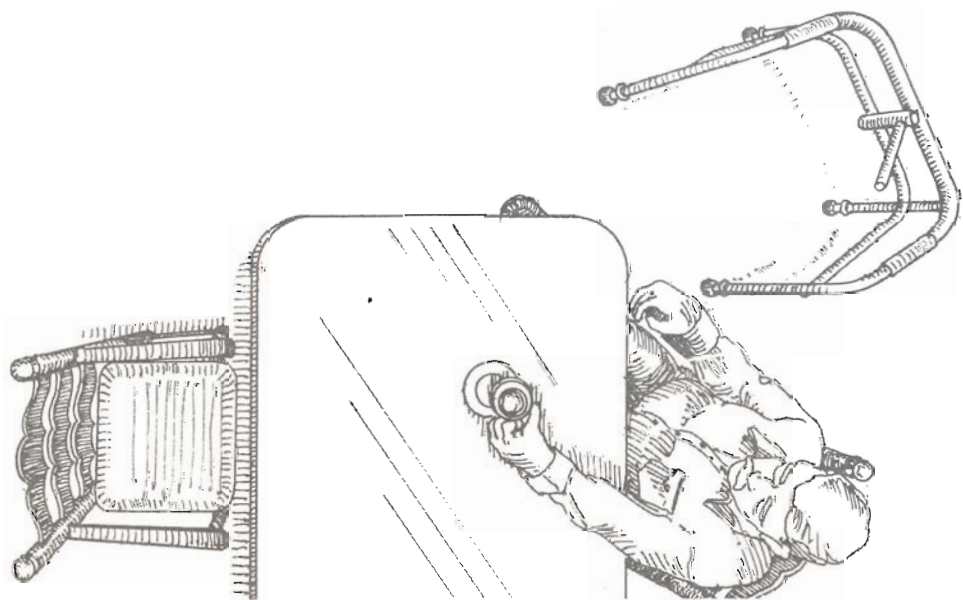


In Support of Mobility: Kitchen Design for Independent Older Adults

Lois J. Moore and Edward R. Ostrander



Acknowledgments

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Illustrations by Jeffrey Miller and Jim Powers

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Aging and Mobility

Maintaining independence is an important objective for most older adults. But as people age, the probability of functional impairment increases. While only 20 percent of people between the ages of 70 and 80 require help in performing some activities of daily living, 40 percent of those over the age of 80 require help.¹

According to T. Franklin Williams, M.D., former director of the National Institute on Aging, loss of mobility is one of the greatest threats to an individual's independence and places a serious burden on caregivers.² Loss of mobility can happen quickly, as the result of an accident or sudden illness, or it can happen slowly, as chronic conditions worsen. In either case, mobility impairment may be the result of

- weak muscles in the hips, legs, and feet
- limited range of movement of the lower extremities
- painful movement
- numbness in the feet or legs
- partial paralysis of a limb
- poor balance
- artificial limbs or joints

It is common for older adults to maintain their ability to walk in spite of these functional limitations. Kitchen design can support the mobility of older adults in two ways:

1. By reducing the possibility of accidents that result in mobility impairment
2. By facilitating effective functioning despite mobility impairment

The number of people over the age of 80 is growing faster than the number of people in any other age group. It is important that as homes are built or renovated for people of all ages today, they are designed to support independent living for older adults tomorrow.

About This Bulletin

Many publications explain how to design kitchens for people who have lost their ability to walk and are confined to a wheelchair. This bulletin addresses the need for information about kitchen design features that support the mobility of *ambulant* older adults. Ambulant older adults need kitchens that are easy to work in when they have difficulty moving around. Most importantly, they need kitchens that will safeguard them from accidents and keep them out of wheelchairs.

The information in this bulletin is compiled from kitchen design recommendations published by gerontological environmental design researchers and experts in related fields. Only kitchen design recommendations specific to the needs of ambulant older adults with mobility limitations are included. This bulletin does not address other common physical limitations of older adults, such as vision loss, hearing loss, upper body limitations, and stamina problems.

Please note that federal, state, and local building codes and other laws must be followed when building or renovating any structure. Those legal requirements take precedence over any design recommendation provided here. Consult a licensed professional designer and local building code authorities for that information.

The kitchen design recommendations in this bulletin deal with the relatively permanent architectural features of kitchens, including

- overall kitchen plan
- kitchen cabinetry and counters
- walls, floors, doors, and windows
- plumbing, heating, and electrical requirements

They do not address the many portable kitchen products and assistive devices, such as cooking utensils, that make specific food preparation tasks easier. Because architectural features are usually expensive to change, it is important to select them correctly. If you buy a kitchen gadget and then find that its design doesn't work for you, you can probably buy a different one. But if you can't reach an item stored in your kitchen, you may have to get along without it.

This bulletin is not a complete reference on the basic principles of good kitchen design. Rather, the information provided here supplements what every good kitchen designer knows by offering detailed design recommendations specific to the needs of ambulant older adults with mobility problems. Check your local library for a more comprehensive guide to kitchen design or consult an experienced designer.

Kitchens for older adults should be constructed so they can be easily remodeled for wheelchair accessibility, thereby easing the transition to a wheelchair if that assistive device becomes necessary. The design requirements for a wheelchair-adaptable kitchen have been defined by the federal government in publications such as the *Uniform Federal Accessibility Standards* (1984). Consult a licensed professional for the most current details on how to design a wheelchair-adaptable kitchen.

Using This Bulletin

The kitchen design recommendations in this bulletin can help persons of all ages make housing decisions today that will help them or their loved ones remain independent as they age. These recommendations should be particularly useful for anyone involved in renovating, designing, renting, or buying a home that will be occupied by an older adult.

Renovating

Most older homeowners prefer not to give up their home and recognize that renovating existing spaces can help them remain in their home for as long as possible. This bulletin can help them decide which features to incorporate into the design of a new kitchen. It also can help kitchen designers, architects, interior designers, general contractors, and other professionals advise older people on how to renovate their kitchens to meet their needs as they age.

Owners, managers, and boards of directors of multi-unit housing for older adults will find this bulletin helpful as they plan kitchen renovations to modernize their properties. Landlords may find that an investment in appropriate kitchen design features will improve the marketability of their housing units.

Caregivers will find this guide helpful if they are renovating their home or adding an apartment to their home so an older family member can live with them.

Designing

Persons of all ages who are building a new home can use this bulletin to help them design their kitchen right the first time, thereby reducing future costly alterations. Real estate developers, nonprofit corporations, and others who build multi-unit housing for senior citizens should find that following the kitchen recommendations offered here will improve the marketability of their project. Design and construction professionals familiar with this information will be better prepared to serve their clients.

Renting

Prospective tenants can use the recommendations in this bulletin to evaluate the kitchen features of an apartment, a duplex, a single-family home, or a unit in a retirement community. Similarly, caregivers will find this guide helpful when assisting a friend or relative with finding a rental home.

