.[16]
- Services: Duplicate services when possible, e.g.: more than one telephone in the house, an informal dining area in the kitchen, etc.[16]

MINIMIZE BARRIERS

- Open planning arrangements are preferred because the need to navigate the wheelchair through door openings and around barriers are reduced.[4]
- Floor surfaces should be firm, level and unbroken to facilitate the operation of the wheelchair.[4]
- Work surfaces should be level to allow an individual to slide items on the work surface to reduce the need for lifting and the risk of spilling.[1]

EASE OF OPERATION AND MANIPULATION

- Provide features which are easy to access, operate, and control, e.g..: large rocker-type switches, easy-to-use controls, etc.
- Provide opportunities for the user to reduce the job into tasks, e.g..: double sink with drying rack—wash dishes in first sink and place them in the second sink to rinse; move wheelchair; take dishes from the rinse sink and place dishes on drying rack.[4]
- Provide features within the immediate reaching area, directly in front or beside, the user, e.g.: pull-out storage, pull-out boards, controls at the front of an appliance, etc.[4]
- Everything should be operable with one hand.[17]
- Access to pull-out units and units behind side-hinged doors can be made certain by making sure that the wheelchair can be positioned so that the user can reach far inside the unit. This usually means placing the wheelchair at a right angle to the unit.[18]

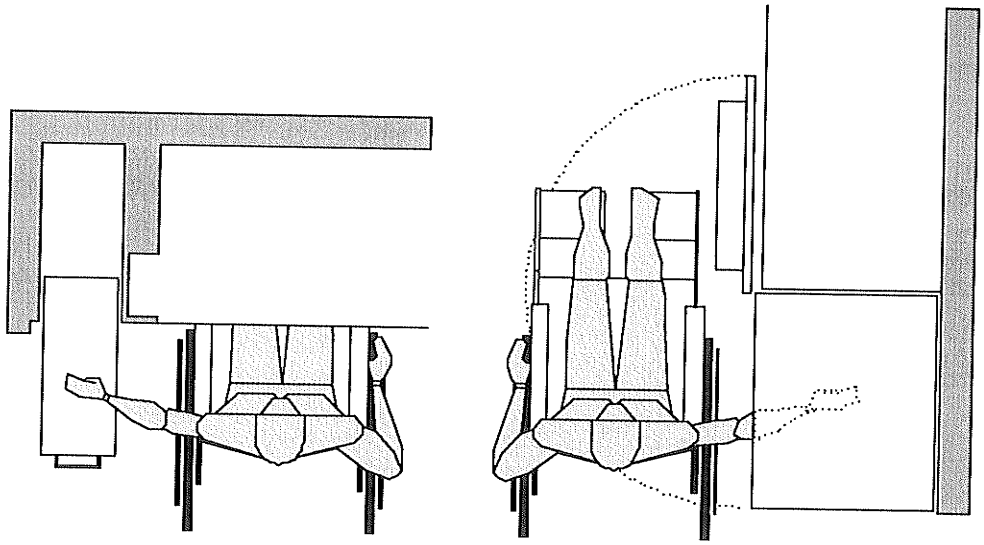


Figure 8.11: Recommended Approach to Pull-out and Side-hinged Door Units

MINIMIZE MAINTENANCE

- Provide features which promote simple maintenance, e.g.: easy-to-clean flooring, self-cleaning ovens, etc.
- Provide features which protect against wheelchair damage, e.g.: corner molding, kick plates on doors, etc.

SAFETY

- Residential environments should include basic safety features.
  - ◊ Individuals with disabilities and elderly people have a strong preference for features that increase their safety, i.e.: smoke detectors, nonslip surfaces in the bathroom, no sharp edges to reduce injuries due to falls, etc.[19]
  - ◊ One decision facing designers is how far to take the effort to ensure personal safety in light of monetary constraints. Features that offer protection from fires, prevent falls and permit summoning help quickly in case of need are probably cost effective in the long run.[19]

- Safety features in the home should be readily available but unobtrusive and nontherapeutic looking. People do not wish to be identified as impaired and will be resistant to design that is institutional in appearance.[16]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS COMMON TO KITCHENS AND BATHROOMS

DOORS AND DOORWAYS

Accessibility

- Doorways must be wide enough to allow a wheelchair to pass through. The minimum clear opening of doorways should be 810mm (32") with a minimum door swing of 90°, measured between the face of the door and the stop.[20]

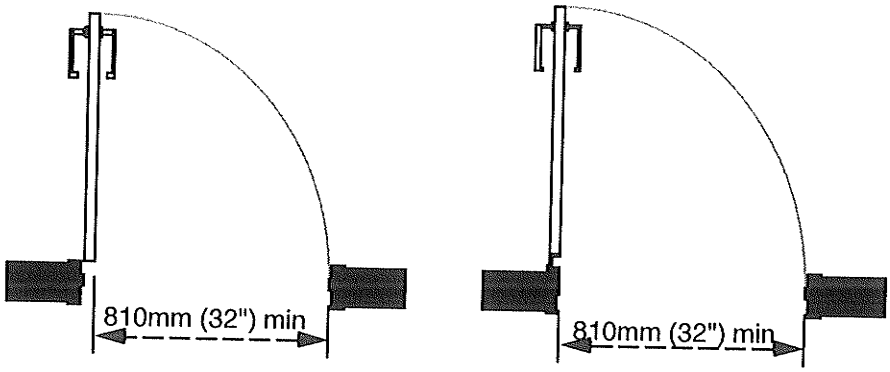


Figure 8.12: Clear Width of Doorway, Hinged Doors.

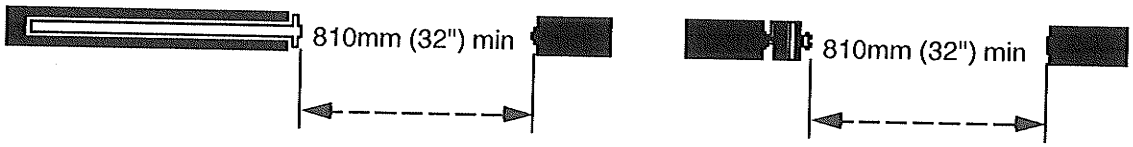
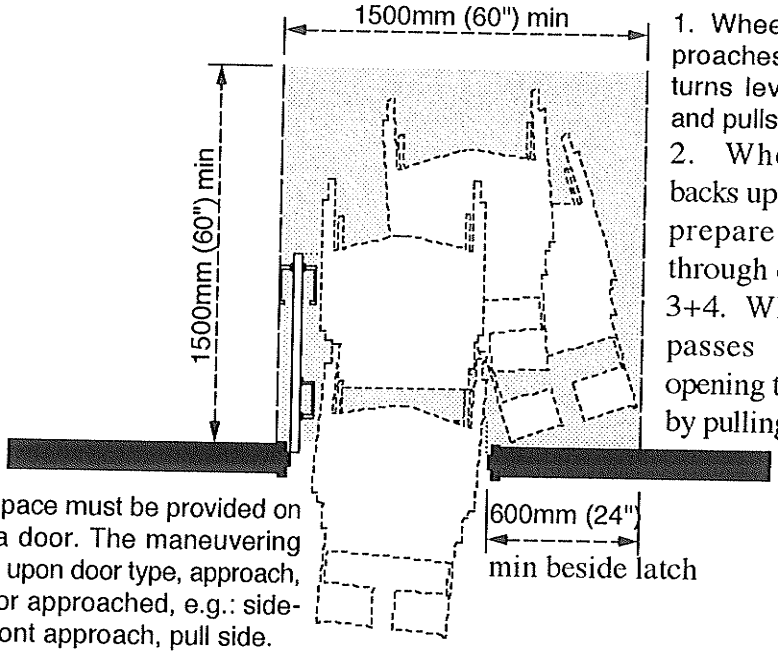


Figure 8.13: Clear Width of Doorway, Sliding and Folding Doors.

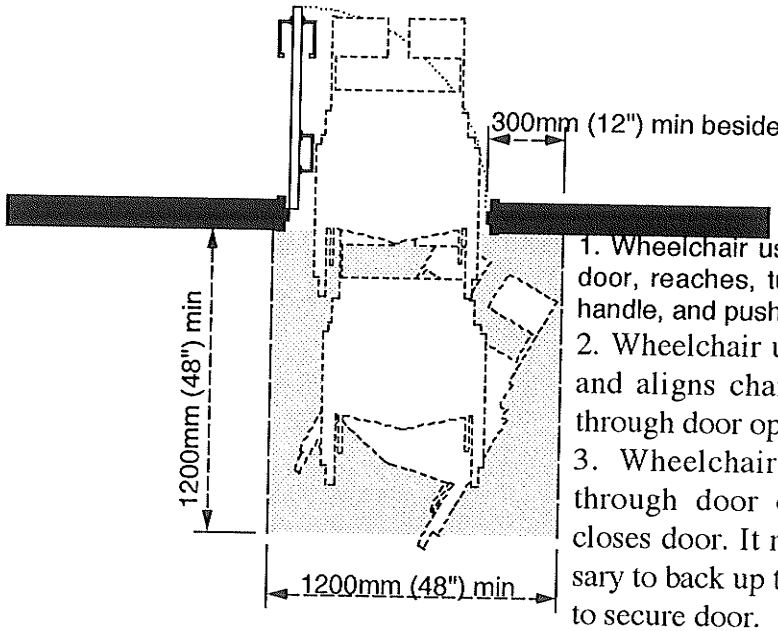
- Sufficient maneuvering space around the door is needed to open the door, to back up while pulling the door open, and to pull the door closed once through the door. Space requirements to enter and close a door vary according to the type of door, the placement of the door, the approach to the door space and the space needed to accommodate the wheelchair. Figures 8.14 to 8. 22 show the maneuvering space need to open a door while operating a wheelchair. The lightly toned area in each of the figures must be level.



1. Wheelchair user approaches door, reaches, turns lever door handle, and pulls open door.
2. Wheelchair user backs up to align chair to prepare for passing through door opening.
3+4. Wheelchair user passes through door opening then closes door by pulling on pull handle

Maneuvering space must be provided on both sides of a door. The maneuvering space depends upon door type, approach, and side of door approached, e.g.: side-hinged door, front approach, pull side.

Figure 8.14: Minimum Doorway Maneuvering Space, Side-hinged Door, Front Approach, Pull Side



1. Wheelchair user approaches door, reaches, turns lever door handle, and pushes door open.
2. Wheelchair user backs up and aligns chair for passing through door opening.
3. Wheelchair user passes through door opening then closes door. It may be necessary to back up the wheelchair to secure door.

Figure 8.15: Minimum Doorway Maneuvering Space, Side-hinged Door, Front Approach, Push Side

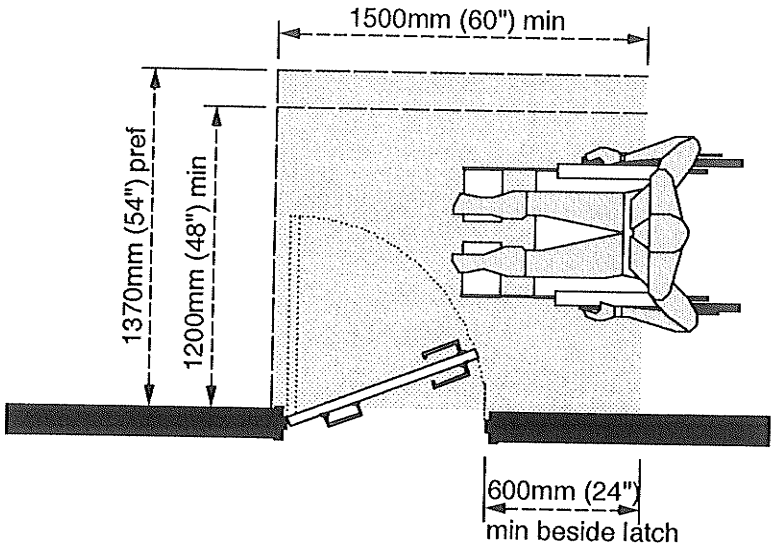


Figure 8.16: Minimum Doorway Maneuvering Space, Side-hinged Door, Latch Side Approach, Pull Side

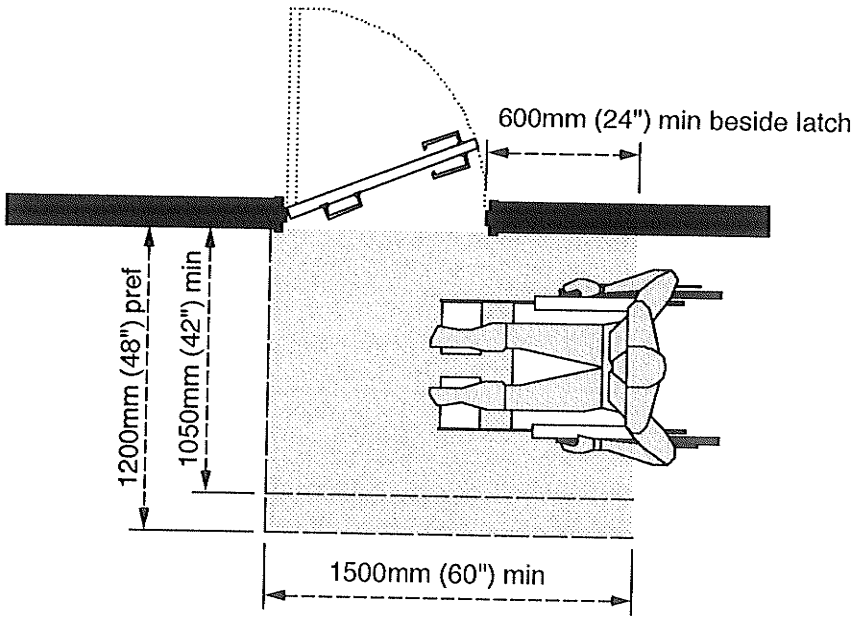


Figure 8.17: Minimum Doorway Maneuvering Space, Side-hinged Door, Latch Side Approach, Push Side

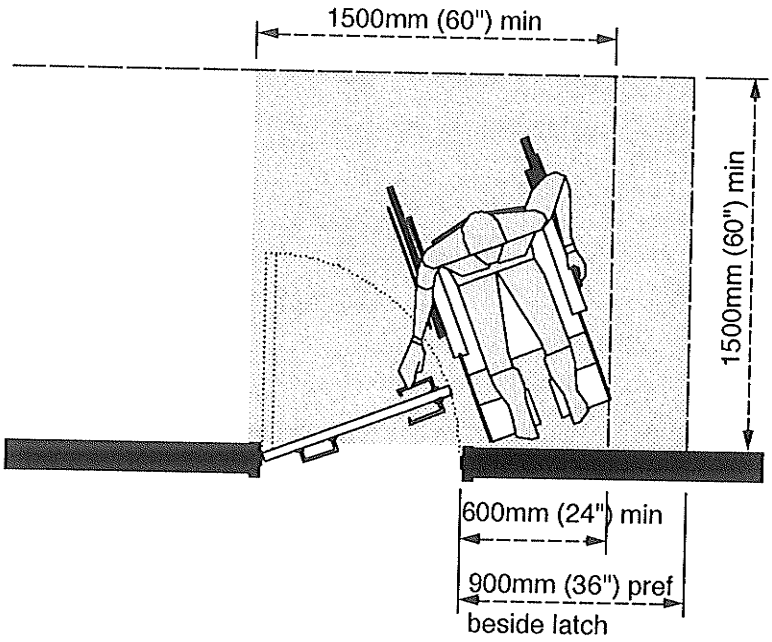


Figure 8.18: Minimum Doorway Maneuvering Space, Side-hinged Door, Hinge Side Approach, Pull Side

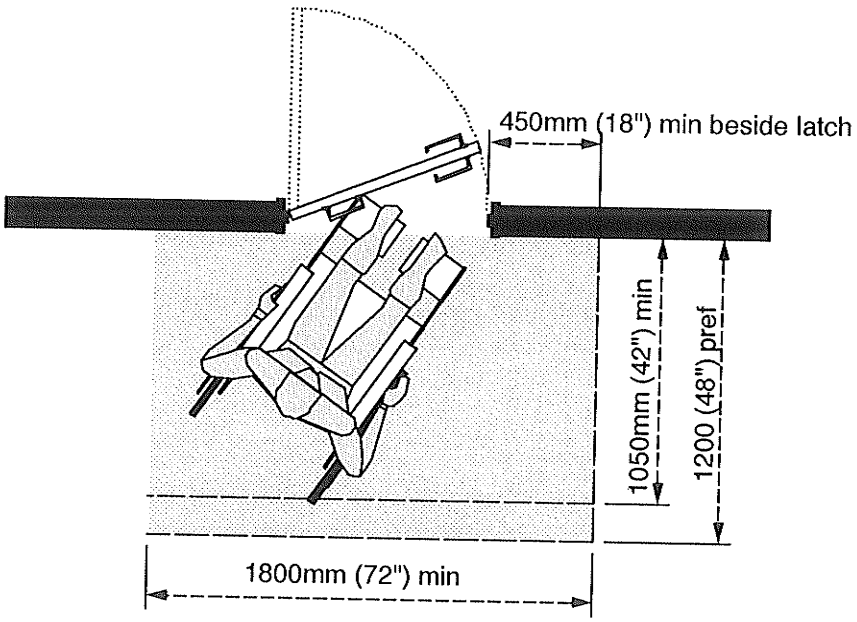


Figure 8.19: Minimum Doorway Maneuvering Space, Side-hinged Door, Hinge Side Approach, Push Side

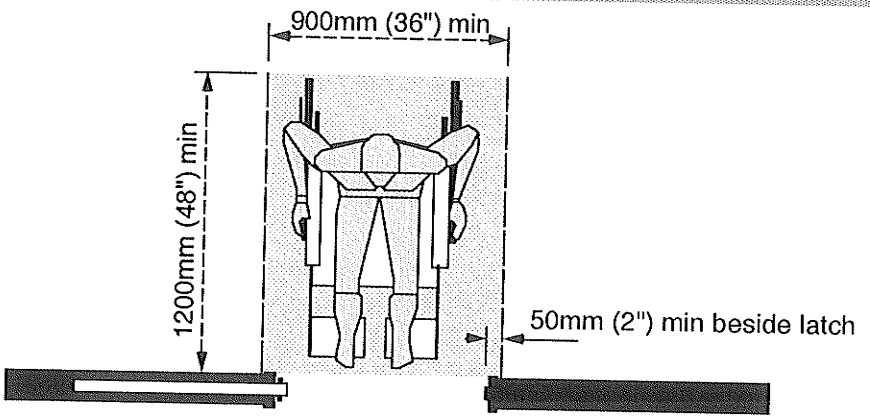


Figure 8.20: Minimum Doorway Maneuvering Space, Sliding Door, Front Approach

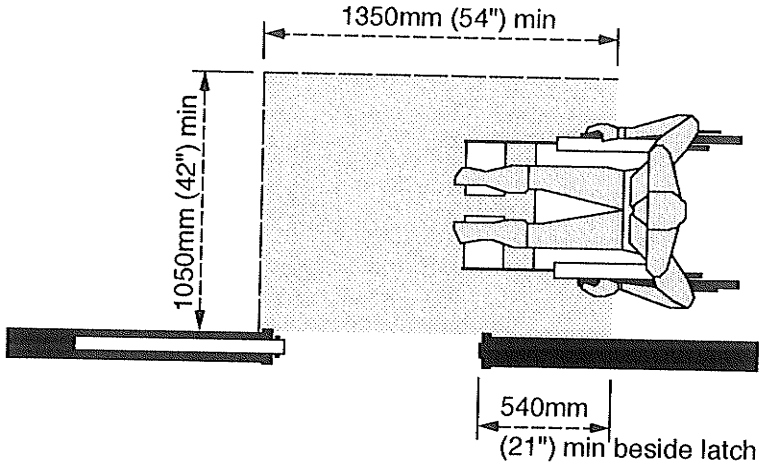


Figure 8.21: Minimum Doorway Maneuvering Space, Sliding Door, Latch Side Approach

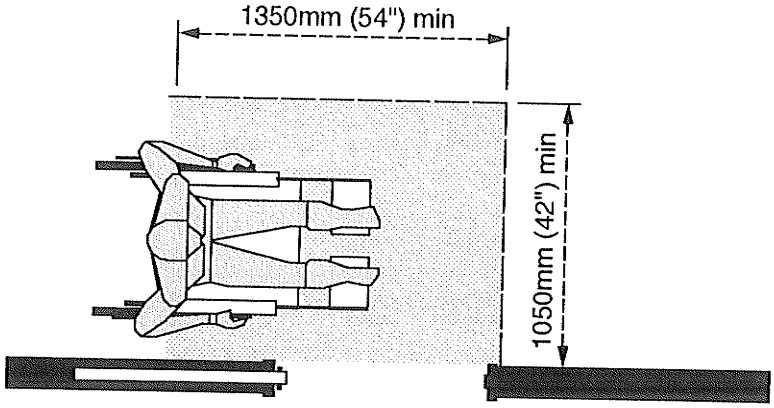


Figure 8.22: Minimum Doorway Maneuvering Space, Sliding Door, Slide Side Approach

Minimize Barriers

- Door placement in the wall should be such that the door is able to swing completely open to at least 90 degrees without bumping into other structures. If the swing space of two doors intersects, the hinge side of one or both doors may be changed so there is no swing space intersection. Doors should open in a direction that allows maximum movement space.[26] If an out-swinging door is used, place the door so that it does not swing into areas where people normally walk or stand.[4]
- Thresholds should be avoided. If a threshold must exist it should be no more than 15mm (5/8") high.[1]

Ease of Operation and Manipulation

- Sliding doors are preferred to side-hinged doors where space is tight and where doors are infrequently closed.[4] Sliding door hardware should be easy to manipulate and reach and be exposed and operable from both sides of the door when the door is fully open.[21]
- Door handles and locks must be mounted between 750-1050mm (30-42") above the floor.[22] A height of 900-950mm (36-38") is preferred.[26]
- A 150mm (6") minimum D-shaped pull handle can be placed on a door 180-200mm (7-8") from the hinge at the same level as the door knob. A person passing through can pull on it instead of backing up to grasp the door knob.[26]
- Doors must have hardware that is easy to operate and which does not require fine grasp. Lever-type handles are preferred because they can be operated by a single, non-precise movement.[22] Lever-type door handles should have a curved or angled end to avoid snagging clothing.[4]

Minimize Maintenance

- A smooth kick plate at the push side of a side-hinged door is recommended.[22] The kick plate should cover the bottom 300mm (12") of the door.[23]

FLOORING

Minimize Barriers

- Avoid changes in floor levels and floor surfaces. Very small level changes or ridges may be dangerous, e.g.: the bump caused by a change of floor surface may cause a wheelchair operator to spill liquid if they are carrying a container.[4]

Ease of Operation and Manipulation

- Floor surfaces should be firm and slip-resistant.[24]
- Floor mats and throw rugs/carpets should be avoided, if used, they should not bunch up under the wheelchair.[1]
- If carpet is used, it should
  - ◊ have a level loop, textured loop, level cut pile, or level cut/uncut pile texture with a maximum pad and pile height of 13mm (1/2").[24]
  - ◊ have no underlay.[4]
- Cushioned linoleum should be avoided.[4]

HARDWARE AND ELECTRICAL

Accessibility

- All controls, devices for light, power, heat, fire alarms, and thermostats, ventilation, and similar controls intended to be operated by a wheelchair user should be mounted between 900-1200mm (36-48") above the floor.[25]

- It is recommended that electrical outlets be located no lower than 450mm (18") from the floor.[25]

WALLS

Minimize Maintenance

- Provide features to protect against wheelchair damage, e.g.: corner moldings, tall base boards, etc.[3]

WINDOWS

Accessibility

- The ability to use windows is dependent upon their location and construction. A person sitting in a wheelchair should be able to get close to the window and be able to view out of the window. A sill height of 760mm (30") or less is sufficient.[27]

Ease of Operation and Manipulation

- The opening mechanisms should be easy to reach and operate for purposes of ventilation and temperature control. The curtains, drapes, or blinds should be easily manipulated in order to control lighting and privacy. Ease in cleaning also influences the use of the window. Window controls should be located with the range of 700-1050mm (28-42").[28]
- Horizontal sliding windows with an easy release lock are preferred. A crank-out window is also acceptable, but this type of window may be difficult to operate in the winter.[4]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS SPECIFIC TO KITCHENS

GENERAL PLANNING AND ORGANIZATION

Accessibility

- Maneuvering space: A clear floor space at least 750 x 1200mm (30 x 48") should be provided for side approach at all appliances in the kitchen, including the range or cooktop, oven, refrigerator/freezer, and dishwasher.[35] Maneuvering space for T-turns should be provided when undercounter spaces are provided.

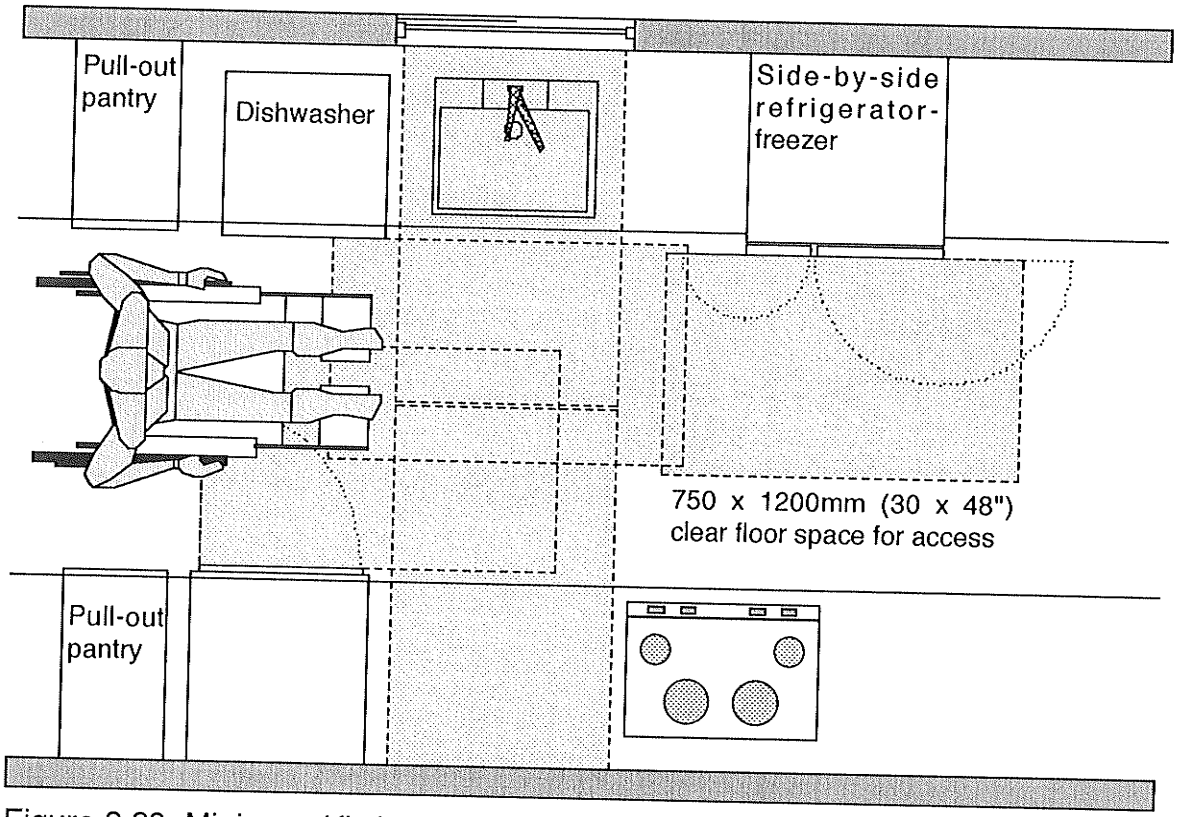


Figure 8.23: Minimum Kitchen Maneuvering Space

- Kitchen layout: The amount and arrangement of space in a kitchen influences task organization, task time, and energy output. The number of movements one must make, the distance moved, and the amount of things to carry are all greatly affected by space and arrangement. This is an important consideration for wheelchair users.[29]

- ◊ U-shaped and L-shaped designs are the most desirable kitchen layout for individuals in wheelchairs because fewer bumps and accidents occur in these two layouts in comparison to the one-wall and corridor kitchen layouts.[29]
- ◊ The U-shaped design allows for continuous movement from one working space to another. Ideally, the sink and cooking facilities should be close to each other and separated by a work space. In this design, it is preferable to place the sink in the middle of the "U" with a kneespace underneath the sink and a work space on either side.[29]
- ◊ The L-shaped design allows kitchen activity to be concentrated by placing working areas closer. Movement between work centres can be kept to a minimum in this design, reducing fatigue from lifting. In this design, it is preferable to place the sink in the corner of the "L" with a knee space underneath the sink and a work space on either side.[29]
- ◊ A corridor or galley kitchen may be preferred by wheelchair users who are able to reach and bend easily.[4]
- ◊ Wheelchair users generally use a greater number of work saving devices, such as small appliances, than the average kitchen is designed for. Provide extra storage space, extra power points, and electrical lines with greater wattage to support these devices.[4]

• Storage: (See also: Cabinetry) Storage spaces influence safety, task speed, amount of movement needed, and organization of meal preparation activities. Each work area should have a storage space.

- ◊ Providing sufficient and accessible kitchen storage is often a problem because the reach range of a wheelchair user is limited. The design must maximize storage opportunities and consider storage alternatives such as pantries (roll-out, wheel-in), locating general storage space near the kitchen to act as a kitchen storage overflow, etc.[4]

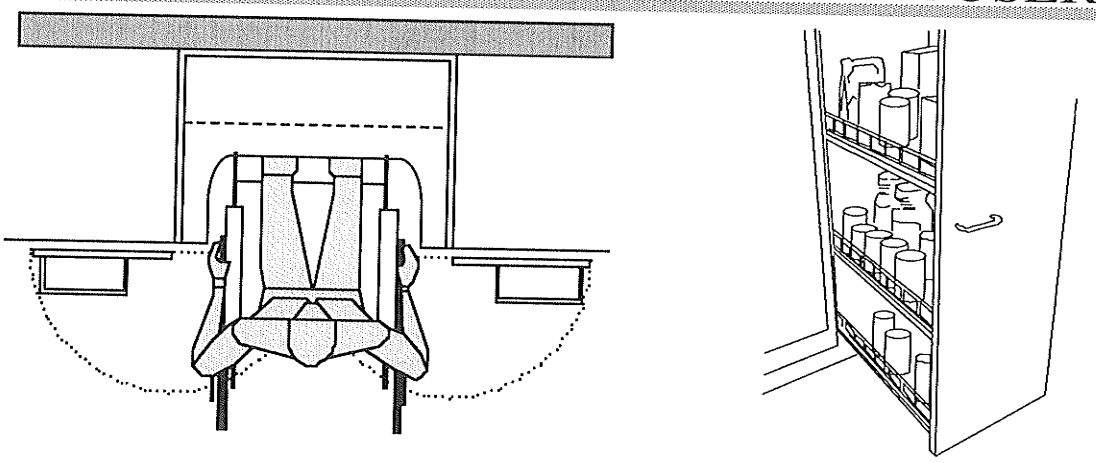


Figure 8.24: Alternative Pantries, Partial Wheel-in and Pull-out

Minimize Travel Through Residence

- Create storage opportunities near areas of use, e.g.: storage for dishes and cutlery near the sink, storage for large pots and pans near the cooking facilities, etc.[29]
- An informal dining area should be located in the kitchen.[30]
- A telephone should be located in the kitchen.[30]
- A storage trolley should be provided to allow a wheelchair user to cart heavy or hot items. The trolley may be designed so that it can be parked under a work surface then pulled out when that space is required for knee space.[31]

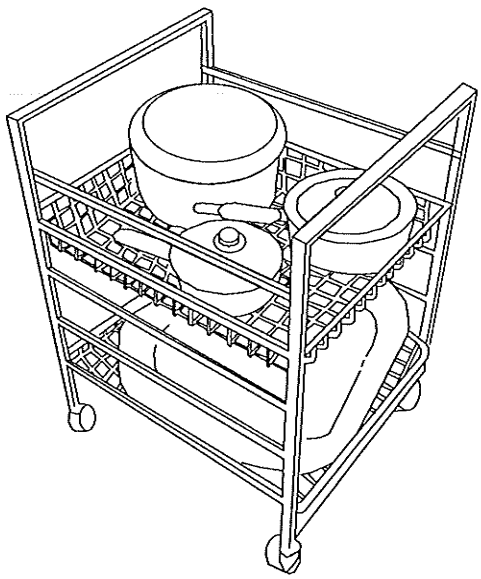


Figure 8.25: Storage Trolley

Ease of Operation and Manipulation

- Task lighting should be provided above all major work areas.[4]
- Furniture should be light and easy to move.[4]

Safety

- A person lying on the floor should be able to pull the phone to the floor in an emergency.[4]
- The kitchen towel bar should be able to bear the weight of a person supporting themselves on it.[1]

WORK SURFACES (COUNTERTOPS)

Accessibility

- The location and amount of work surfaces influences the organizational and time factors of mealtime activities. Work surface space should be designed so that minimal movement is required and so that a logical, efficient flow of tasks can be performed. Work space should be located near the cooking facilities, sink, and refrigerator. A minimal work space of 450mm (18") next to the opening side of the refrigerator door, 600mm (24") of heat-resistant surface to the left of the cooktop, and 900mm (36") to the right and 600mm (24") to the left of the sink is suggested. There should also be a place available to put dishes prior to serving meals.[29]
- Many kitchens lack an adequate amount of work space. Pull-out boards often provide sufficient workspace.[33] Provide at least one pull-out board at each work area.[3]

Minimize Barriers

- Work surfaces should be the same height for easy sliding of dishes and pans.[29]

Ease of Operation and Manipulation

- Power points should be reachable from a wheelchair, e.g.: at the front or side of a work surface, not at the back.[30]
- Pull-out boards are very effective for activities which require the user to bend over an object to get improved leverage, e.g.: cutting and mixing.[3] Pull-out boards may have apertures cut in them to help stabilize bowls.[34]

SINK

Accessibility

- There should be knee access under the sink. The sink drainage pipe should be located at the back of the sink.[29]
- The depth of the sink bowl shall be no greater than 165mm (6 1/2"). Only one bowl of double- or triple-bowl sinks need meet this requirement.[36]

Ease of Operation and Manipulation

- The faucet control levers should be easily operated with one hand. A faucet with single operation lever-type handles that control the water volume and temperature is recommended. The installation of a retractable hose with a faucet end can be helpful for filling pans away from the sink and rinsing large objects in the sink.[29]
- The faucet may be located at the side of one-bowl sinks for ease of access.[4]
- A dishwasher may be a helpful appliance for an individual who has difficulty washing and drying dishes.[29]
- People with coordination problems often find it difficult to operate the standard sink stopper.[4] A chain attached to a large flat rubber stopper is preferred.[1]