Landlords, property managers, and rental agents will find this publication a useful tool for evaluating the suitability of their properties for older residents and for marketing suitably designed properties to this growing population.

Buying

Older homeowners who have decided to move can use the recommendations in this bulletin to compare and evaluate kitchens. Whether they are considering a single-family home, a condominium, a mobile home, an elder cottage, a cooperative apartment, or a life care community, the kitchen design features recommended here will help them assess their options. A careful choice now can help them remain independent for as long as possible.

Real estate agents familiar with the kitchen design recommendations in this bulletin will be better prepared to help their older clients find a home that meets their needs.

Kitchen Design Recommendations to Support Mobility

There are five basic goals to keep in mind when designing a kitchen to support the mobility of independent, ambulant older adults:

1. Increase safety.
2. Increase the resident's effective range of motion.
3. Accommodate walking aids and human helpers.
4. Simplify and reduce maintenance.
5. Contribute to the resident's positive self-image by designing a kitchen that looks *normal*.

The kitchen design recommendations that follow address one or more of these goals. The recommendations that affect kitchen safety are identified with an asterisk (*) and should be given high priority.

Design recommendations are grouped into four sections for easy reference:

- Kitchen Plan
- Cabinets and Counters
- Structural Components (walls, floors, doors, and windows)
- Mechanical Systems (plumbing, heating, and electrical)

Recommendations are keyed by number to the accompanying illustrations. Endnotes are provided for those who would like more information about the research base behind each recommendation.

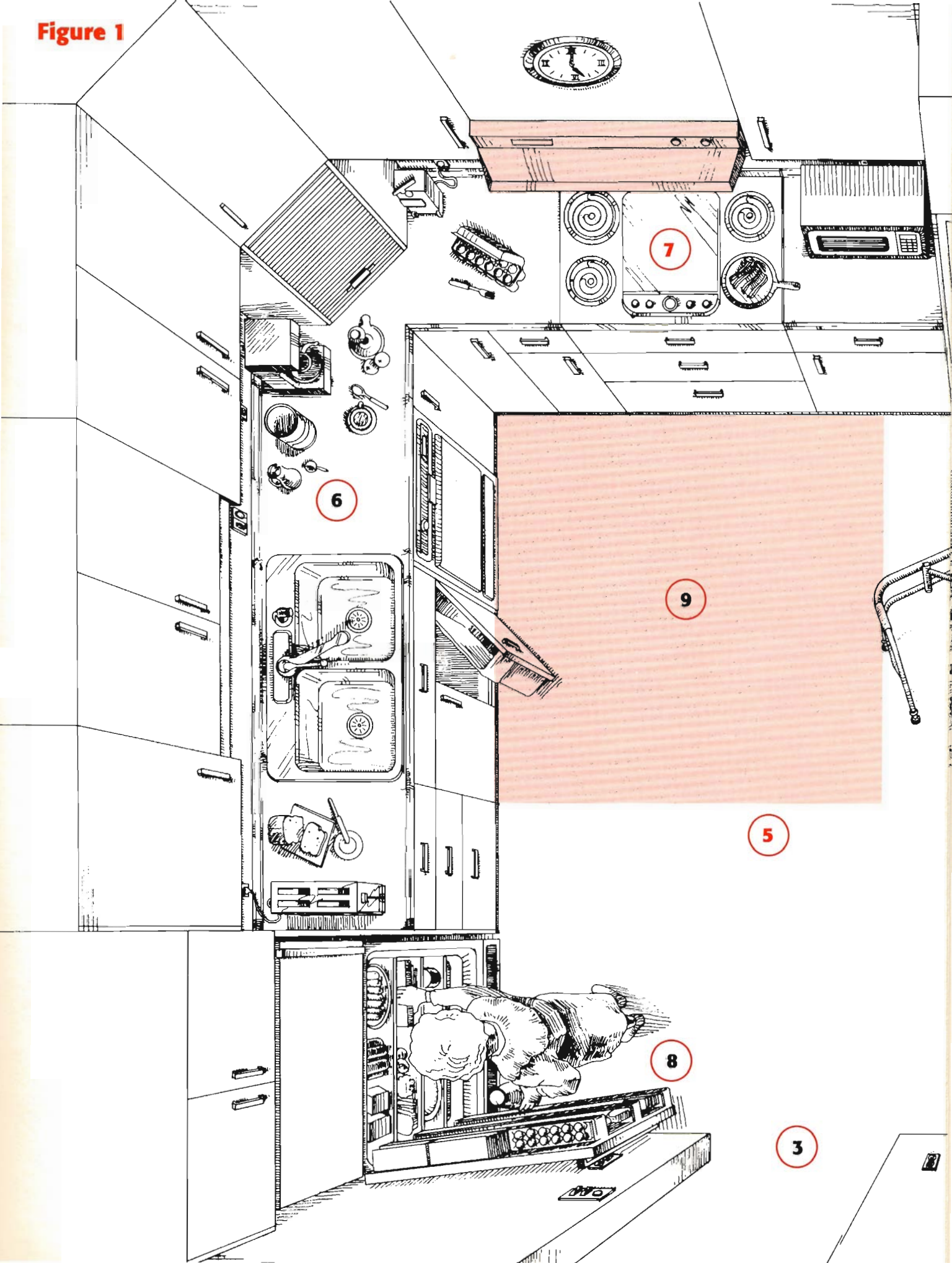
Although this publication attempts to make available the best of what is known about kitchen design for ambulant, mobility-impaired older adults, basic research on how to design kitchens for older adults with common physical limitations is still incomplete. It is therefore important that you consider the recommendations provided here in light of your own experiences and common sense and decide which ones are most appropriate for your particular purposes and circumstances. You can create your own personal set of design recommendations by checking those that are most important to you in the boxes (☐) provided.