Safety

- There should be no sharp or abrasive surfaces under the sink. Hot water pipes and drain pipes under sinks should be insulated or otherwise covered.[29]

CABINETRY

Accessibility

- Shelves
  - ◊ Adjustable shelves are preferred because they allow the shelves to be placed at the optimal reaching zone of the user.[29]
  - ◊ Shelves should be narrow in depth. A depth of 100mm (4") for shelves allows items such as cans and boxes to be stored without having other items in front of them. This allows items to be easily located and facilitates reaching.[29]
  - ◊ Corner areas in kitchens can be wasted space. Shelves placed at a diagonal in the corner minimize reaching. Lazy Susans can also make corner space more usable.[29]
  - ◊ Shelves with vertical partitions can be used to store wide items such as pans and mixing bowls. This allows the cook to reach one item at a time without lifting or moving other items out of the way. Interval grooves allow the shelves to be placed at a desired width.[29]
- Upper Cabinetry:
  - ◊ Upper cabinetry generally are not very accessible for wheelchair users, provide pull-out and door-mounted storage which brings items forward to increase accessible space.[4]
  - ◊ Items should be placed in the front part of the cabinet shelves. A narrow board can be attached to the shelf to prevent items from being pushed back out of reach. The location of the board on the shelf will depend upon the optimal reach zone of the users.[29]

- Lower Cabinetry:
  - ◊ Minimize situations where the user must reach under and into cabinetry.[4]
  - ◊ Drawers are preferred to lower cabinets because they reduce bending and reaching.[29]
  - ◊ Side-hinged doors should open fully 180 degrees. The hinges and hinge connections should be strong enough to bear the weight of a person supporting themselves on the door.[3]
  - ◊ Wheelchair users may wish to remove undercounter cabinets so that there is adequate footrest and kneespace underneath the work surface.[29]
- Other Storage Options:
  - ◊ Storage bins on work surfaces may be used to provide additional storage that is within the user's reach zone.[29]
  - ◊ Wall racks and hanging hooks can be placed in most locations in the kitchen for additional storage of pans and utensils.[29]
  - ◊ One- or two-tiered lazy Susans are convenient storage devices that help move small items closer to the user. They may be used on shelves or in cabinets, refrigerators, and bathrooms.[29]
  - ◊ The storage trolley may be used for storage as well as transportation.[29]

Ease of Operation and Manipulation

- Provide D-shaped or lever handles on cabinetry.
- For people with coordination problems, maximize compartments within drawers and cabinets. Stored items are stabilized and thus easier to grab.[1]
- Upper Cabinetry:
  - ◊ Doors on upper cabinetry often are difficult to open from the wheelchair because the user can not get sufficient leverage to pull the door open, place handles on upper cabinetry near the bottom of the doors or use a push-release mechanism.[3]

- Lower Cabinetry:
  - ◊ Place handles on lower cabinetry near the top of the door/drawer to reduce bending and reaching.[32]
  - ◊ Drawers and pull-out devices should be on easy-gliding, full-extension glides. There should be an end stop to prevent the drawer or pull-out device from being accidentally pulled out.[1]

COOKING FACILITIES

Accessibility

- Stoves and ovens should be evaluated carefully as these appliances greatly affect safety, speed of preparation, quality of food, and amount of cleanup needed.[29]
- A cooktop/wall oven arrangement is preferred to a conventional range because the conventional range's cooking elements are normally too high for a wheelchair user to reach and the controls are difficult and dangerous to reach.[37]
- Controls should be accessible. Cooktop controls may be located on or near the front of the cooktop to eliminate the need to reach over or between hot burners and steaming posts to adjust the temperature.[37] Controls located to the side of the cooktop are a secondary option because they may cause spills when pots are slide along the cooktop.[1] Controls for a wall oven should be located below the door for easy access.[1] Range hood controls may be located on the lower front panel of the hood to reduce the reach distance required to operate them. It is preferable that stove hood controls be located on the stove control panel or in the face panel of nearby base cabinets just below the work surface.[37]
- Oven:
  - ◊ Side-hinged oven doors are best for many people because they allow the user to get closer to the oven and thus require less reaching or bending while moving hot pans.[40]

- ◊ If a wheelchair user does not favour a parallel approach to a wall oven a kneespace adjacent to the appliance may be necessary. A kneespace below an oven is not recommended because of the danger due to hot spills.[33]
- ◊ A wall oven with a side-opening door and heat resistant, pull-out shelf below often is more accessible than a drop-down door wall oven. But, side-opening door wall ovens tend not to be as well insulated as drop-down door wall ovens and individuals may burn themselves on the side-opening oven door. Also, self-cleaning side-opening ovens are difficult to find. Individuals may become injured while cleaning conventional side-opening ovens. In an emergency a drop-down door wall oven allows a surface to place hot items. When choosing a wall oven one may need to look at the trade-offs for each wall type.[1]

Ease of Operation and Manipulation

- Controls should be large, easy to operate, and reachable from the seated position. A positive "click" or sensation should occur upon return to the "off" position and each control should have a pilot light to indicate when "on". [38]
- A microwave oven can have many advantages for a person in a wheelchair, e.g.: speeds up the cooking process.[38]
- Cooktop:
  - ◊ Cooktops and heating elements should be flush with adjacent work surfaces to assist in sliding objects.[39]
- Oven:
  - ◊ The oven should be placed so that the most often used shelf is located level with the adjacent work surface.[3]
  - ◊ Wall ovens with side-hinge doors should have a shelf or pull-out board below. The shelf should be approximately 250mm (10") wide and extend the full width of the

oven or greater. This shelf can be used when needed for transferring hot pans.[40]

◊ Oven shelves should be pull-out, non-tipping and have a stop.[1]

Minimize Maintenance

- Cooktop:
  - ◊ Sealed heating elements are preferred because they are easy to clean but present a raised profile which may be an obstacle and cause tipping.[39]
- Oven:
  - ◊ A self-cleaning oven is preferred.[29]

Safety

- It is generally considered safer to have an electric cooking device rather than a gas one because of the open flames of the gas cooking device.[29]
- Cooktop:
  - ◊ Heating elements should be arranged in a half-moon or staggered layout to avoid reaching over hot surfaces to access rear heating elements.[29]

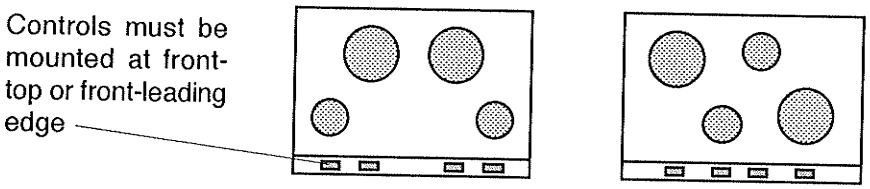


Figure 8.26: Recommended Cooktop Element Arrangement

◊ A kneespace under a cooktop is not recommended because of the danger due to spills and the risk of burns from the underside of the cooktop. If the wheelchair user does not favour a parallel approach, provide kneespace beside the cooktop.[33]

REFRIGERATOR

Accessibility

- A compact refrigerator may be more accessible for wheelchair users because the shelves and controls are easy to reach. Compact refrigerators should not be placed on the floor as this height is inconvenient for most individuals.[29]
- Refrigerator doors should open so that the door does not interfere with the pathway or movement of the users. The door should open away from the line of approach and, if possible, away form the sink, stove and work surface. The door should open so that the individual can remove objects from the refrigerator and easily place them on an adjacent work surface. [29]
- A space next to the opening side of the refrigerator is desirable for wheelchair users so that a side approach is possible. This may be a clear space under a work surface.[29]
- If the wheelchair user approaches the refrigerator from a side position the door should open 180 degrees.[29]
- Side-by-side refrigerator-freezers are preferred by wheelchair users, however, the doors open from the middle, which may cause approach and mobility difficulties.[29]
- Both the light and the temperature controls should be at the front of the refrigerator for easy access.[29]

Ease of Operation and Manipulation

- The door handle should be one which is easy to grasp and open, a long D-shaped handle which allows the entire hand to be used in the opening is preferred.[29]
- Conveniences such as ice makers and external cold water spouts can be very helpful. Units with these attachments require a plumbing hook-up.[29]
- Shelves should be pull-out, non-tip. I may be helpful to place a lazy Susan on the shelves to minimize the need for reaching.[41]

- Door storage capacity is very important because items stored in the door are easy to access from a wheelchair, however the deeper the door storage the further the user must reach into the refrigerator.[1]

Minimize Maintenance

- Frost-free and automatic de-frost refrigerators are a great advantage.[41]

DESIGN RECOMMENDATIONS FOR BUILDING COMPONENTS SPECIFIC TO BATHROOMS

GENERAL PLANNING AND ORGANIZATION

Accessibility

- The most important consideration in space planning of a minimal sized accessible bathroom is that the water closet must be located parallel and adjacent to an uninterrupted wall so that a grab bar of adequate length can be installed.[9]
- Side-hinged bathroom doors should open out so that if someone falls behind the door, one can still open the door. A side benefit of the out-swinging door is that space within the bathroom can be kept to a minimum, because less space is needed on the push side of the door than the pull side, and the door swing will not interfere with bathroom fixtures.[43] If an out-swinging door is used place the door so that it does not swing into areas where people normally walk or stand (see page 194).[4]

Minimize Travel Through Residence

- A second bathroom off the bedroom or a private entry to the main bathroom from the bedroom is preferred. The second bathroom or entry is required to ensure privacy because many wheelchair users prefer to combine personal hygiene and dressing duties into one activity.[4]
- A storage closet for towels and other related bathroom articles should be located in the bathroom.[4]

Ease of Operation and Manipulation

- Provide a heat source in the washroom. The heat source is necessary to because it may take a long time for a wheelchair user to dress following a bath/shower. [4]
- The controls for the heat source should be at eye level. [4]

Safety

- A telephone jack should be provided in the bathroom.[44]
- The towel bar should be able to support the weight of a person.[1]

HANDBASIN

Accessibility

- There must be a kneespace under the handbasin.[46]
- The handbasin must be mounted so that the minimum distance between the centreline of the fixture and the side wall is 460mm (18").[45]
- There must be a clear floor space, 750mm (30") minimum wide by 1200mm (48") minimum depth, that extends a maximum of 480mm (19") under the handbasin.[45]

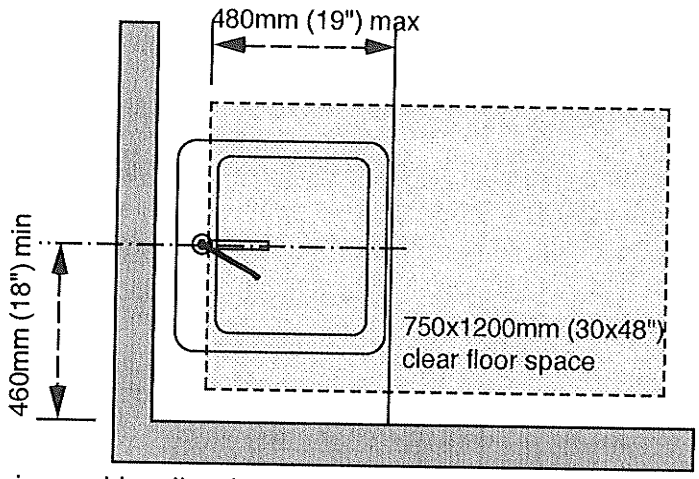


Figure 8.27: Minimum Handbasin Maneuvering Space.

- The sink depth should be no greater than 165mm (6 1/2"). The drain pipes should be in the back and should be wrapped or protected so that hot pipes or sharp edges will not harm legs.[42]
- The mirror must be mounted no higher than 1000mm (40") off the floor.[46]
- Lower cabinetry (see recommendations under kitchen cabinetry)

Ease of Operation and Manipulation

- Handbasins with an adjacent work surface are preferred for personal accessories.[47]
- Faucets must be able to operate without gripping or twisting. Tap handles of a lever or capstan type with a quarter-turn operation are preferred.[47]
- It is beneficial if the handbasin is accessible while sitting on the watercloset.[4]
- It is beneficial if the handheld shower hose able to reach the sink.[4]

MEDICINE CABINET

Accessibility

- Medicine cabinets should be installed so that the bottom edge of the cabinet is 50mm (2") above the sink height. D-shaped handles can be mounted on the door to make opening and closing it easier.[42]
- The use of shelves, pegboards and hooks mounted to the wall near the handbasin can be an alternative to medicine cabinets. These open storage adaptations will be unacceptable for storage of medicines and potentially harmful items in households with family members who do not understand the danger of these products.[42]

WATER CLOSET

Accessibility

- Water closets for use by wheelchair users are best located in a corner where the wall behind and beside the fixture can be reinforced, and grab bars can be mounted if they are needed. To provide space for a person's shoulders 460mm (18") of clearance should be allowed between the centre line of the water closet and the side wall.[48]
- There should be ample clear floor space in front and beside the water closet fixture to allow a person using an wheelchair to maneuver, approach the seat, and make a safe transfer.[48]

- The amount of maneuvering space varies depending upon the direction of approach to the water closet.[48]

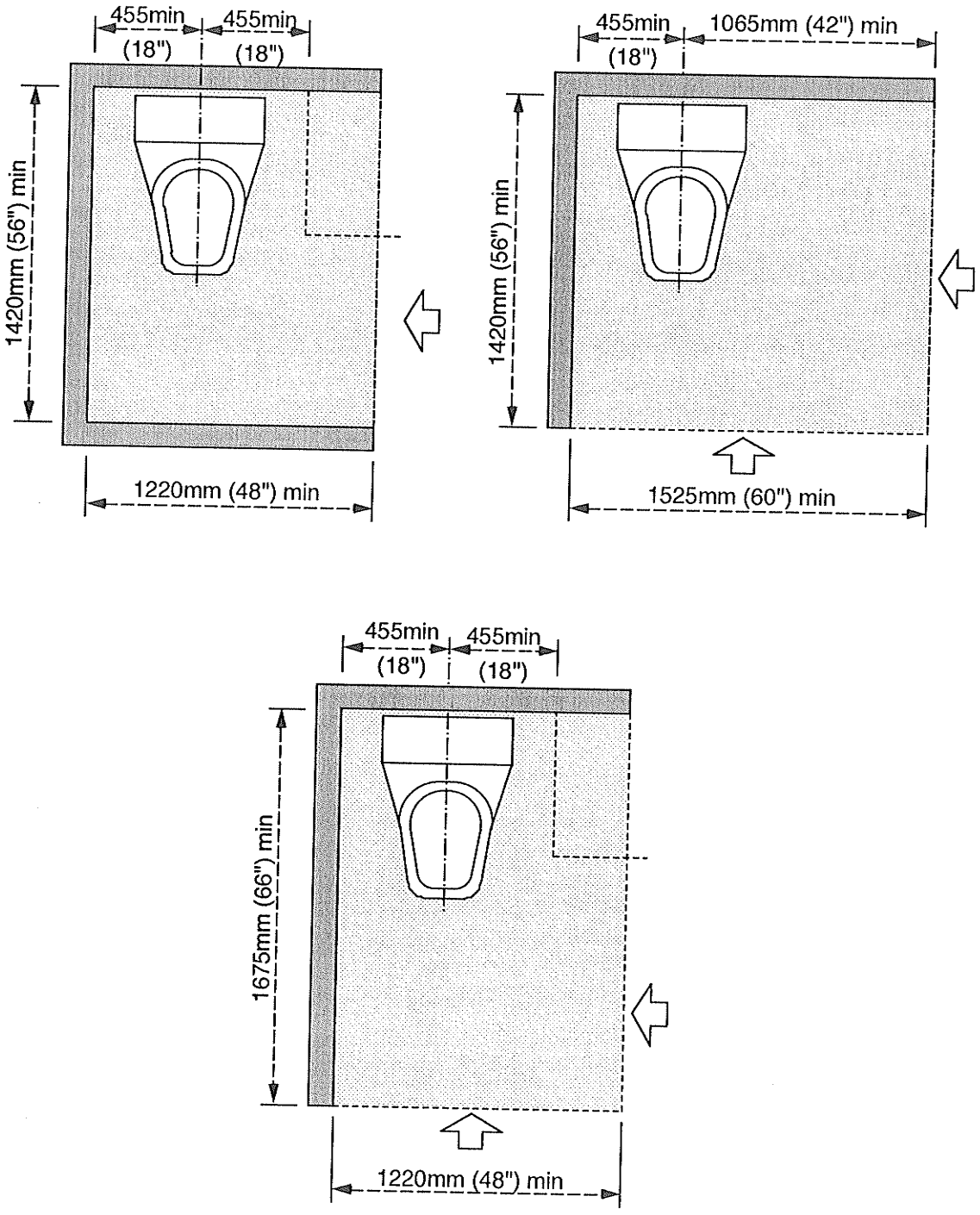
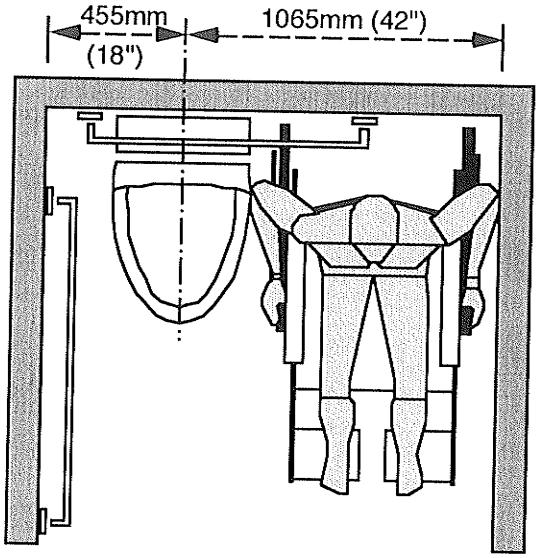
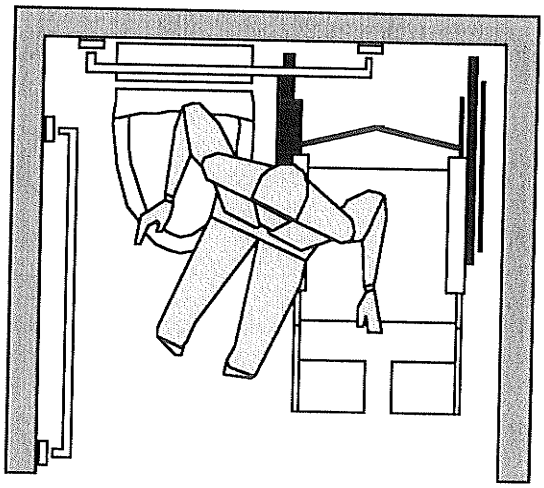


Figure 8.28: Minimum Water Closet Maneuvering Space

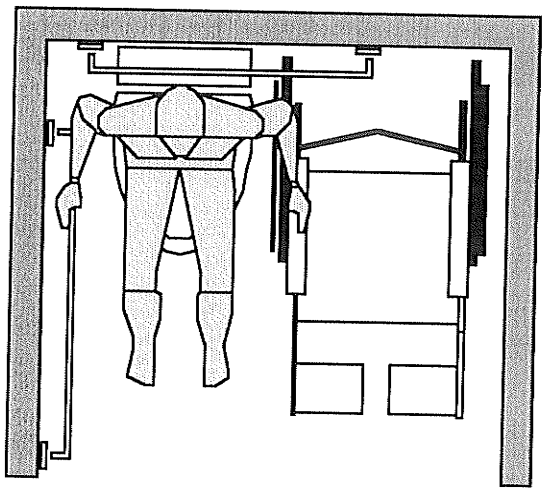
- Some people can transfer to and from the water closet from only one side. Others can complete right, left, or front transfers. The technique used depends on which approach is familiar, easier, and safest to complete. Whenever possible, it is best to position the water closet to allow both front and side transfers.[48]



1 Wheelchair user takes transfer position, removes armrest, sets breaks.

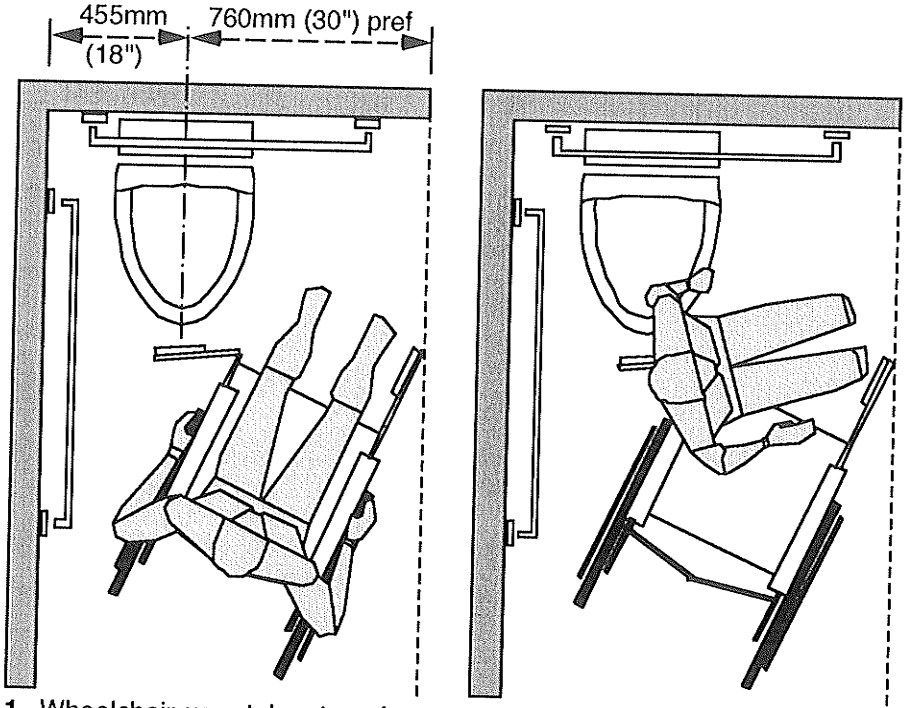


2 User lifts, slides onto w.c. seat.



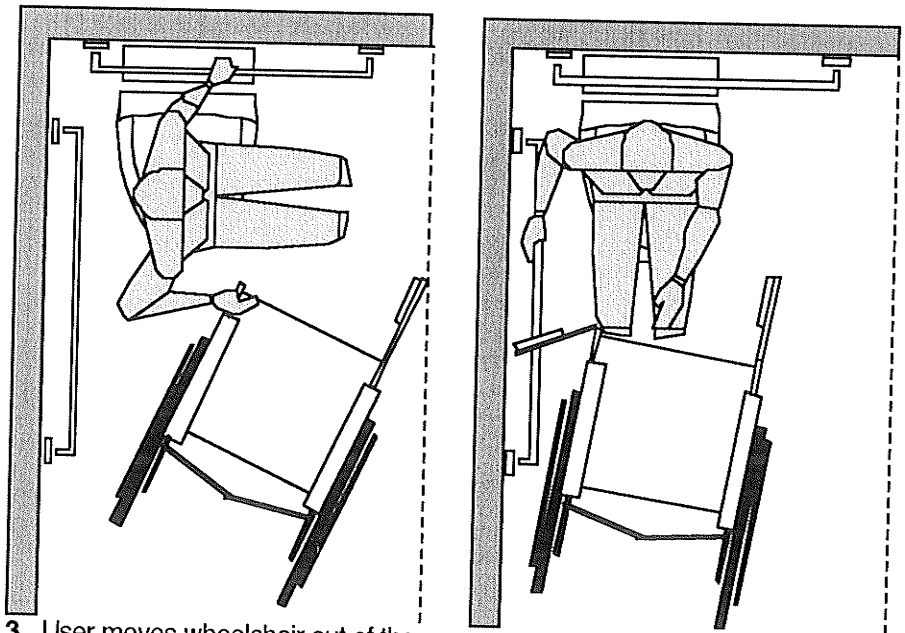
3 Positions self on w.c. Body stability is maintained by grasping grab bar and seat of chair.

Figure 8.29: Wheelchair Water Closet Transfer, Parallel Approach



1 Wheelchair user takes transfer position, swings footrest to side for clearance, sets brakes.

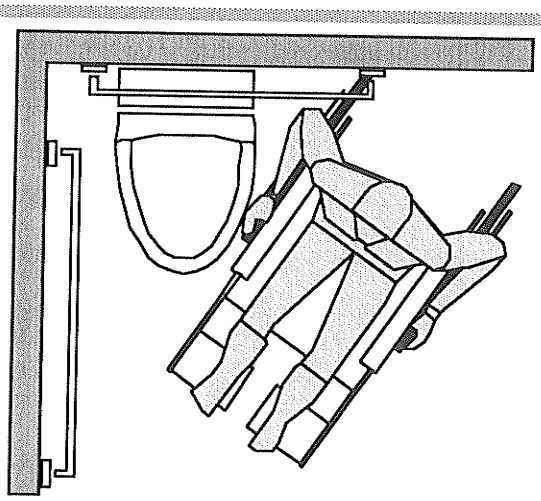
2 Removes armrest, user lifts, slides and rotates onto w.c. seat.



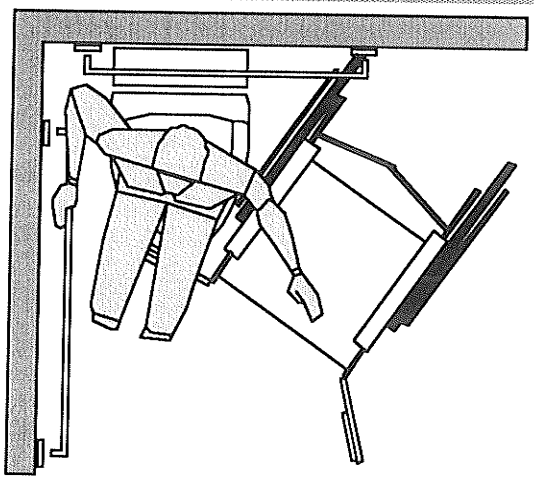
3 User moves wheelchair out of the way. Changes position (some people fold chair or pivot it 90° to the w.c.).

4 User positions self on w.c. seat, releases brakes. Body stability is maintained by grasping grab bar.

Figure 8.30: Wheelchair Water Closet Transfer, Reverse Diagonal Approach

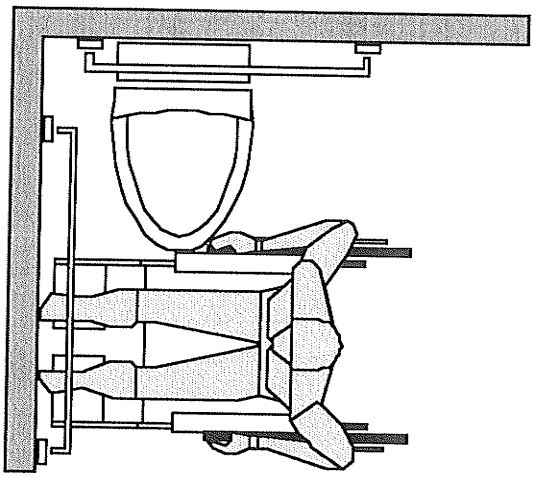


1 The user parks at a comfortable angle with the chair seat against the w.c.

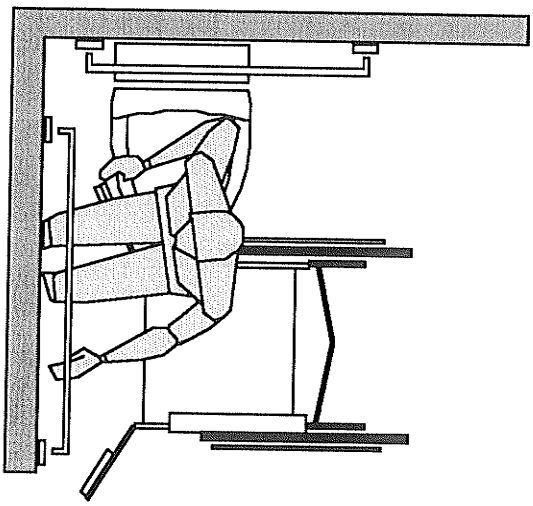


2 After swinging the footrests out of the way and possibly removing the armrests, the user makes a sliding transfer using the grab bars and chair for support.

Figure 8.31: Wheelchair Water Closet Transfer, Diagonal Approach.



1 The user positions their chair at 90 degree angle to the w.c., locating the wheelchair seat as close as possible to the w.c. seat.



2 After removing one armrest and using the grab bar and toilet for support, the user makes a sliding and pivoting transfer onto the w.c. seat.

Figure 8.32: Wheelchair Water Closet Transfer, Perpendicular Approach

- The height of a water closet seat can radically affect the use of the fixture by a wheelchair user.[48] Wheelchair users need a water closet height that is close to the height of the wheelchair seat.[42] As a general rule, 460mm (18") max. is a good height. This dimension is the same as most wheelchair seats[48] and can be achieved by adding an attachment onto a normal height watercloset.[4]
- The toilet paper dispenser should be located below the grab bar in line with the front of the toilet seat not less than 600mm (24") from the floor.[50]

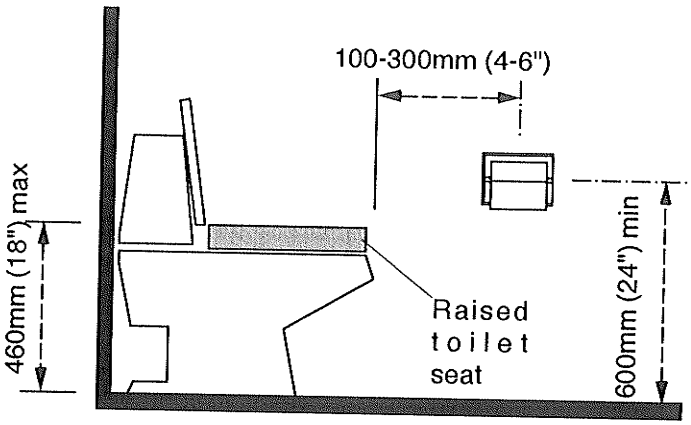


Figure 8.33: Wheelchair Water Closet Seat Height.

- Water closets should be equipped with horizontal grab bars, which should: be mounted on the side wall closet to the water closet extending from a point not more than 300mm (12") from the rear wall to at least 450mm (18") in front of the fixture's seat; be at least 600mm (24") long and be mounted on the wall behind the toilet; and, be mounted between 750-850mm (30-34") from the floor level.[50]

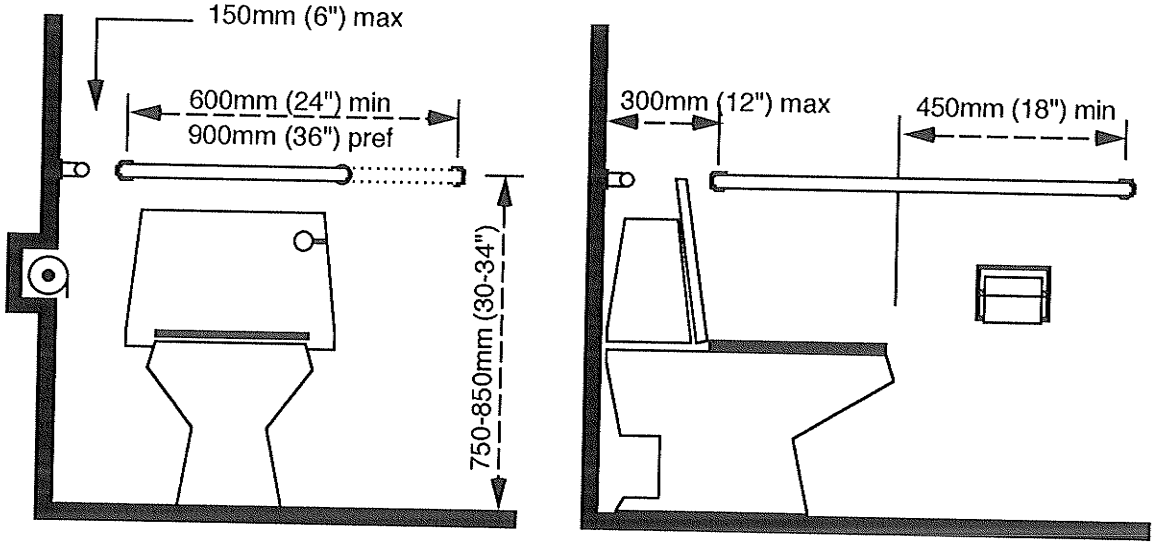


Figure 8.34: Wheelchair Water Closet Grab Bar Clearances.