Kitchen Plan (Figure 1)

- 1 Provide a short, direct path between the kitchen and an exterior door.³
- 2 Provide two doorways into the kitchen from adjacent spaces if it will shorten the path between rooms.⁴
- 3 Install doors only where they are necessary for security, privacy, fire safety, or sound control.⁵ Openings without doors should be 36 inches to 48 inches wide.⁶
- 4 Provide visual separation between the kitchen and other living spaces.⁷
- 5* Keep major circulation routes free of obstructions,⁸ including light fixtures, appliance doors, kitchen table and chairs, kitchen islands, and room-dividing cabinets.
- 6 Choose an L-shaped plan⁹ or a U-shaped plan¹⁰ with a continuous counter surface.¹¹ Locate tall appliances, such as a refrigerator and a wall oven, at the ends of the L or the U.¹² It is best if all major appliances are part of a continuous cabinet assembly rather than freestanding.¹³
- 7* Locate the range or cooktop and oven so that a fire in one of these appliances would not block a resident's path of escape from the room.
- 8 Locate the refrigerator close to the kitchen entry.¹⁴
- 9 Provide 48 inches to 60 inches of clear space between opposing cabinets, appliances, and walls wherever two people might be working together.¹⁵
- 10 Allow space for a table in the kitchen,¹⁶ preferably a 30-by-40-inch table.¹⁷ If you must compromise, provide space for a smaller table or a table-height counter, but don't eliminate this feature altogether.¹⁸
- 11 Allow a minimum of 36 inches, preferably 44 inches, between the edges of the kitchen table and the walls or cabinets behind the table for chair clearance.¹⁹
- 12 Provide a window with an interesting view,²⁰ and locate it so that the view can be enjoyed by a person seated at the kitchen table.²¹
- 13* Locate operable windows where they are easily accessible and can be opened and closed without bending or stretching at an awkward angle.²² Locate windows no closer than 12 inches to the left or right of the range or cooktop.²³

*Safety recommendation

Figure 1

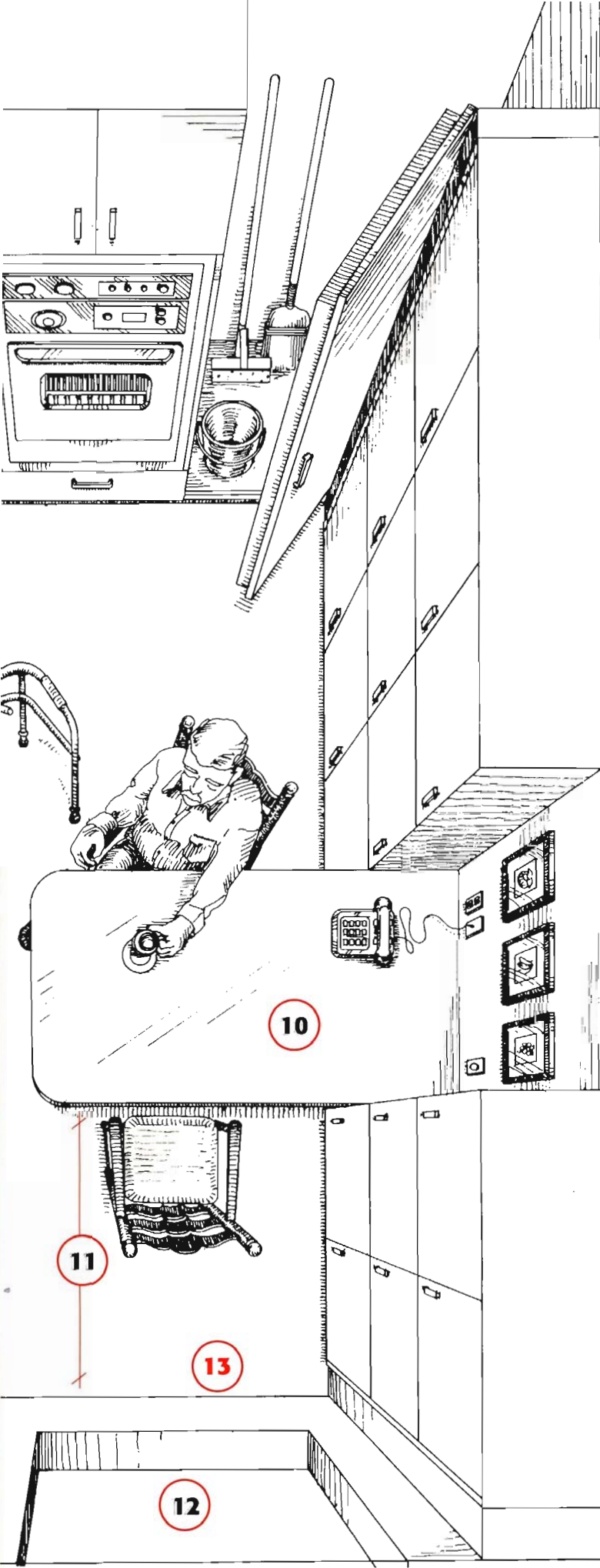


Cabinets and Counters (Figure 2 →)

General Recommendations

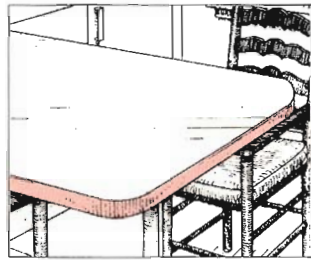
- 14 Provide generous storage space for food and equipment.²⁴
- 15 Specify frameless cabinets to maximize usable storage space.²⁵
- 16 Provide ample counter space²⁶ so that as many as eight small appliances²⁷ can be stored on the counter and an adequate work surface area will still be clear. Appliances to be stored on the counter may include a microwave oven, a toaster oven, an electric can opener, a coffee maker, a food processor, a crock pot, a blender, and an electric mixer.
- 17* Specify sturdy cabinet components and attach them securely to maximize stability.²⁸
- 18 Select cabinet door and drawer fronts and backs that are flat and have no small grooves, indentations, or texture that can collect dirt.²⁹
- 19 Choose a cabinet color and pattern that won't show dirt, such as a medium-colored hardwood.³⁰
- 20 Specify easy-to-clean materials for cabinet interiors and exteriors.³¹
- 21* Provide high-quality hardware that will operate easily for the life of the cabinet.³²
- 22* Specify rounded edges on cabinet door and drawer pulls and a style that cannot catch clothing,³³ such as bracket-shaped () pulls.

continued on page 8



- 23*** Provide rounded corners on kitchen islands, room-dividing cabinets, built-in tables, and other projecting features.³⁴

- 24*** Clearly identify the ends of kitchen islands, room-dividing cabinets, and other projections with colors that contrast³⁵ in value and hue.