- Where a vertical grab bar is installed, it should be located 250mm (9") in front of the water closet.[50]

Ease of Operation and Manipulation

- A watercloset should have a back rest. A backrest is very important for people with poor balance.[4]
- The water closet flush control should be easy to operate.[4] The control should be located on the open side of the watercloset, not adjacent to a wall.[4]
- The handbasin should be accessible while being seated on the watercloset.[4]

BATHTUB AND SHOWER

Accessibility

- There must be sufficient maneuvering space adjacent to the bathtub and shower to allow for easy access.
  - ◊ A clear floor space at least 750mm (30") wide shall be provided in front of the bathtub. The washbasin can encroach a maximum of 300mm (12") into this floor space, providing there is clear knee and toe space under the washbasin. [53]

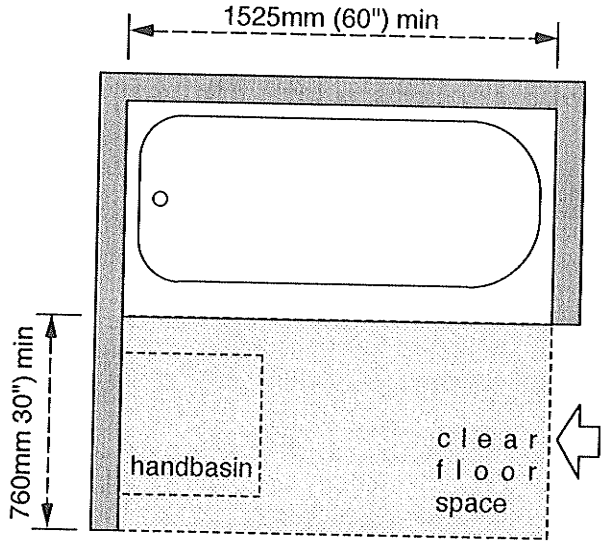


Figure 8.35a: Wheelchair Bathtub, Minimum Maneuvering Space

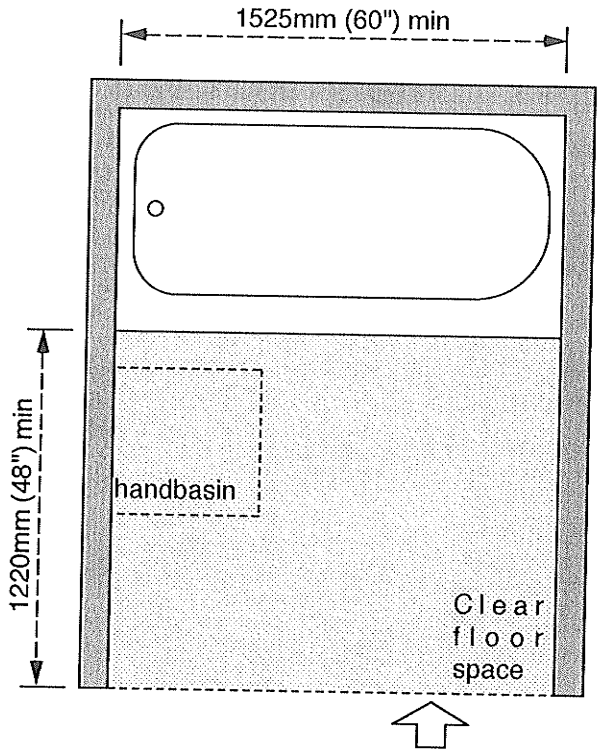


Figure 8.35b: Wheelchair Bathtub, Minimum Maneuvering Space

◊ The minimum clear floor space in front of the shower entrance shall be 900x1200mm (36x48") with the 1200mm (48") dimension parallel to the shower entrance, starting from the stall wall opposite the seat where a seat is provided.[52]

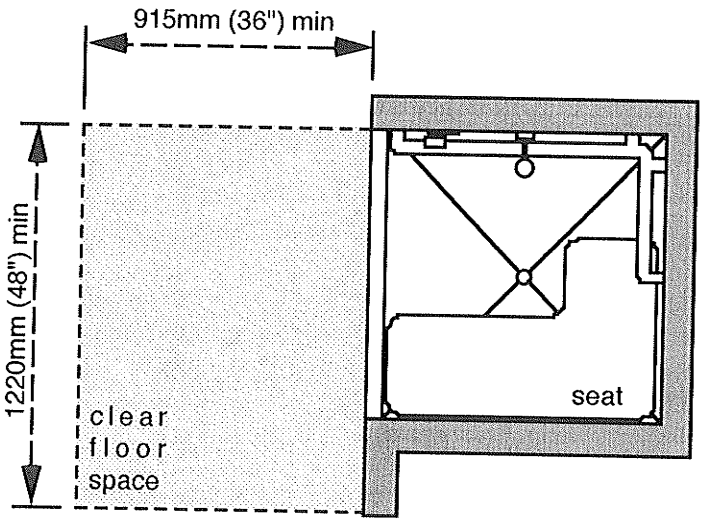
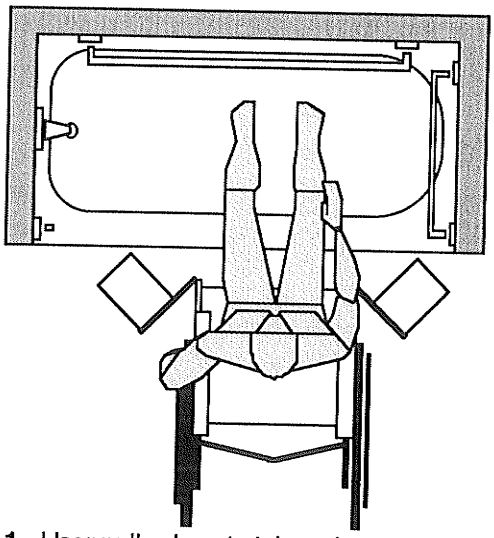
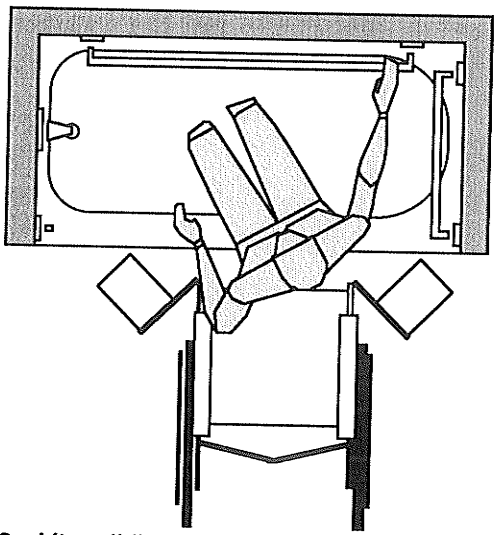


Figure 8.36: Wheelchair Shower, Minimum Maneuvering Space

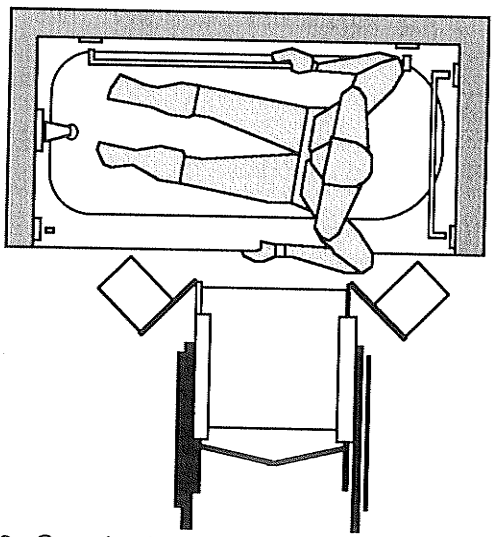
- Some people who use wheelchairs can transfer from their chairs and get down into the tub independently. For transfers, the tub may need grab bars on one, two, or all three of the enclosing walls and enough clear floor space in front to allow a front or parallel approach.[58]



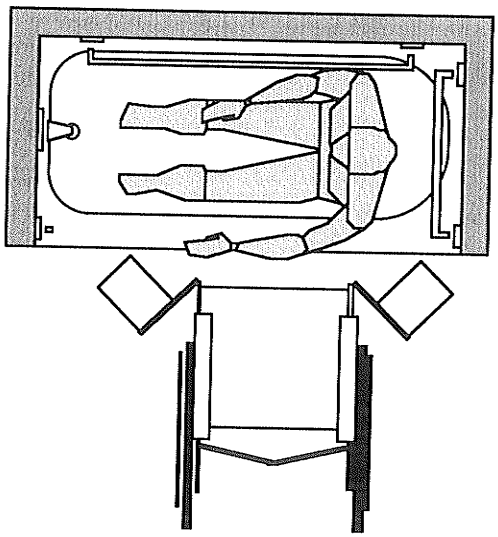
1 User pulls close to tub, swings footrests to side, lifts legs over tub rim, and pulls chair tight to wall of tub.



2 After sliding forward in chair and onto the tub rim, the user reaches for a grab bar in preparation for transferring.



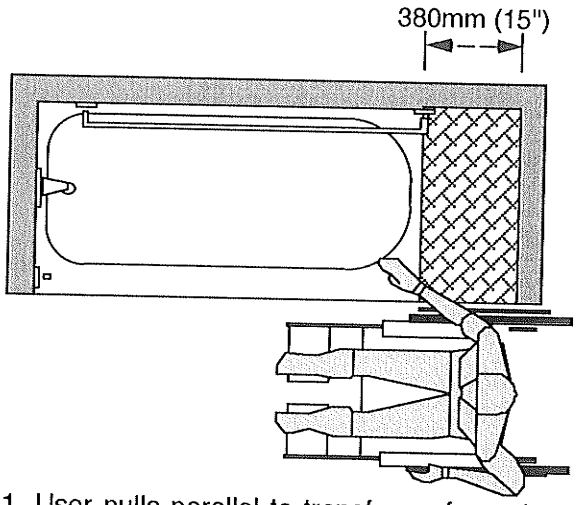
3 Grasping both the tub rim and the grab bar on the back wall, the user slides off the tub rim and lowers self into the water—



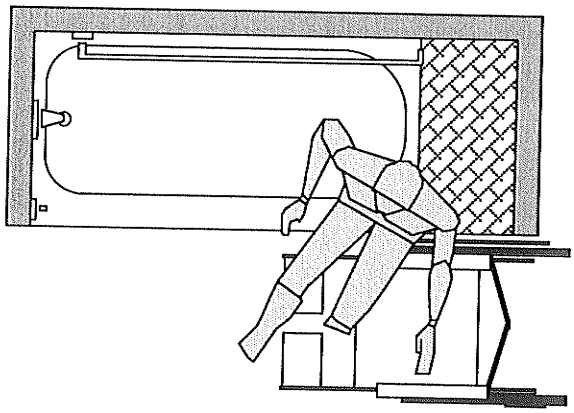
4 for a relaxing bath!

Figure 8.37: Wheelchair Bathtub Transfer, Forward Approach

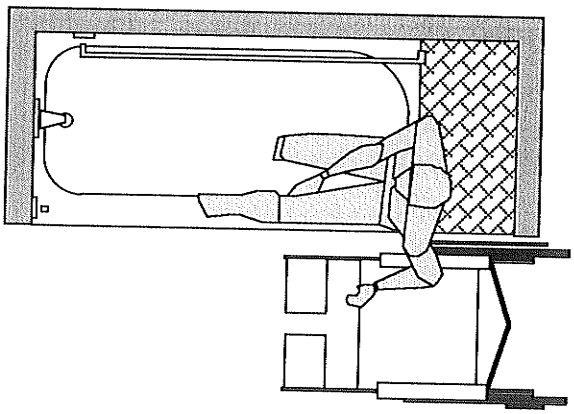
- For people with strength and coordination problems a 380mm (15") seat at the head of the bathtub can facilitate transfers into the bathtub.[3]



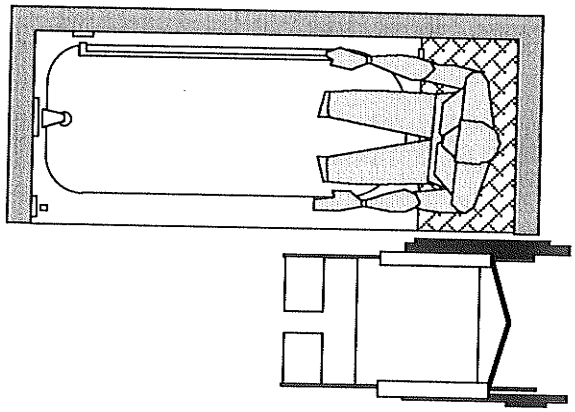
1. User pulls parallel to transfer surface at head of tub, removes arm rest, and holding onto wheelchair begins to slide over onto the transfer surface,`



2. Once securely in position, the user lifts their legs, one at a time, over the tub rim,



3. And places them into the tub.



4. Gripping the grab bar and the wheelchair for support, the user slides forward on the transfer surface. Using the grab bar and the tub rim, the user lowers themself into the water—for a relaxing bath.

Figure 8.38: Wheelchair Bathtub Transfer, Parallel Approach with a Transfer Surface

- Faucets should have single mixing control and be easy to use and access.[42] The faucet should have a pressure and temperature control device.[1]
  - ◊ Bathtub controls should: be located at the foot end of the bathtub between the centreline of the bathtub and the clear floor space; and, be not more than 450mm (18") from the bathtub rim. The controls should be accessible from out side the bathtub.[52]

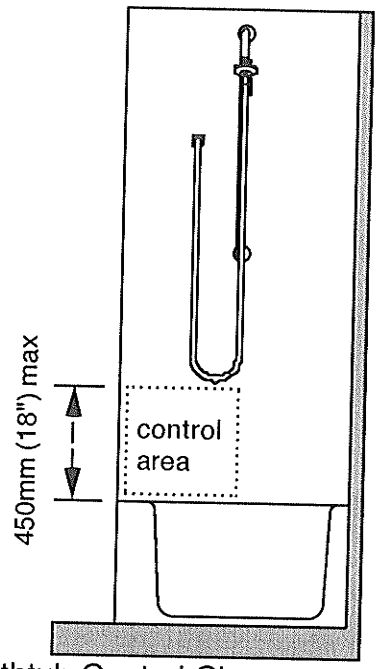


Figure 8.39: Wheelchair Bathtub Control Clearances

  - ◊ For shower stalls with a seat, all controls, faucets, and the shower unit should be mounted on the wall opposite the seat not more than 1200mm (48") from the floor, and accessible from outside the stall.[55]

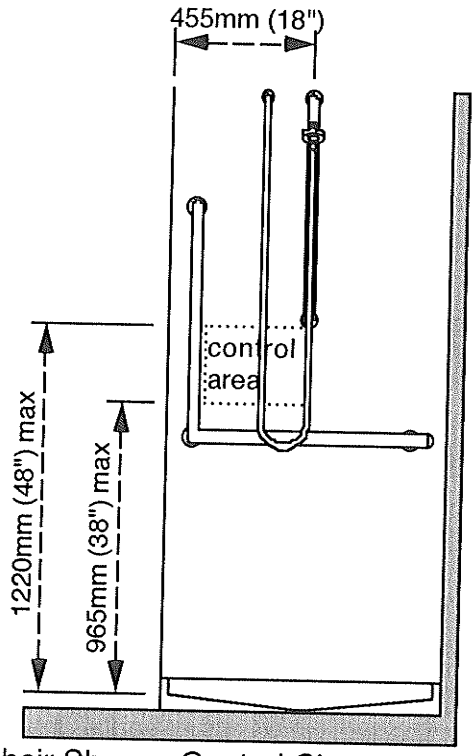


Figure 8.40: Wheelchair Shower Control Clearances

- Grab bars are needed on the side, front, and back tub and shower walls. [42]
  - ◊ Bathtub grab bars should: be at least 1200mm (48") long, located horizontally along the length of the bathtub, 180-280mm (7-11") above the bathtub rim; and, be at least 1200mm (48") long, located vertically at the foot end of the bathtub adjacent to the clear floor space, with the lower end between 180-280mm (7-11") above the bathtub rim. Care should be taken that the vertical grab bar does not interfere with the shower curtain.[52]

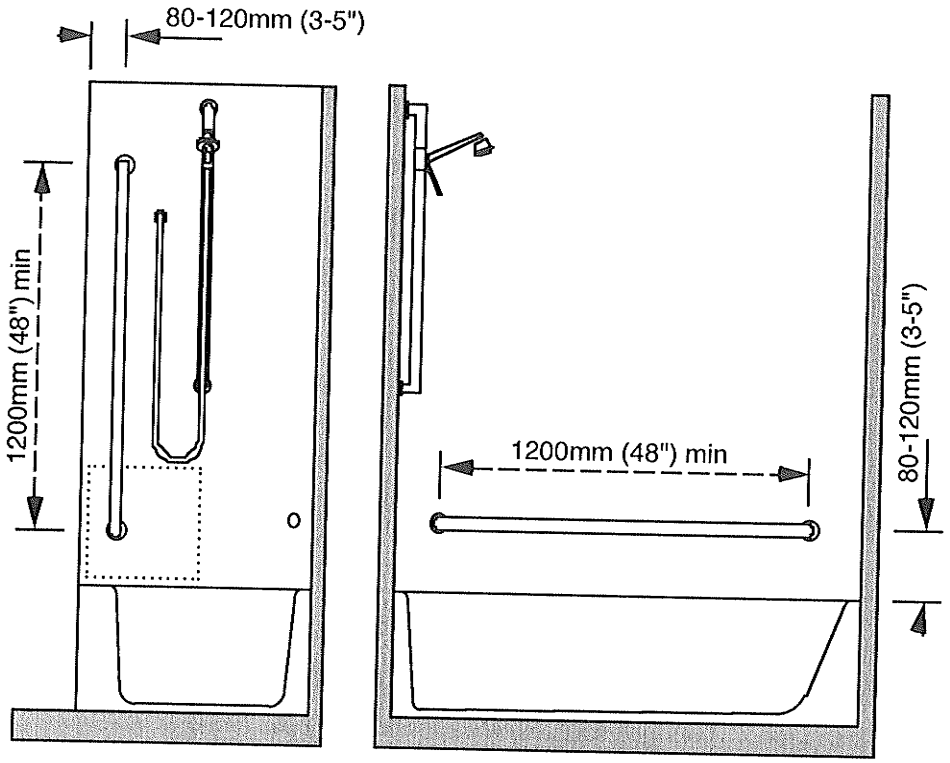


Figure 8.41: Wheelchair Bathtub Grab Bar Clearances

  - ◊ Grab bars in shower stalls with a seat should have one grab bar at least 750mm (30") long installed horizontally on the back wall between 700-800mm (28-31") from the shower floor, and have another grab bar at least 750mm (30") long installed vertically 80-120mm (3-5") from the front edge starting between 700-800mm (28-31") from the floor.[54]