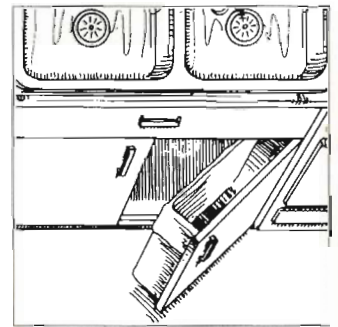
Wall Cabinets

- 25** Hang wall cabinets so that the bottom of each cabinet is 51 inches from the floor,³⁶ except where greater height is needed over appliances such as the refrigerator and the sink.
- 26*** Do not provide cabinets or shelving over a range or a cooktop.³⁷
- 27** Provide solid doors on wall cabinets rather than glass doors or open shelves.³⁸
- 28** Specify wall cabinets with an interior depth of at least 12 inches.³⁹
- 29** Specify adjustable shelves⁴⁰ in wall cabinets with shelves.
- 30*** Specify a range hood⁴¹ in a color that contrasts with adjacent cabinets and walls.⁴² The range hood should be equipped with a light.⁴³
- 31** Install the range hood so that the bottom edge is 56 inches to 60 inches from the floor. A shallow range hood (17 inches deep or less) can be placed at 56 inches; a deeper range hood should be placed at 60 inches.⁴⁴

*Safety recommendation

Base Cabinets

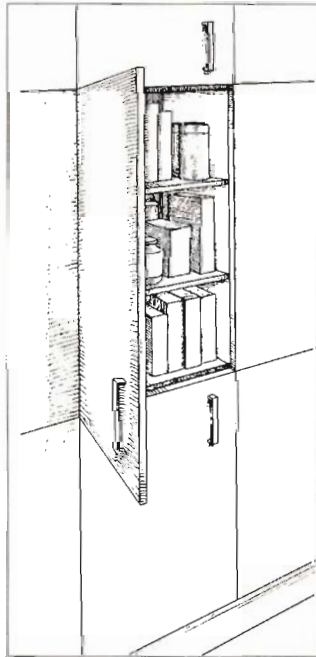
- 32** Specify standard depth (24-inch) base cabinets and a standard height (36-inch) base cabinet/counter assembly⁴⁵ unless the kitchen is being designed for an individual whose height and other relevant measurements are the basis for different cabinet dimensions.
- 33** Provide easy-access devices in place of base-cabinet shelving⁴⁶ (e.g., lazy susans, roll-out shelves, half-moon wire baskets, deep drawers).
- 34*** Provide a trash can in a location that is convenient and out of the circulation path,⁴⁷ for example, mounted on the inside of one sink-base-cabinet door. Containers for recyclable materials should also be in a convenient location.
- 35** Install a dish towel rack near the sink, for example, mounted on the inside of a sink-base-cabinet door.
- 36** Specify a tilt tray on the drawer front under the sink.⁴⁸
- 37*** Provide drawers with a secure stop⁴⁹ and self-closing drawer glides.
- 38** Locate cabinet door and drawer pulls no lower than 18 inches from the floor.⁵⁰
- 39** Provide only one drawer pull on each drawer.⁵¹



Appliances and Special Cabinets

- 40** Provide a frost-free refrigerator⁵² with a large freezer compartment.⁵³ If you specify a cabinet above it, specify a full-depth cabinet.⁵⁴
- 41*** Provide an electric self-cleaning⁵⁵ wall oven,⁵⁶ and install the oven so that the **middle** rack is at counter height.⁵⁷
- 42*** Locate a microwave oven so that the bottom of the oven cabinet is at counter height.⁵⁸ When designing a kitchen for a specific individual, locate the bottom shelf of the microwave oven at elbow height plus or minus 6 inches.⁵⁹
- 43** Dishwashers should be built-in and should contain a silverware basket with one handle.⁶⁰

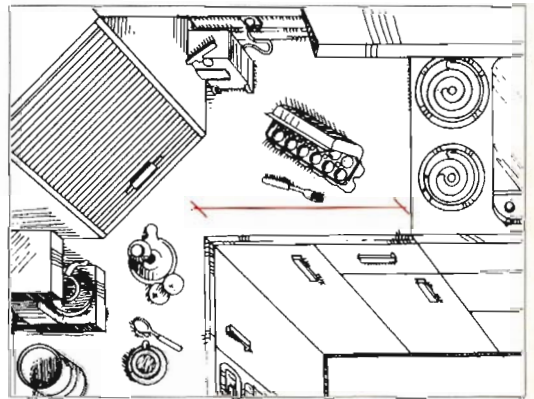
- 44** Provide at least one large pantry cabinet⁶¹ with a depth of about 12 inches, or a deeper cabinet with shelves on the doors to take up some of the interior depth.



- 45** Provide a utility closet for mops, brooms, and other cleaning supplies.⁶²

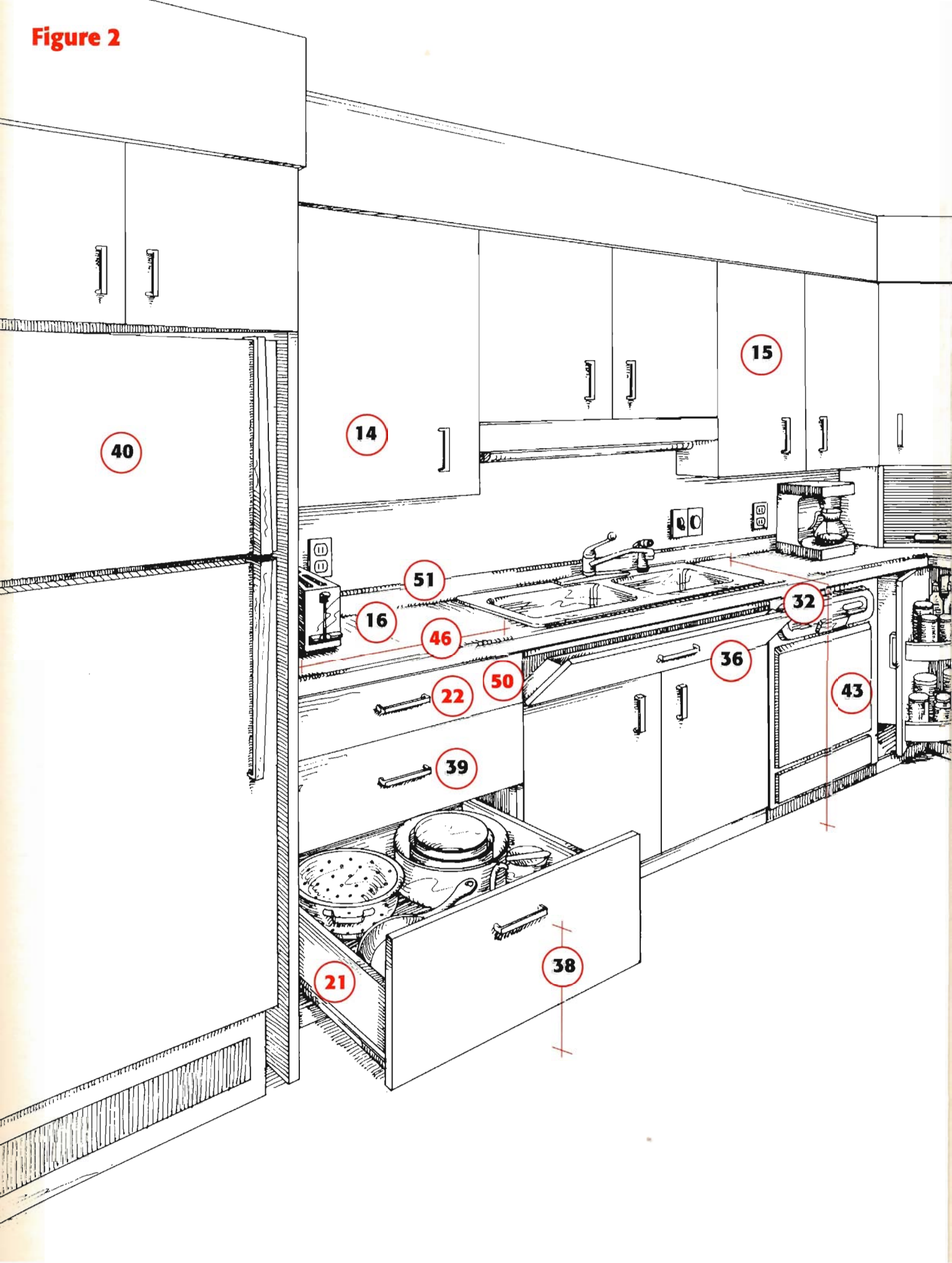
Counters

- 46*** Provide counter space at least 12 inches wide on both sides of the range or cooktop⁶³ and at least 15 inches wide on the opening side of the refrigerator.⁶⁴
- 47*** Provide counter space at least 12 inches wide between the side of a sink, range, or cooktop and an interior corner of the counter.⁶⁵ Provide counter space at least 15 inches wide between the side of any tall appliance (e.g., refrigerator, wall oven) and an interior corner of the counter.⁶⁶



- 48*** Provide heat-resistant counters next to the range and oven.⁶⁷
- 49*** Provide heat-resistant counters in front of and beside a microwave oven.
- 50*** Specify counters with a raised lip at the front edge (a no-drip edge).⁶⁸
- 51** Choose a backsplash shape that is easy to keep clean.⁶⁹

Figure 2



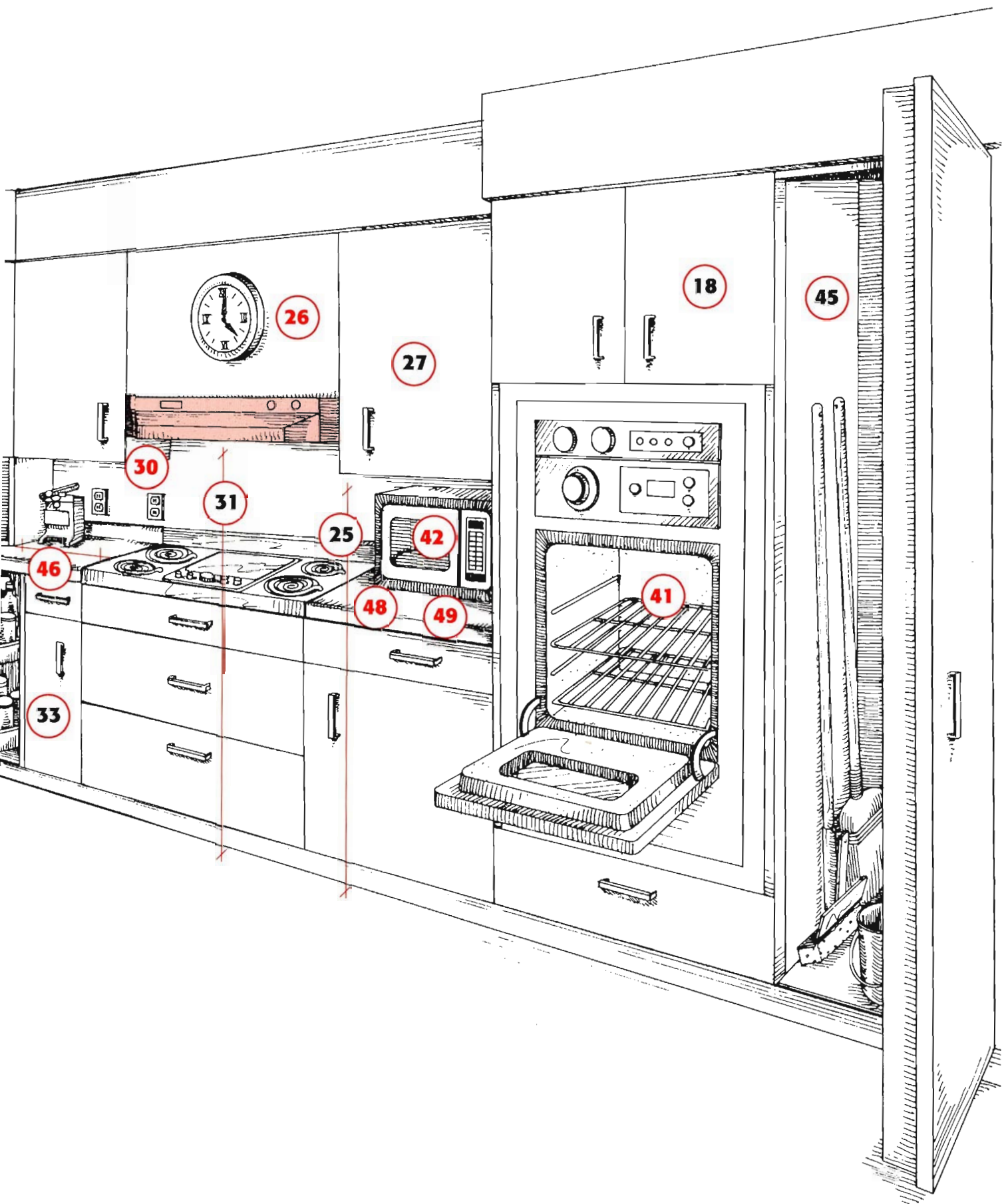
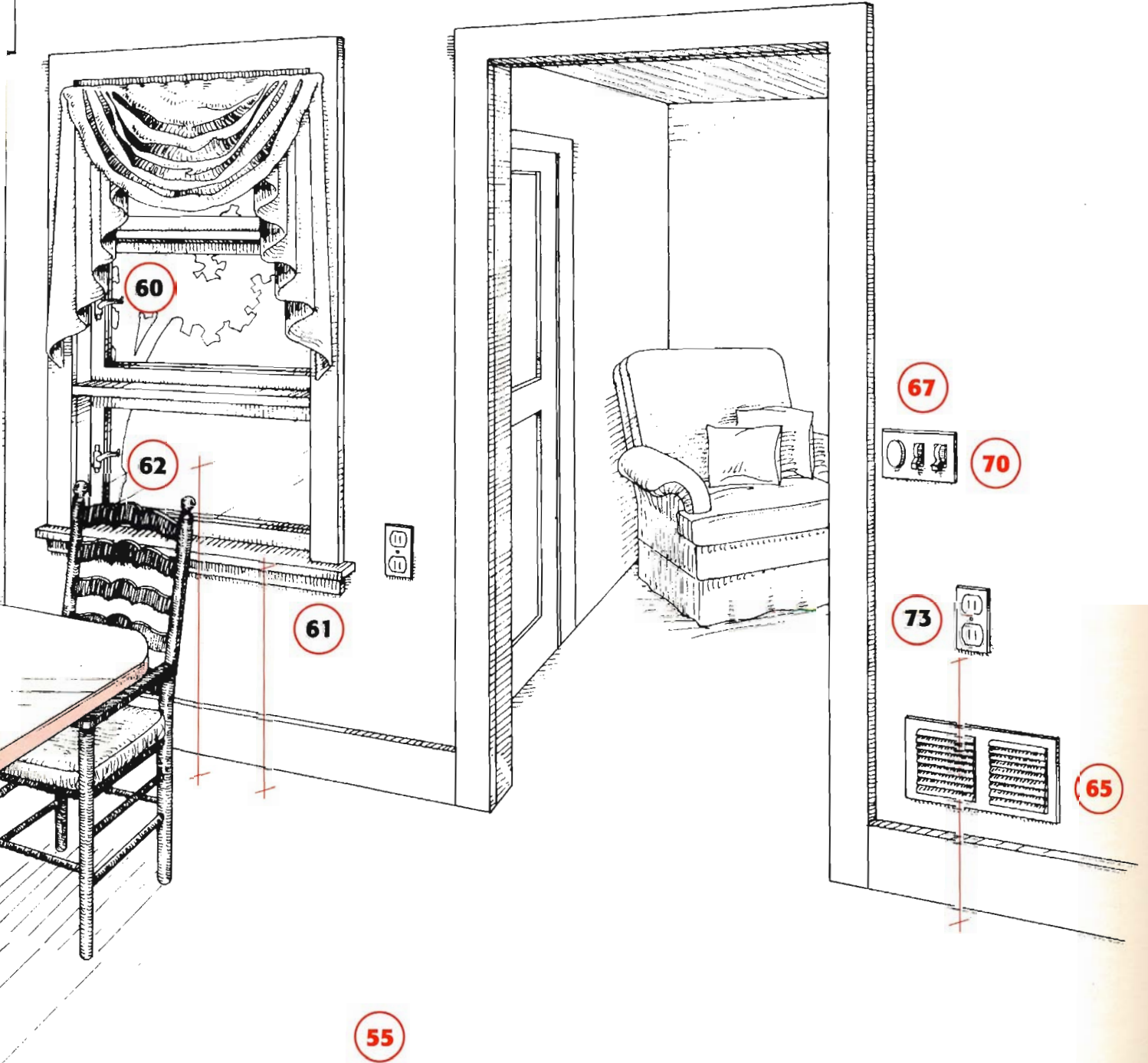