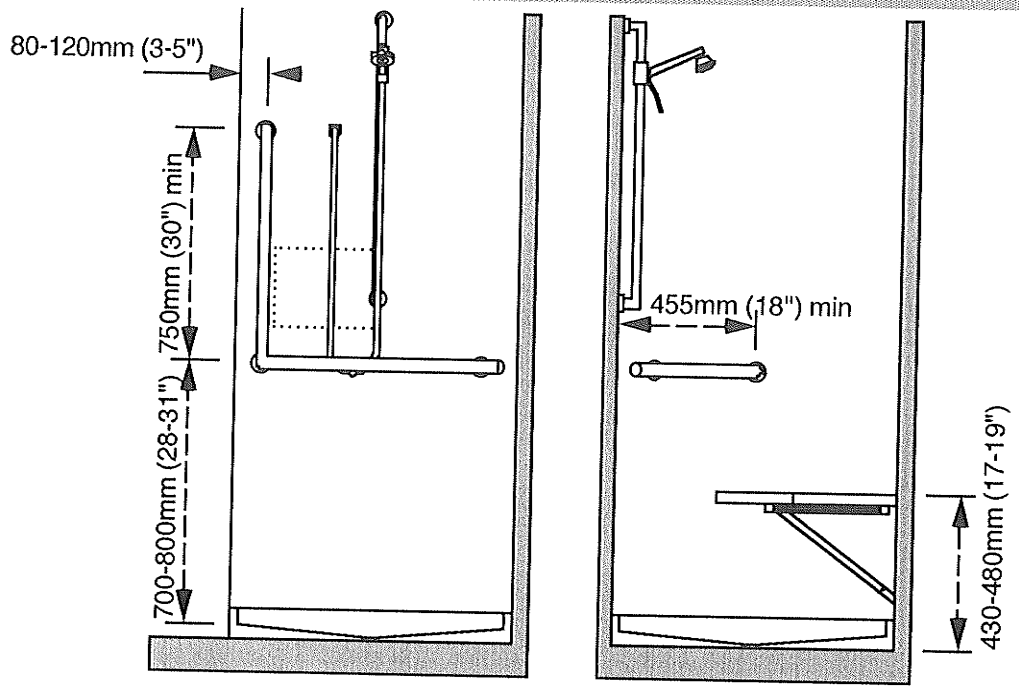


Figure 8.42: Wheelchair Shower Grab Bar Clearances

- A chair or seat should be provided to make mobility easier and safer in the bathtub and shower.[42]
  - ◊ In a shower stall the seat should be on the wall opposite the controls, be a minimum of 400mm (16") wide extending the full depth of the stall, and have its top 430-480mm (17-19") from the floor.[51]

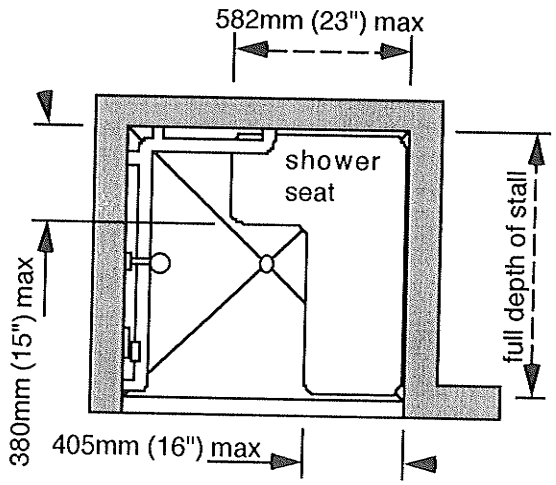


Figure 8.43: Shower Seat Preferred Design

- Bathtub enclosures should not obstruct the controls, not interfere with a person transferring from a wheelchair, and not have tracks mounted on the bathtub rim.[55]
  - ◊ Sliding doors should be removed as they block transfers into the tub and since they are not very sturdy, may present a safety risk.[42]

Minimize Barriers

- Eliminating the curb in the shower makes transferring easier by allowing wheelchair users to get closer to the seat and even to roll into the stall if it equipped with a folding seat.[57]

Ease of Operation and Manipulation

- Flexible shower attachments which can be mounted on the wall at a desired height or held in the hand while sitting allow better control over water flow than traditional showers and bathtub faucets.[42] An on/off water control on the shower head is advantageous.[56]
- The flexible shower hose should be able to reach to the handbasin.[4]
- A seat at the head of the bathtub allows for easier transferring from a wheelchair to a bathtub.[3]

Safety

- Nonskid surfaces should be provided to help prevent slipping in the tub or shower.[42] However, paraplegic and quadriplegic individuals may find nonskid surfaces harmful.[4]
- The soap holder should be recessed to prevent injuries.[56]