Figure 3





Structural Components (Figure 3)

Walls

- 52** Choose wall coverings that are durable and easy to clean.⁷⁰ Vinyl wall coverings are more durable than paint.⁷¹ Smooth wall coverings are easier to clean than textured wall coverings, and patterned wall coverings hide small spots and splashes, thereby reducing the frequency of cleaning.⁷²

Floors

- 53*** Choose materials that provide a smooth, level, and uniform floor surface with no cracks or indentations.⁷³
- 54*** Eliminate raised thresholds wherever possible.⁷⁴ If a raised threshold is necessary, it should be no more than $\frac{1}{2}$ inch higher than the finished floor surface,⁷⁵ it should have beveled edges,⁷⁶ and it should be in a color that contrasts⁷⁷ in both value and hue with the finished flooring.
- 55*** Specify a solid color floor that will provide good visual contrast to objects on it.⁷⁸
- 56*** Avoid flooring materials with a slippery-looking shine.⁷⁹
- 57** Select a flooring material that is easy to clean.⁸⁰
- 58*** Specify a slip-resistant floor finish.⁸¹

Doors

- 59*** Where doors are required, specify doors that are 36 inches⁸² or wider. Do not use doors that swing two ways (like restaurant kitchen doors).⁸³

Windows

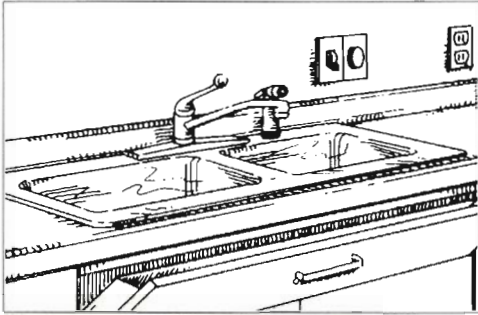
- 60** Specify windows that are easy to operate⁸⁴ with one hand.⁸⁵
- 61** Low window sills provide the best view. They should be between 18 inches and 30 inches from the floor.⁸⁶
- 62** If casement windows are used, locate the operating crank no lower than 18 inches from the floor.⁸⁷

*Safety recommendation

Mechanical Systems (Figure 3)

Plumbing

- 63 Specify a double-bowl sink.⁸⁸
- 64 Specify a single-control water faucet.⁸⁹



Heating

- 65* Install heat registers in the wall rather than on the floor.⁹⁰

Light Fixtures

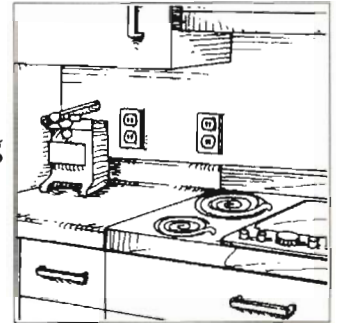
- 66* Whenever possible, locate light fixtures where they can be reached without a ladder or step stool.⁹¹ If you must use ceiling fixtures, specify fluorescent fixtures.⁹²
- 67* Provide good general room lighting,⁹³ controlled by a dimmer switch.⁹⁴
- 68* Provide lighting over the sink, range, and work counters,⁹⁵ controlled by dimmer switches to provide 200 to 1,000 lux (approximately 19 to 93 footcandles).⁹⁶
- 69* Provide a light over the kitchen table, controlled by a dimmer switch⁹⁷ to provide 150 to 300 lux (approximately 14 to 28 footcandles).⁹⁸

Light Switches

- 70* Locate at least one switch at the kitchen doorway.⁹⁹
- 71 Be generous in the use of two-way switches.¹⁰⁰

Receptacles

- 72* Place duplex receptacles every 12 inches to 36 inches along the kitchen counter, or provide a multi-outlet strip.¹⁰¹ Closer spacing is advisable where one large countertop appliance (e.g., microwave oven or toaster oven) might cover a receptacle, making it inaccessible.



- 73 Locate wall receptacles so that the outlets are between 30 inches and 40 inches above the floor.¹⁰²
- 74 Locate an outlet behind the kitchen table and a few inches above table height.¹⁰³

Telephone Jack

- 75 Provide a telephone jack in the kitchen,¹⁰⁴ located so that the resident can sit at the kitchen table while talking on the phone. Install the jack between 30 inches and 40 inches above the floor.¹⁰⁵

*Safety recommendation

Notes

1. Williams 1986, p. 15
2. Williams 1986, p. 15
3. Beall et al. 1981, p. 111; Kira 1958, p. 35; Parker 1965, p. 15 and 1990, p. 127
4. Reinius 1984, p. 111
5. Aslett and Simons 1986, p. 158
6. Aslett and Simons 1986, p. 164; Diffrient et al. 1974, Selector 3b; Kira 1958, p. 47; Kira 1960, p. 375; Panero and Zelnik 1979, p. 54; Parker 1990, p. 128
7. Beall et al. 1981, p. 111; Kira 1958, p. 34
8. Bendixson 1962, p. 60; Raschko 1982, pp. 72, 294, 301
9. Beall et al. 1981, p. 112; Valins 1988, p. 114
10. Beall et al. 1981, p. 112; Goldsmith 1976, p. 237; Valins 1988, p. 114
11. Jones and Kapple 1984, p. 17
12. Jones and Kapple 1984, pp. 5, 49
13. Aslett and Simons 1986, p. 45; Olson 1988, pp. 5, 7
14. Jones and Kapple 1984, p. 5
15. This range is recommended by Jones and Kapple (1984, p. 15). Beyer and Kira (1990, p. 46) recommend 48 inches or more of clearance between opposing walls or cabinets for two people working together. A minimum of 54 inches of clear space is recommended by Hoke (1988, p. 6) and by Parker (1965, p. 15 and 1990, p. 127).
16. Beall et al. 1981, p. 112; Goldsmith 1976, p. 237; Howell and Epp 1978, pp. 6.101, A.123; Huttman 1977, p. 176; Kira 1958, p. 35; Raschko 1982, pp. 210–211
17. Howell and Epp 1978, pp. 6.101, A.123
18. Beall et al. (1981, p. 112) recommend space for at least a 24-by-24-inch table, counter, or pull-out shelf at table height.
19. Hoke 1988, pp. 6, 10; Jones and Kapple 1984, p. 27
20. Beall et al. 1981, p. 111
21. Howell and Epp 1978, p. 6.101; Huttman 1977, p. 176; Kira 1958, p. 35; Parker 1990, p. 128; Raschko 1982, pp. 210, 215
22. Lawton 1975, p. 154; Valins 1988, p. 113
23. Jones and Kapple 1984, p. 24; Schumacher and Cranz 1975, sec. 6.1.5., p. 6
24. Aslett and Simons 1986, p. 41; Lawton 1975, pp. 150, 214
25. This is based on Lawton's (1975, pp. 150, 214) recommendation to provide generous storage space and the fact that frameless cabinets provide greater usable storage space than face-frame cabinets do. Also, Aslett and Simons (1986, p. 41) point out that hidden hinges don't get dirty as quickly.
26. Parker 1965, p. 15 and 1990, p. 127

27. Howell 1979, p. 3. Kitchen designers should note that the National Kitchen and Bath Association's standards for counter space are based on the use of only six appliances (Jones and Kapple 1984, p. 14) and may therefore require adjustment to meet the needs of older adults.

28. Musson 1963, p. 96; Raschko 1982, p. 294

29. Aslett and Simons 1986, pp. 13–14, 36, 41

30. Aslett and Simons 1986, pp. 33, 41

31. Aslett and Simons 1986, pp. 13–14; Howell 1979, p. 6; Musson 1963, p. 97

32. Goldsmith 1976, p. 315; Howell 1979, p. 6; Musson 1963, p. 96

33. Aslett and Simons 1986, p. 42; Musson 1963, p. 96; Raschko 1982, p. 195

34. Beall et al. 1981, p. 106; Raschko 1982, p. 301; Schumacher and Cranz 1975, sec. 6.1.5., p. 6

35. Charness and Bosman 1990, p. 453; Musson 1963, p. 97

36. Goldsmith (1976, p. 246) recommends a height of 51¹/₄ inches for ambulant disabled persons. This measurement is near the low end of the standard range (51 inches to 54 inches) specified by the National Kitchen and Bath Association (Jones and Kapple 1984, p. 11). We have rounded off Goldsmith's recommendation to 51 inches because the extra ¹/₄ inch is

probably a result of converting the measurement from meters to inches.

37. Beall et al. 1981, p. 113; Huttman 1977, p. 177; Kira 1960, p. 374; Parker 1990, p. 127; Schumacher and Cranz 1975, sec. 6.1.5., p. 6; Zeisel, Epp, and Demos 1977, p. 34

38. Howell 1979, pp. 5, 15; Steinfeld 1987, p. 328

39. Beall et al. 1981, p. 113; Howell 1979, p. 11

40. Beall et al. 1981, p. 111; Howell 1979, p. 23; Jones and Kapple 1984, p. 12; Schumacher and Cranz 1975, sec. 6.1.5., p. 7. We recommend adjustable shelving rather than a fixed maximum shelf height because there is considerable variation in how high different persons can easily reach. Defining a maximum shelf height based on the capabilities of the most infirm person would rule out shelving at heights that are easily accessible to many other older people.

41. Aslett and Simons 1986, p. 93; Jones and Kapple 1984, p. 25; Kira 1958, p. 37; Lawton 1975, p. 150; Parker 1965, p. 22 and 1990, p. 127