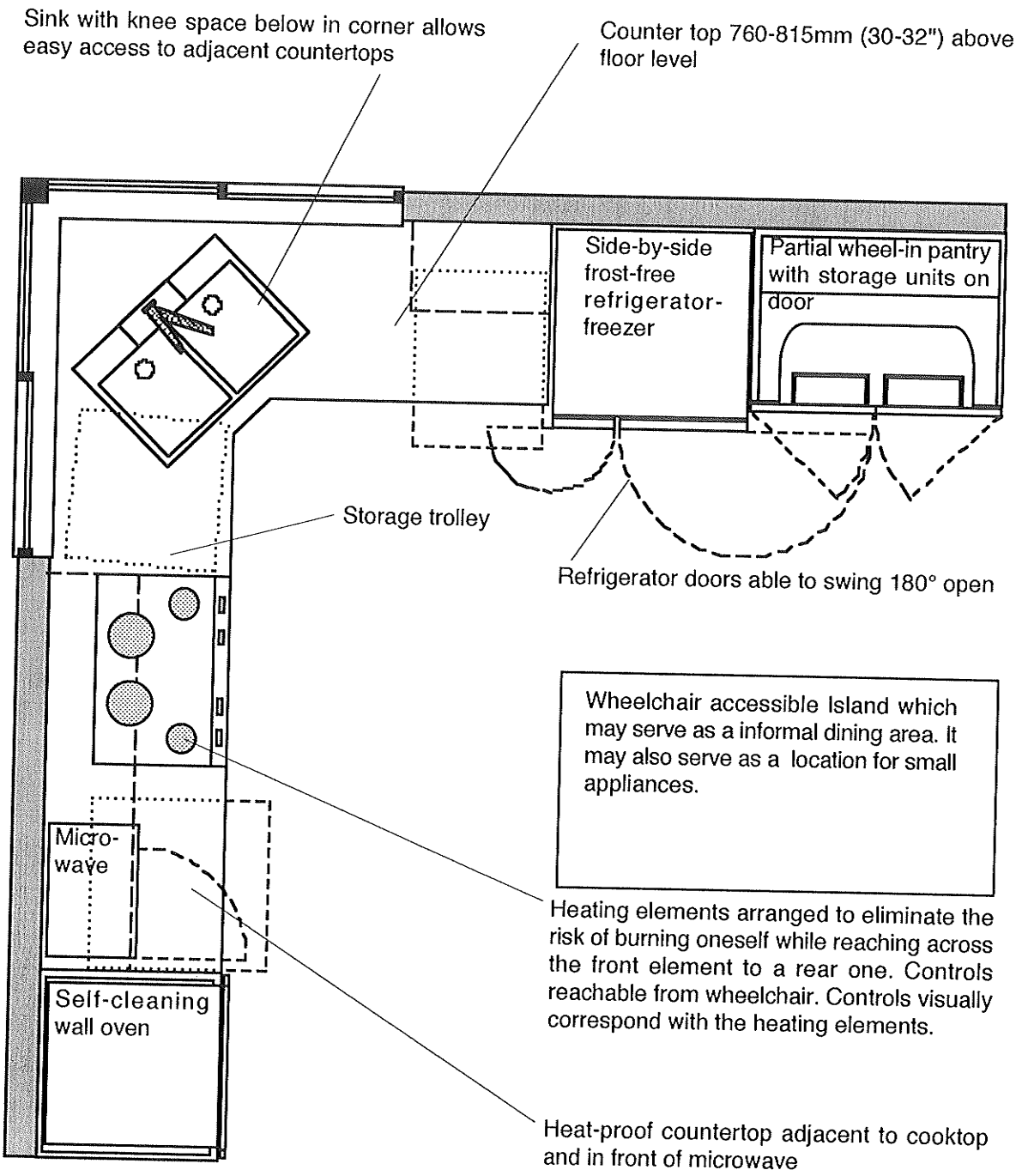


Figure 8.44: Wheelchair Kitchen Plan, Design Suggestions

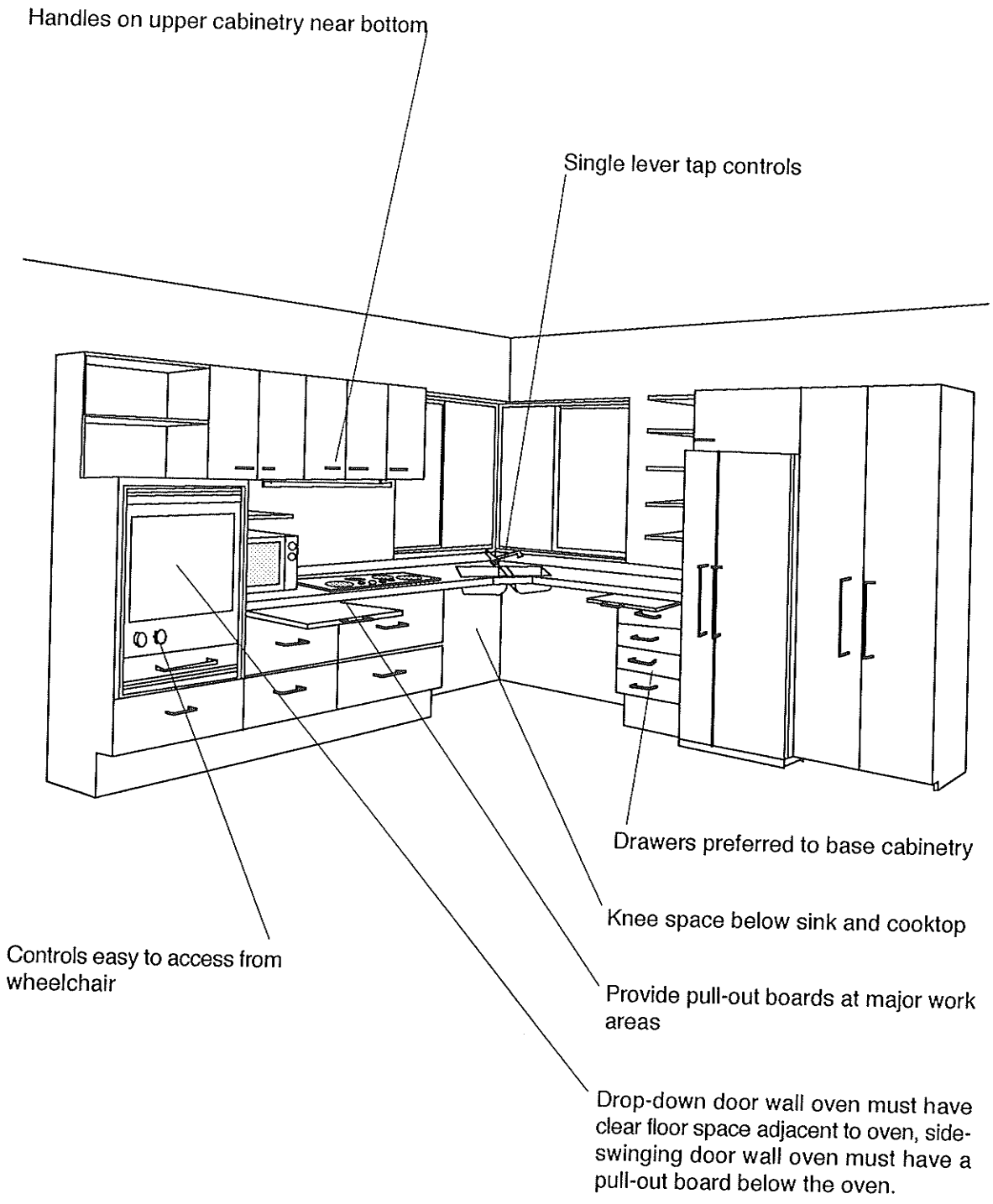


Figure 8.45: Wheelchair Kitchen, Design Suggestions

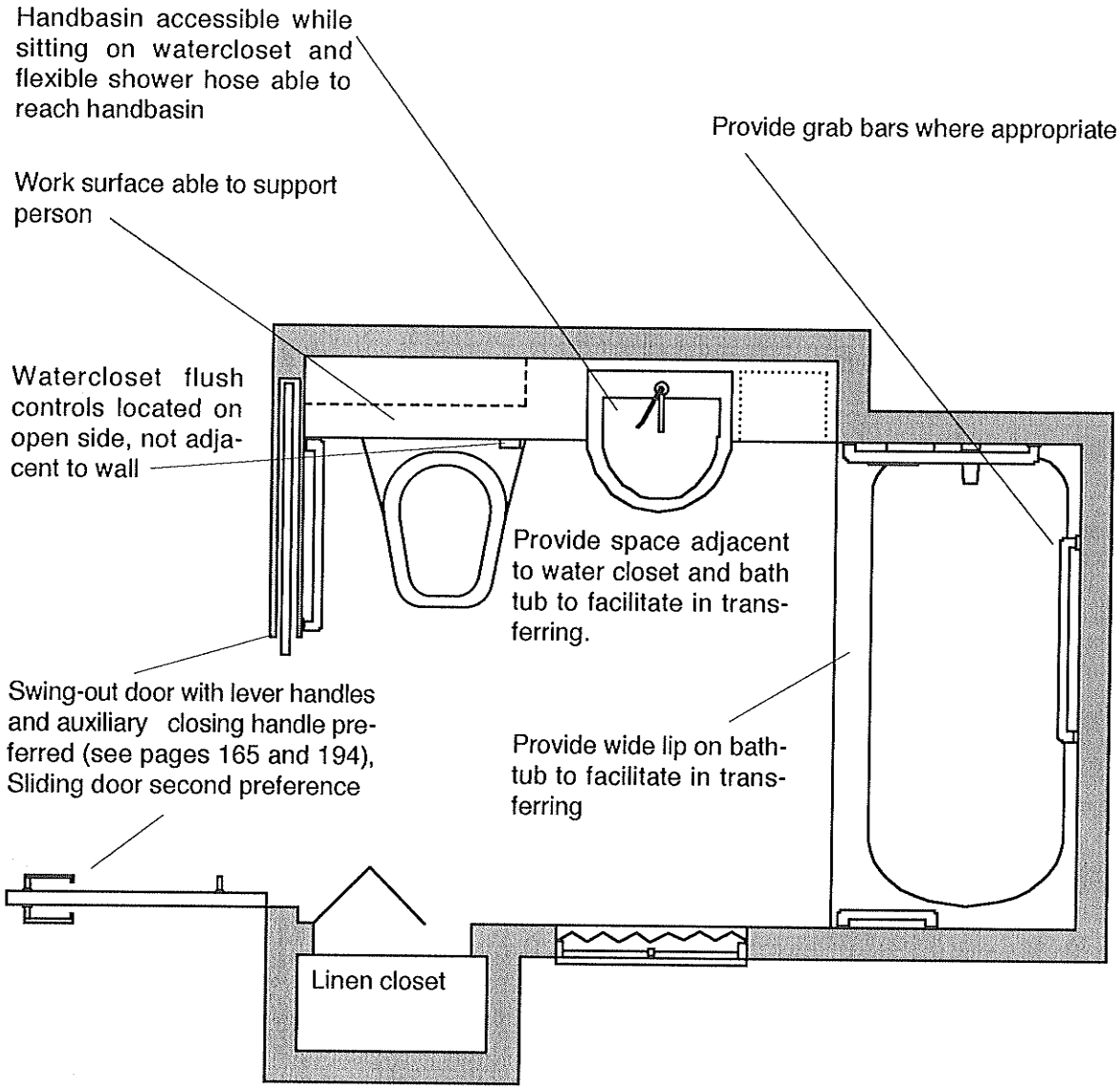


Figure 8.46: Wheelchair Bathroom Plan, Design Suggestions

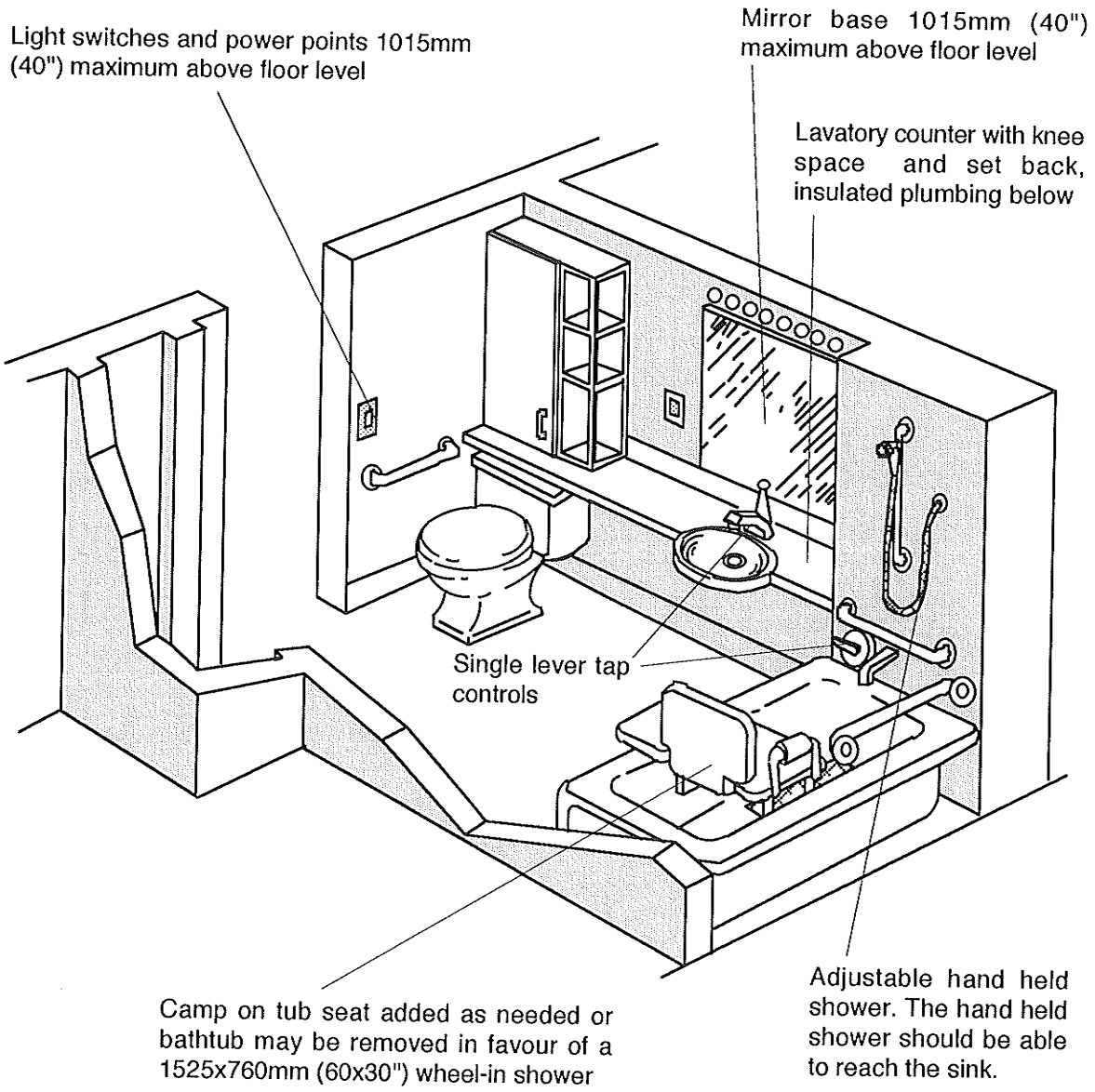


Figure 8.47: Wheelchair Bathroom, Design Suggestions

1 Donna Collins, May, 1992.
2 CSA 1990, 106.
3 Don Ament, June, 1992.
4 John Lane, April, 1992.
5 Kelly 1987, 65.
6 Mace 1990, 108-110.
7 Steinfeld 1987, 321.
8 CSA 1990, 109.
9 Steinfeld 1987, 334.
10 Mace 1990, 111.
11 Mace 1990, 174.
12 Moakley 1987, 248.
13 Mace 1990, 197.
14 Koncelik 1987, 387-388.
15 CSA 1990, 103.
16 Pynoos et al. 1987, 299.
17 CMHC 1988b, 8.
18 Cochrane and Wilshere 1987.
19 Moos et al. 1987, 198.
20 CSA 1990, 81-82.
21 ANSI 1990, 32.
22 Barrier-Free Environments 1980, 31.
23 Kelly 1987, 42.
24 CSA 1990, 86.
25 Barrier-Free Environments 1980, 32.
26 Christiansen and Baum 1991, 715-717.
27 Kelly 1987, 77.
28 Christiansen and Baum 1991, 720-721.
29 Christiansen and Baum 1991, 723-731.
30 Aitkens and Finan 1987, Chapter 3, page 68-71.
31 Independent Living Centre, N.S.W. 1987a, 11.
32 Mace 1990, 118.
33 Kelly 1987,67-71.
34 Independent Living Centre, N.S.W. 1987a, 6.
35 CSA 1990, 97.
36 ANSI 1980, 58.
37 Mace 1990, 122.
38 Independent Living Centre, N.S.W. 1987a, 13.
39 Independent Living Centre, N.S.W. 1987a, 12.
40 Mace 1990, 126.
41 Independent Living Centre, N.S.W. 1987a, 14.
42 Christiansen and Baum 1991, 734-738.
43 Steinfeld 1987, 333.
44 Aitkens and Finan 1987, Chapter 3, page 66.
45 CSA 1990, 90.
46 Mace 1990, 171.
47 Independent Living Centre, N.S.W. 1987b, 12-13.
48 Mace 1990, 174-180.
49 CSA 1990, 96.
50 CSA 1990, 89.
51 CSA 1990, 94.
52 CSA 1990, 92.

[53] CSA 1990, 91.
[54] CSA 1990, 95.
[55] CSA 1990, 93.
[56] Independent Living Centre, N.S.W. 1987, 11.
[57] Mace 1990, 164.
[58] Mace 1990, 149.

CONCLUSIONS

GENERAL SUMMARY

The central focus of this thesis was to develop a reference manual containing design recommendations regarding the accessibility needs of six different disability groups in residential kitchen and bathroom environments. The six disability groups studied were low vision, blind, hard of hearing, deaf, wheelchair, and mobility aids. The research and related literature review focused on determining the critical issues designers must be aware of so that kitchens and bathrooms they design may be accessible and supportive for individuals with one of the above physical or sensory disabilities.

The ultimate aim of this research (in phases two and three) is to develop a prototypical universally accessible and adaptable kitchen and bathroom. This may lead to several prototypes because the needs of the various disability groups may conflict and not be resonably resolved in a single prototype.

ASSESSMENT and CONCLUSIONS

The recommendations presented in this thesis were developed from the literature review and from input by practising experts who have drawn upon their experience and training. The recommendations offer potentially viable solutions, but they have not been tested by objective research.

The investigation suggests that the design recommendations presented in this document be regarded as generalizations. This is because within each disability group there are many related or subordinate disability groups. These related or subordinate disability groups frequently require access solutions which have distinct and important differences when compared to the access solutions of the main disability group. For example, people with low vision generally see better in brightly lit environments, but people with cataracts see better in subdued light.

Related disability groups and their distinct access needs are presented in the "Disability Definition and Limitations" section for each of the six disability groups in this thesis. Additional distinct access needs are found in the recommendation sections for each disability group.

The recommendations in this thesis affect many stages of the design process: location and site analysis; master planning; schematic design studies; design development; preplanning production; plans, sections, elevations; details, schedules; and specifications. Due to the level of coordination needed to carry through these design recommendations in the building process, the design of residential kitchen and bathroom environments which are accessible to any one of the six disability types is a very difficult undertaking.

This thesis is valuable when designing for a client in the early stages of a degenerative auditory, mobility, or visual condition because the designer has the opportunity to compare the accessibility needs of related disability groups, e.g.: auditory–hard of hearing and deaf; mobility–mobility aids and wheelchair; and visual–low vision and blind. By comparing the accessibility needs at the early stages of a degenerative condition with the accessibility needs when the disability has progressed, the designer can anticipate future requirements and design an environment so that the client can remain in their residence.

When comparing the design recommendations of specific building components (e.g.: doors and doorways, cooking facilities, water closet) among the six disability groups it was found that recommendations fall into three categories: conflicting, parallel, or supportive.

Conflicting recommendations occur when two design recommendations disagree or are in opposition with each other, e.g.:

- Blind design group, Flooring: A change in flooring (texture and/or hardness) may act as a location cue indicating a change in functional use. Each room may be given a unique flooring surface to define it.
- Wheelchair design group, Flooring: Avoid changes in floor levels and floor surfaces. Very small level changes or ridges may be dangerous, e.g.: the bump caused by a change of floor surface may cause a wheelchair operator to spill liquid if they are carrying a container.

Parallel recommendations occur when two design recommendations are similar or identical, e.g.:

- Blind design group, Bath and Shower: The bathtub faucet should have a pressure and temperature control device.

- Wheelchair design group, Bath and Shower: The bathtub faucet should have a pressure and temperature control device.

Supportive recommendations occur when two design recommendation are neither conflicting nor parallel. Supportive recommendations generally help the public cope with the environment, e.g.:

- Blind design group, Doors and Doorways: The door opening device may be textured to indicate that the door leads to a potentially dangerous situation, e.g.: stairs.
- Doors must have hardware that is easy to operate and which does not require fine grasp. Lever-type handles are preferred because they can be operated by a single, non-precise movement. Lever-type door handles should have a curved or angled end to avoid snagging clothing.

IDENTIFICATION OF AREAS OF ADDITIONAL RESEARCH

In the literature review certain areas were identified as requiring further research or development. These include:

- Accessibility space requirements for electric wheelchairs and scooters, e.g.: turnaround space; maneuvering space; knee space; toe space.
- Additional information on the accessibility needs of individuals with auditory impairments (hard of hearing and deaf) in residential kitchen and bathroom environments.
- Additional information on the accessibility needs of individuals with visual impairments (low vision and blind) in residential bathroom environments.

Further research, by modelling or by construction, must be performed to objectively test this thesis' findings. By building a pilot kitchen and bathroom many of the recommendations outlined in this thesis could be tested by members of the six disability groups to determine the effectiveness of the recommendations.

UNIVERSALLY ACCESSIBLE DESIGN

In the introduction, a brief description outlined a possible approach to develop a universally accessible and adaptable kitchen and bathroom environment. The description listed some critical areas of research which need to be resolved before a universally accessible kitchen and bathroom could be designed. With regards to these critical areas, some relevant information regarding conflicting design recommendations and built-in features were identified in the course of the research of this thesis.

The following "conflicting design recommendations" and "built-in feature recommendations" are presented for consideration by individuals who wish to continue with phases two and three of this study.

CONFLICTING DESIGN RECOMMENDATIONS

Low Vision and Wheelchair

- Low vision individuals prefer electrical hardware, door hardware and work surfaces to be at a "normal" height. Wheelchair users prefer these items to be set at a "lower than normal" height.[1]
- Low vision individuals prefer some kitchen controls to be at eye level (microwave, wall oven). Wheelchair users likely would not be able to reach these controls.[2]
- Low vision and blind individuals prefer cooktop heating elements to be slightly raised. Other groups generally prefer the cooktop heating element to be flush with the adjacent surface.[1]

Blind and Mobility Aids

- Blind individuals prefer each room or major space be given a unique flooring surface. Mobility aid users prefer a single continuous flooring surface.[1]

Blind and Wheelchair

- Blind individuals prefer each room or major space be given a unique flooring surface. Wheelchair users prefer a single continuous flooring surface.[1]
- Blind individuals prefer electrical hardware (switches, power points, etc.), door hardware and work surfaces to be at a "normal" height. Wheelchair users prefer these items to be set at a "lower than normal" height.[1]
- Blind individuals prefer upper cabinetry doors to be lift-up flap, tambour, or roller blinds. Wheelchair users may not be able to operate these door types.[1]
- Blind and low vision individuals prefer cooktop heating elements to be slightly raised. Other groups generally prefer the cooktop heating element to be flush with the adjacent surface.[1]

Mobility Aids and others

- Mobility aid users prefer a water closet with a 455mm (18") high seat. Other groups generally prefer the water closet seat height to be lower. Some wheelchair users prefer a 455mm (18") water closet seat height. For these individuals install a raised toilet seat on a standard height water closet.

Wheelchair and others

- Wheelchair users prefer work surfaces to be designed for an individual operating from a sitting position. The other design groups generally prefer work surfaces to be designed for an individual operating from a standing position.
- Wheelchair users prefer grab bars to be horizontal to the ground. Ambulatory individuals prefer a sloping grab bar.[3]

Door Controversy

- In the mobility aids and wheelchair chapters a recommendation states side-hinged doors for the bathroom should swing out so that a person inside the bathroom can not accidently block the door if they fall. John Lane has remarked that an out-swinging door is more likely to be a danger than a benefit. That the risk of a person being struck and injured by an opening door greatly outweighs the benefit of ease of access to a person in need of assistance laying on the floor.

Open versus Closed Planning

- In the mobility aids and wheelchair chapters a recommendation states open planning arrangements are preferred. Hard of hearing individuals prefer closed planning arrangements.

BUILT-IN FEATURES (making environments adaptive to different users)

- The kitchen countertop and cabinetry should be height adjustable, either manually or mechanically. The electrical lines, water lines, and plumbing must be flexible. Base cabinetry may have to be removable.[4]
- An adjustable height work surface should be provided in the bathroom. The water lines and plumbing for the handbasin must be flexible. Base cabinetry may have to be removable.[4]
- Structural support should be provided by the water closet and bathtub to accommodate grab bars.[4]
- Storage space should be provided for a raised toilet seat beside the water closet. The raised toilet seat is used by wheelchair users to increase the water closet seat height so that they may transfer easily.[3]
- Structural support should be provided on the bathroom ceiling to accommodate a hoist.[4]

- An electrical outlet should be provided beside the water closet to accommodate an electrical water closet/bidet.[4]
- Necessary wiring for visual and acoustic systems should be provided.[5]

1 Lynn Mayor, March, 1992.
2 Don Ament, June, 1992.
3 John Lane, April, 1992.
4 Donna Collins, May, 1992.
5 Mace 1987.

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A

Accessibility
  mobility aids 100–102, 105–106, 107, 109–111, 111, 112, 113–114, 114–115, 117, 119, 120, 121–123, 123–127
    design principle 100–102
  wheelchair 136–141,145–151, 151–152, 152, 153–156, 156, 157, 158–159, 160–161, 163, 165, 166, 167, 167–173, 173–180
    design principle 136–141
Auditory and visual cues. *See* Maximize coincident auditory and visual cues
Avoid visual contrast
  deaf 85, 89
    design principle 85
  hard of hearing 70, 74
    design principle 70

B

Bathtub and shower
  blind
    ease of operation and manipulation 61
    safety 61
  low vision 38–39
    ease of operation and manipulation 38
    maximize contrast 38
    safety 39
  mobility aids 123–127
    accessibility 123–127
    ease of operation and manipulation 127
    minimize barriers 127
    safety 127
  wheelchair 173–180
    accessibility 173–180
    ease of operation and manipulation 180
    minimize barriers 180
    safety 180
Blind
  bathtub and shower 61
    ease of operation and manipulation 61
    safety 61
  cabinetry 55–56
    consistency, uniformity, and organization 55
    ease of operation and manipulation 56
    minimize maintenance 56
    orientation 55
    safety 56
  characteristic problems of... 46
  cooking facilities 56–58
    ease of operation and manipulation 56–57
    minimize maintenance 57
    orientation 56
    safety 57–58
  design principles 48–50
    consistency, uniformity, and organization 49
    ease of operation and manipulation 49
    minimize maintenance 50
    minimize travel through residence 49
    orientation 48
    safety 50
  design recommendations - bathroom 60–61
  design recommendations - common 51–53
  design recommendations - kitchen 54–59
  disability definition and limitations 46–47
  doors and doorways 51
    consistency, uniformity, and organizatioin 51
    orientation 51
    safety 51
  flooring 52
    minimize maintenance 52
    orientation 52
    safety 52
  general planning and organization - bathroom 60
    minimize travel through residence 60
  general planning and organization - kitchen 54
    consistency, uniformity, and organization 54
    minimize travel through residence 54
    safety 54
  handbasin 60
    ease of operation and manipulation 60
    safety 60
  hardware and electrical 52
    ease of operation and manipulation 52
  medicine cabinet 60
    safety 60

refrigerator 59
consistency, uniformity, and organization 59
ease of operation and manipulation 59
minimize maintenance 59
related disability groups 46–47
cane users 46
guide dog 47
sink 55
ease of operation and manipulation 55
walls 53
orientation 53
safety 53
windows 53
consistency, uniformity, and organization 53
orientation 53
safety 53
work surfaces 54–55
consistency, uniformity, and organization 55
ease of operation and manipulation 55
minimize travel through residence 55
orientation 54

C

Cabinetry
blind 55–56
consistency, uniformity, and organization 55
ease of operation and manipulation 56
minimize maintenance 56
orientation 55
safety 56
low vision 32–33
consistency, uniformity, and organization 32
ease of operation and manipulation 32
maximize contrast 32
minimize and control glare 32
minimize maintenance 33
safety 33
mobility aids 113–114
accessibility 113–114
ease of operation and manipulation 114
wheelchair 158–160
accessibility 158–159
ease of operation and manipulation 159–160
Cane users
blind 46
Ceiling
hard of hearing 71
control sound by architectural means 71
Characteristic problems of...
blind 46
deaf 84
hard of hearing 68
low vision 20
mobility aids 99
wheelchair 134
Consistency, uniformity, and organization
blind 49, 51, 53, 54, 55, 59
design principle 49
low vision 21–22, 24, 30, 32, 36
design principle 21–22
Consistency, uniformity, and organzation
blind 55
Contrast. *See* Avoid visual contrast; Maximize contrast
Control sound by architectural means
hard of hearing 69, 71, 74
design principle 69
Cooking facilities
blind 56–58
ease of operation and manipulation 56–57
minimize maintenance 57
orientation 56
safety 57–58
deaf 90–91
maximize coincident auditory and visual cues 90–91
hard of hearing 77
maximize coincident auditory and visual cues 77
low vision 33–35
ease of operation and manipulation 33–34
maximize contrast 33
minimize maintenance 34
safety 35
mobility aids 114–116
accessibility 114–115
ease of operation and manipulation 115–116
minimize maintenance 116
safety 116

wheelchair 160
accessibility 160–161
ease of operation and manipulation 161–162
minimize maintenance 162
safety 162

D

Deaf
characteristic problems of... 84
cooking facilities 90
maximize coincident auditory and visual cues 90–91
design principles 85–86
avoid visual contrast 85
maximize coincident auditory and visual cues 85
minimize and control glare 85
safety 85–86
design recommendations - bathroom 92
design recommendations - common 87–89
design recommendations - kitchen 90–91
disability definition and limitations 84
doors and doorways 87
safety 87
flooring 87
safety 87
general planning and organization - bathroom 92
maximize coincident auditory and visual cues 92
general planning and organization - kitchen 90
maximize coincident auditory and visual cues 90
handbasin 92
safety 92
hardware and electrical 87
minimize sound interference 87
lighting devices 87
avoid visual contrasts 89
maximize coincident auditory and visual cues 89
minimize and control glare 87–88
refrigerator 91
maximize coincident auditory and visual cues 91
related disability groups 84
guide dog 84
sink 90
maximize coincident auditory and visual cues 90
safety 90
special considerations of... 84
illumination 84
sound 84
walls 89
avoid visual contrasts 89
windows 89
minimize and control glare 89
Design principles
blind 48–50
consistency, uniformity, and organization 49
ease of operation and manipulation 49
minimize maintenance 50
minimize travel through residence 49
orientation 48
safety 50
deaf 85–86
avoid visual contrast 85
maximize coincident auditory and visual cues 85
minimize and control glare 85
safety 85–86
hard of hearing 69–70
avoid visual contrast 70
control sound by architectural means 69
maximize coincident auditory and visual cues 70
minimize and control glare 69
minimize sound interference 69
safety 70
low vision 21–23
consistency, uniformity, and organization 21–22
ease of operation and manipulation 22–23
maximize contrast 21
minimize and control glare 22
minimize maintenance 23
minimize travel through residence 22
safety 23–24
mobility aids 100–104
accessibility 100–102
ease of operation and manipulation 103
minimize barriers 103
minimize maintenance 104
minimize travel through residence 103
safety 104

wheelchair 136–144
accessibility 136–141
ease of operation and manipulation 142
minimize barriers 142
minimize maintenance 143
minimize travel through residence 142
safety 143–144
Design recommendations - bathroom
blind 60–61
deaf 92
hard of hearing 78
low vision 37–39
mobility aids 119–127
Wheelchair 165–180
Design recommendations - common
blind 51–53
deaf 87–89
hard of hearing 71–75
low vision 24–29
mobility aids 105–108
wheelchair 145–152
Design recommendations - kitchen
blind 54–59
deaf 90–91
hard of hearing 76–77
low vision 30–36
mobility aids 109–118
wheelchair 153–164
Disability definition and limitations
blind 46–47
deaf 84
hard of hearing 67–68
low vision 19–20
mobility aids 98–99
wheelchair 133–135
Doors and doorways
blind 51
consistency, uniformity, and organization 51
orientation 51
safety 51
deaf 87
safety 87
hard of hearing 71
safety 71
low vision 24
consistency, uniformity, and organization 24
maximize contrast 24
safety 24
mobility aids 105–106
accessibility 105–106
ease of operation and manipulation 106
minimize barriers 105–106
wheelchair 145–151
accessibility 145–151
ease of operation and manipulation 150
minimize barriers 150
minimize maintenance 151

E

Ease of operation and manipulation
blind 4952, 55, 56, 56–57, 59, 60, 61
design principle 49
low vision 22–23, 26, 27, 31, 32, 33–34, 36, 37, 38
design principle 22–23
mobility aids
103, 106, 107, 108, 111, 112, 112–113, 114, 115–116, 117, 119, 120, 123, 127
design principle 103
wheelchair
142, 150, 151, 156, 157, 159–160, 161–162, 163–164, 165, 167, 173, 180
design principle 142

F

Flooring
blind 52
minimize maintenance 52
orientation 52
safety 52
deaf 87
safety 87
hard of hearing 71
control sound by architectural means 71
minimize sound interference 71
safety 71
low vision 25
maximize contrast 25
minimize and control glare 25
minimize maintenance 25
safety 25

mobility aids 106–107
ease of operation and manipulation 107
minimize barriers 106
safety 107
wheelchair 151
ease of operation and manipulation 151
minimize barriers 151

G

General planning and organization - bathroom
blind 60
minimize travel through residence 60
deaf 92
maximize coincident auditory and visual cues 92
hard of hearing 78
maximize coincident auditory and visual cues 78
safety 78
low vision 37
maximize contrast 37
minimize and control glare 37
minimize travel through residence 37
mobility aids 119
accessibility 119
ease of operation and manipulation 119
minimize travel through residence 119
safety 119
wheelchair 165–166
accessibility 165
ease of operation and manipulation 165
minimize travel through residence 165
safety 166
General planning and organization - kitchen
blind 54
consistency, uniformity, and organization 54
minimize travel through residence 54
safety 54
deaf 90
maximize coincident auditory and visual cues 90
hard of hearing 76
maximize coincident auditory and visual cues 76
low vision 30
consistency, uniformity, and organization 30
minimize travel through residence 30
safety 30
mobility aids 109–111
accessibility 109–110
ease of operation and manipulation 111
minimize travel through residence 110
safety 111
wheelchair 153–156
accessibility 153–154
ease of operation and manipulation 156
minimize travel through residence 155
safety 156
Glare. *See* Minimize and control glare

H

Handbasin
blind 60
ease of operation and manipulation 60
safety 60
deaf 92
safety 92
hard of hearing 78
safety 78
low vision 37–38
ease of operation and manipulation 37
maximize contrast 37
safety 38
mobility aids 120
accessibility 120
ease of operation and manipulation 120
wheelchair 166–167
accessibility 166
ease of operation and manipulation 167

Hard of hearing
ceiling 71
control sound by architectural means 7 1
characteristic problems of... 68
cooking facilities 77
maximize coincident auditory and visual cues 77
design principles 69–70
avoid visual contrast 70
control sound by architectural means 6 9
maximize coincident auditory and visual cues 70
minimize and control glare 69
minimize sound interference 69
safety 70
design recommendations - bathroom 78
design recommendations - common 71–7 5
design recommendations - kitchen 76–7 7
disability definition and limitations 67–6 8
doors and doorways 71
safety 71
flooring 71
control sound by architectural means 7 1
minimize sound interference 71
safety 71
general planning and organization - bathroom 78
maximize coincident auditory and visual cues 78
safety 78
general planning and organization - kitchen 76
maximize coincident auditory and visual cues 76
handbasin 78
safety 78
hardware and electrical 72
maximize coincident auditory and visual cues 72
minimize sound interference 72
safety 72
lighting devices 72
avoid visual contrasts 74
minimize and control glare 72–73
minimize sound interference 72
refrigerator 77
maximize coincident auditory and visual cues 77
sink 76
maximize coincident auditory and visual cues 76
minimize sound interference 76
safety 76
special considerations of... 67–68
illumination 67
sound 67–68
walls 74
avoid visual contrasts 74
control sound by architectural means 7 4
windows 74
control sound by architectural means 7 4
minimize and control glare 74–75
Hardware and electrical
blind 52
ease of operation and manipulation 52
deaf 87
minimize sound interference 87
hard of hearing 72
maximize coincident auditory and visual cues 72
minimize sound interference 72
safety 72
low vision 26
ease of operation and manipulation 26
maximize contrast 26
wheelchair 151–152
accessibility 151–152

L

Lighting devices
deaf 87–89
avoid visual contrasts 89
maximize coincident auditory and visual cues 89
minimize and control glare 87–88
hard of hearing 72–74
avoid visual contrasts 74
minimize and control glare 72–73
minimize sound interference 72
low vision 26–27
ease of operation and manipulation 27
minimize glare 26–27

Limitations
6 disability groups def'ns 6
does not focus on
children or cognitive disabled 7
cost limitations 7
in depth description of each disability 7
multi disability or conflicting design requirement 7
focus on
minimum health and safety standards 7
prototypical residential construction 6
residential kitchens and bathrooms 6
Low vision
bathtub and shower 38–39
ease of operation and manipulation 38
maximize contrast 38
safety 39
cabinetry 32–33
consistency, uniformity, and organization 32
ease of operation and manipulation 32
maximize contrast 32
minimize and control glare 32
minimize maintenance 33
safety 33
characteristic problems of... 20
cooking facilities 33–35
ease of operation and manipulation 33–34
maximize contrast 33
minimize maintenance 34
safety 35
design principles 21–23
consistency, uniformity, and organization 21–22
ease of operation and manipulation 22–23
maximize contrast 21
minimize and control glare 22
minimize maintenance 23
minimize travel through residence 22
safety 23–24
design recommendations - bathroom 37–39
design recommendations - common 24–29
design recommendations - kitchen 30–36
disability definition and limitations 19–20
doors and doorways 24
consistency, uniformity, and organizatioin 24
maximize contrast 24
safety 24
flooring 25
maximize contrast 25
minimize and control glare 25
minimize maintenance 25
safety 25
general planning and organization - bathroom 37
maximize contrast 37
minimize and control glare 37
minimize travel through residence 37
general planning and organization - kitchen 30
consistency, uniformity, and organization 30
minimize travel through residence 30
safety 30
handbasin 37–38
ease of operation and manipulation 37
maximize contrast 37
safety 38
hardware and electrical 26
ease of operation and manipulation 26
maximize contrast 26
lighting devices 26–27
ease of operation and manipulation 27
minimize glare 26–27
low vision elderly 20
medicine cabinet 38
safety 38
refrigerator 36
consistency, uniformity, and organization 36
ease of operation and manipulation 36
minimize maintenance 36
related disability groups 20
low vision elderly 20
low vision with cognitive impairment 20
sink 32
ease of operation and manipulation 32
maximize contrast 32
special consideration of ... 19–20
walls 27–28
maximize contrast 27–28
minimize and control glare 28
safety 28
water closet 38
maximize contrast 38

windows 28–29
minimize and control glare 28–29
safety 29
work surfaces 30–31
ease of operation and manipulation 31
maximize contrast 30–31
minimize and control glare 31
minimize travel through residence 31
safety 31
Low vision elderly 20
Low vision with cognitive impairment 20

M

Maintenance. *See* Minimize maintenance
Maximize coincident auditory and visual cues
deaf 85,88, 90, 90–91, 91, 92
design principle 85
hard of hearing 70,72, 76, 77, 78
design principle 70
Maximize contrast
low vision 21,24, 25, 26, 27–28, 30–31, 32, 33, 37, 38
design principle 21
Medicine cabinet
blind 60
safety 60
low vision 38
safety 38
mobility aids 120
accessibility 120
wheelchair 167
accessibility 167
Minimize and control glare
deaf 85,87–88, 89
design principle 85
hard of hearing 69,72–73, 74–75
design principle 69
low vision 22,25, 26–27, 28, 28–29, 31, 32, 37
design principle 22
Minimize barriers
mobility aids 103, 105–106, 106, 111, 127
design principle 103
wheelchair 142,150, 151, 156, 180
design principle 142
Minimize maintenance
blind 50,52, 56, 57, 59
design principle 50
low vision 23,25, 33, 34, 36
design principle 23
mobility aids 104,107, 116, 118
design principle 104
wheelchair 143,151, 152, 162, 164
design principle 143
Minimize sound interference
hard of hearing 69,71, 72, 76
design principle 69
Minimize travel through residence
blind 49,54, 55, 60
design principle 49
low vision 22,30, 31, 37
design principle 22
mobility aids 103,110, 119
design principle 103–104
wheelchair 142,155, 165
design principle 142
Mobility aids
bathtub and shower 123–127
accessibility 123–127
ease of operation and manipulation 127
minimize barriers 127
safety 127
cabinetry 113–114
accessibility 113–114
ease of operation and manipulation 114
characteristic problems of... 99
cooking facilities 114–116
accessibility 114–115
ease of operation and manipulation 115–116
minimize maintenance 116
safety 116
design principles 100–104
accessibility 100–102
ease of operation and manipulation 103
minimize barriers 103
minimize maintenance 104
minimize travel through residence 103
safety 104
design recommendations - bathroom 119–127
design recommendations - common 105–108
design recommendations - kitchen 109–118
disability definition and limitations 98–99

doors and doorways 105–106
accessibility 105
ease of operation and manipulation 106
minimize barriers 105–106
flooring 106–107
ease of operation and manipulation 107
minimize barriers 106
safety 107
general planning and organization - bathroom 119
accessibility 119
ease of operation and manipulation 119
minimize travel through residence 119
safety 119
general planning and organization - kitchen 109–111
accessibility 109–110
ease of operation and manipulation 111
minimize travel through residence 110
safety 111
handbasin 120
accessibility 120
ease of operation and manipulation 120
medicine cabinet 120
accessibility 120
refrigerator 117–118
accessibility 117
ease of operation and manipulation 117
minimize maintenance 118
sink 112
accessibility 112
ease of operation and manipulation 112–113
special considerations of... 98–99
walls 107
minimize maintenance 107
water closet 121–123
accessibility 121–123
ease of operation and manipulation 123
windows 107–108
accessibility 107
ease of operation and manipulation 108
work surfaces 111–112
accessibility 111
ease of operation and manipulation 112
minimize barriers 111

O

Operation and Manipulation. *See* Ease of operation and manipulation
Orientation
blind 48, 51, 52, 53, 54, 55, 56
design principle 48

R

Refrigerator
blind 59
consistency, uniformity, and organization 59
ease of operation and manipulation 59
minimize maintenance 59
deaf 91
maximize coincident auditory and visual cues 91
hard of hearing 77
maximize coincident auditory and visual cues 77
low vision 36
consistency, uniformity, and organization 36
ease of operation and manipulation 36
minimize maintenance 36
mobility aids 117–118
accessibility 117
ease of operation and manipulation 117
minimize maintenance 118
wheelchair 163–164
accessibility 163
ease of operation and manipulation 163
minimize maintenance 164
Related disability groups
blind 46–47
blind with cognitive disabilities 46
cane users 46
guide dog 47
deaf
guide dogs 84
low vision
low vision elderly 20
low vision with cognitive disabilities 20

wheelchair 134–135
wheelchair user and attendant 134–135

S

Safety
blind 50,51, 52, 53, 54, 56, 57–58, 60, 61
design principle 50
deaf 85–86,87, 90, 92
design principle 85–86
hard of hearing 70,71, 72, 76, 78
design principle 70
low vision 23–24, 24, 25, 28, 29, 30, 31, 33, 35, 38, 39
design principle 23–24
mobility aids 104, 107, 111, 116, 119, 127
design principle 104
wheelchair 143–144, 156, 158, 162, 166, 180
design principle 143–144
Sink
blind 55
ease of operation and manipulation 55
deaf 90
maximize coincident auditory and visual cues 90
safety 90
hard of hearing 76
maximize coincident auditory and visual cues 76
minimize sound interference 76
safety 76
low vision 32
ease of operation and manipulation 32
maximize contrast 32
mobility aids 112
accessibility 112
ease of operation and manipulation 112–113
wheelchair 157–158
accessibility 157
ease of operation and manipulation 157
safety 158
Sound. *See* Control sound by architectural means; Minimize sound interference
Special considerations of...
deaf 84
hard of hearing 67–68
low vision 19–20
mobility aids 98–99
wheelchairs 133

W

Walls
blind 53
orientation 53
safety 53
deaf 89
avoid visual contrasts 89
hard of hearing 74
avoid visual contrasts 74
control sound by architectural means 74
low vision 27–28
maximize contrast 27–28
minimize and control glare 28
safety 28
mobility aids 107
minimize maintenance 107
wheelchair 152
minimize maintenance 152
Water closet
low vision 38
maximize contrast 38
mobility aids 121–123
accessibility 121–123
ease of operation and manipulation 123
wheelchair 167–173
accessibility 167–173
ease of operation and manipulation 173
Wheelchair
bathtub and shower 173–180
accessibility 173–180
ease of operation and manipulation 180
minimize barriers 180
safety 180
cabinetry 158
accessibility 158–159
ease of operation and manipulation 159–160
characteristic problems of... 134
cooking facilities 160
accessibility 160–161
ease of operation and manipulation 161–162
minimize maintenance 162
safety 162

design principles 136–144
accessibility 136–141
ease of operation and manipulation 142
minimize barriers 142
minimize maintenance 143
minimize travel through residence 142
safety 143–144
design recommendations - bathroom 165–180
design recommendations - common 145–152
design recommendations - kitchen 153–164
disability definition and limitations 133–135
doors and doorways 145–151
accessibility 145
ease of operation and manipulation 150
minimize barriers 150
minimize maintenance 151
flooring 151
ease of operation and manipulation 151
minimize barriers 151
general planning and organization - bathroom 165–166
accessibility 165
ease of operation and manipulation 165
minimize travel through residence 165
safety 166
general planning and organization - kitchen 153–156
accessibility 153–154
ease of operation and manipulation 156
minimize travel through residence 155
safety 156
handbasin 166–167
accessibility 166
ease of operation and manipulation 167
hardware and electrical 151–152
accessibility 151–152
medicine cabinet 167
accessibility 167
refrigerator 163
accessibility 163
ease of operation and manipulation 163
minimize maintenance 164
related disability groups 134–135
wheelchair user and attendant 134–135
sink 157–158
accessibility 157
ease of operation and manipulation 157
safety 158
special considerations of... 133
walls 152
minimize maintenance 152
water closet 167–173
accessibility 167–173
ease of operation and manipulation 173
windows 152
accessibility 152
ease of operation and manipulation 152
work surfaces 156–157
accessibility 156
ease of operation and manipulation 157
minimize barriers 156
Wheelchair user and attendant 134–135
Windows
blind 53
consistency, uniformity, and organization 53
orientation 53
safety 53
deaf 89
minimize and control glare 89
hard of hearing 74–75
control sound by architectural means 74
minimize and control glare 74–75
low vision 28–29
minimize and control glare 28–29
safety 29
mobility aids 107–108
accessibility 107
ease of operation and manipulation 108
wheelchair 152
accessibility 152
ease of operation and manipulation 152

Work surfaces
blind 54–55
consistency, uniformity, and organization 55
ease of operation and manipulation 55
minimize travel through residence 55
orientation 54
low vision 30–31
ease of operation and manipulation 31
maximize contrast 30–31
minimize and control glare 31
minimize travel through residence 31
safety 31
mobility aids 111–112
accessibility 111
ease of operation and manipulation 112
minimize barriers 111
wheelchair 156–157
accessibility 156
ease of operation and manipulation 157
minimize barriers 156