42. Charness and Bosman 1990, p. 453; Musson 1963, p. 97

43. Brotherson 1984, p. 70

44. Brotherson 1984, p. 57; Jones and Kapple 1984, p. 25

45. Goldsmith 1976, pp. 241–244, 246;

- Hoke 1988, p. 6; Jones and Kapple 1984, pp. 11, 17; Schumacher and Cranz 1975, sec. 6.1.5., p. 6
46. Howell 1979, pp. 11, 23; Goldsmith 1976, p. 249; Raschko 1982, pp. 148, 195, 269, 271; Steinfeld 1987, p. 334
47. Beall et al. 1981, p. 111; Schumacher and Cranz 1975, sec. 6.1.5., p. 7
48. This is based on Lawton's (1975, pp. 150, 214) recommendation to provide generous storage space.
49. Musson 1963, p. 96; Schumacher and Cranz 1975, sec. 6.1.5., p. 16
50. Goldsmith (1976, p. 250) recommends a maximum height of 17 ³/₄ inches. This dimension suggests a degree of precision in determining this height that could not be confirmed. Therefore, we have rounded it off to 18 inches.
51. Goldsmith 1976, p. 315; Raschko 1982, p. 273
52. Aslett and Simons 1986, p. 47; Jones and Kapple 1984, p. 56; Kira 1958, p. 39; Kira 1960, p. 374; Olson 1988, p. 4; Parker 1990, p. 127; Schumacher and Cranz 1975, sec. 6.1.5., p. 7
53. Kira 1960, p. 374; Parker 1990, p. 127; Schumacher and Cranz 1975, sec. 6.1.5., p. 7
54. Aslett and Simons 1986, p. 47; Hoke 1988, p. 13
55. Aslett and Simons 1986, p. 46; Olson 1990, p. 5
56. Goldsmith 1976, p. 251; Kira 1958, p. 38; Olson 1988, p. 5; Schumacher and Cranz 1975, sec. 6.1.5., p. 7
57. Goldsmith 1976, p. 252; Steinfeld 1987, p. 325
58. Goldsmith 1976, p. 252
59. Jones and Kapple 1984, p. 49
60. Olson 1988, p. 7
61. Raschko 1982, p. 149
62. Beall et al. 1981, p. 112; Howell 1979, p. 13; Raschko 1982, p. 274; Schumacher and Cranz 1975, sec. 6.1.5., p. 7
63. Jones and Kapple 1984, pp. 18, 25
64. Hoke 1988, p. 13; Jones and Kapple 1984, p. 18
65. Jones and Kapple 1984, p. 19
66. Jones and Kapple 1984, p. 19
67. Jones and Kapple 1984, p. 19
68. Dwoskin (1970, p. 62) points out the need to guard against liquids spilling on the floor.
69. Beall et al. 1981, p. 113; Kira 1958, p. 40
70. Aslett and Simons 1986, pp. 146–147; Lawton 1975, pp. 149–150
71. Aslett and Simons 1986, p. 32
72. Aslett and Simons 1986, pp. 39, 146–147

73. Aslett and Simons 1986, pp. 13–14, 40, 139; Beall et al. 1981, p. 108; Dwoskin 1970, p. 62; Kira 1958, p. 47; Kira 1960, p. 375; Musson 1963, p. 97; Parker 1990, p. 128; Schumacher and Cranz 1975, sec. 6.1.5., p. 7; *Uniform Federal Accessibility Standards* 1984, p. 62

74. Kira 1958, p. 47; Kira 1960, p. 375; Lawton 1975, pp. 123–124; Parker 1965, p. 22 and 1990, p. 128; Raschko 1982, p. 277; Schumacher and Cranz 1975, sec. 6.1.5., p. 7

75. Steinfeld 1987, p. 333

76. Steinfeld 1987, p. 333. Uniform Federal Accessibility Standard #4.5.2 (1984, p. 22) does not require beveled edges on thresholds $\frac{1}{4}$ inch high or less. UFAS #4.13.8 (1984, p. 36) requires beveled edges to slope no more than 1:2.

77. Charness and Bosman 1990, p. 453

78. Dwoskin 1970, p. 62. The need for safety takes precedence over ease of maintenance in this case.

79. Beall et al. 1981, p. 108; Kira 1958, p. 45; Kira 1960, p. 375; Musson 1963, p. 97; Parker 1990, p. 128; Raschko 1982, p. 301; Schumacher and Cranz 1975, sec. 6.1.5., p. 7

80. Goldsmith 1976, p. 196; Schumacher and Cranz 1975, sec. 6.1.5., p. 7

81. Beall et al. 1981, p. 111; Bendixson 1962, p. 60; Goldsmith 1976, p. 196; Kira 1958, pp. 40, 46; Kira 1960, p. 375; Musson 1963, p. 97; Parker 1990, p. 128; Raschko 1982, p. 294; Schumacher and

Cranz 1975, sec. 6.1.5., p. 7; *Uniform Federal Accessibility Standards* 1984, p. 22. The difficulty of meeting this recommendation is noted in the *Uniform Federal Accessibility Standards* (1984, p. 62): “Slip resistance is based on the frictional force necessary to keep a shoe heel or crutch tip from slipping on a walking surface under the conditions of use likely to be found on the surface. Although it is known that the static coefficient of friction is the basis of slip resistance, there is not as yet a generally accepted method to evaluate the slip resistance of walking surfaces.”

82. Goldsmith 1976, p. 153

83. Kira 1960, p. 375; Parker 1990, p. 128

84. Kira 1960, p. 375; Lawton 1975, p. 154; Parker 1965, p. 19 and 1990, p. 128

85. Raschko 1982, p. 290; *Uniform Federal Accessibility Standards* 1984, p. 45

86. Sill-height operating mechanisms will then meet Goldsmith’s (1976, p. 250) recommendation that no handle or knob be lower than $17\frac{3}{4}$ inches from the floor. Kira (1960, p. 375) and Parker (1965, p. 19 and 1990, p. 128) recommend that sill height not exceed 30 inches.

87. Goldsmith (1976, p. 250) recommends that no handle or knob be lower than $17\frac{3}{4}$ inches from the floor.

88. Aslett and Simons 1986, p. 44; Beall et al. 1981, p. 113; Kira 1960, p. 374; Parker 1990, p. 127
89. Aslett and Simons 1986, p. 44; Beall et al. 1981, p. 114; Raschko 1982, p. 150; *Uniform Federal Accessibility Standards* 1984, p. 45
90. Aslett and Simons 1986, p. 143
91. Kira 1960, p. 375; Parker 1990, p. 129
92. Aslett and Simons 1986, p. 132; Raschko 1982, p. 287
93. Beall et al. 1981, p. 107; Bendixson 1962, p. 61
94. Beall et al. 1981, p. 107; Schumacher and Cranz 1975, sec. 6.1.6., p. 10. According to the Illuminating Engineering Society (Kaufman and Hynes 1981, p. 2-3), proper lighting is a function of the details of the object to be seen; the age of the viewer; the need for speed and/or accuracy of visual performance; and the background against which details are viewed. Because there can be wide variation in all four of these variables, in kitchens used by older adults we recommend installing dimmer switches, which allow the user to adjust the light level to the task.
95. Beall et al. 1981, pp. 108, 111, 114; Goldsmith 1976, p. 213; Raschko 1982, pp. 188–189; Schumacher and Cranz 1975, sec. 6.1.5., p. 6
96. Kaufman and Hynes 1981, pp. 10-7, 10-8, 10-9
97. Raschko 1982, p. 216; Schumacher and Cranz 1975, sec. 6.1.6., p. 10
98. Charness and Bosman 1990, p. 452
99. Raschko 1982, pp. 71, 286
100. Goldsmith 1976, p. 211
101. Brotherson 1984, p. 67
102. Kira 1960, p. 375; Parker 1990, p. 129. This recommendation is based in part on Sperling's finding (1984, p. 115) that some older people sit down so that they can safely pull the plug out of the receptacle.
103. Raschko 1982, p. 286
104. Schumacher and Cranz 1975, sec. 6.1.6., p. 10
105. Kira 1960, p. 375; Parker 1990, p. 129

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