Residential Interior Design

A Guide to Planning Spaces

MAUREEN MITTON · COURTNEY NYSTUEN

THIRD EDITION

WILEY

1524 - 1676 mm

2'-0" - 2'-6" | 3'-0" MIN
610 - 762 mm | 914 mm
CIRCULATION ZONE | WORK ZONE

COUNTER WITH BASE CABINETS

LINEN CLOSET

HEAT | FAN

3'-0"
914 mm

SEAT

3'-0"
914 mm

5'-6"
1676 mm

1'-6"
457 mm

2'-8" CLEAR
813 mm

7'-4"
2235 mm

WORK ZONE
4'-0"
1219 mm

COUNTER WITH BASE CABINETS

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A Guide to Planning Spaces

MAUREEN MITTON, CID, NCIDQ
COURTNEY NYSTUEN, AIA EMERITUS

With CAD Illustrations by Melissa Brewer, Shelley Pecha, and Jamey Bowe

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Acknowledgments

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CHAPTER 1

Introduction

Every cubic inch of space is a miracle.

Walt Whitman, *Leaves of Grass*, "Miracles"

WHAT THIS BOOK IS ABOUT

This book is meant to serve as a primer on space planning for rooms and spaces in a home. Related information regarding codes, mechanical and electrical systems, and a variety of additional factors that impact each type of room or space is also provided. In addition, this book includes information about accessible design in each chapter in order to provide a cohesive view of residential accessibility. This new edition includes updated 2015 International Residential Code information and additional updates.

Intended as a reference for use in the design process, this book can aid in teaching and understanding the planning of residential spaces. Most chapters follow a similar format, starting with an overview of the particular room or space and related issues of accessibility, followed by information about room-specific furnishings and appliances. Chapters continue with information about sizes and clearances, organizational flow, related codes and constraints, and issues regarding electrical, mechanical, plumbing, and basic lighting.

This book is meant to aid students and designers in understanding the amount of space that is minimally necessary in order for rooms to function usefully. Examples of larger spaces are also given, but at its heart, this book is intended to show students how to use space wisely and make good use of space throughout the dwelling. With clear knowledge about minimums, designers and students of design can learn when it is appropriate to exceed such standards for a variety of reasons that reflect specific project criteria based on client needs, budget, site, and other constraints.

This book is intended as an introduction to the topics covered with the aim of familiarizing the reader with the basic concepts so that he or she might move forward in design education or on to additional research in certain areas. To that end, an annotated references section is provided at the end of each chapter. Thinking of the information provided in each chapter as basic building blocks that allow for the discovery of the issues involved is a helpful approach in using this book (Figure 1-1).

There is much that goes into the design of a dwelling that is not covered in this book; our intent is to focus on the use and
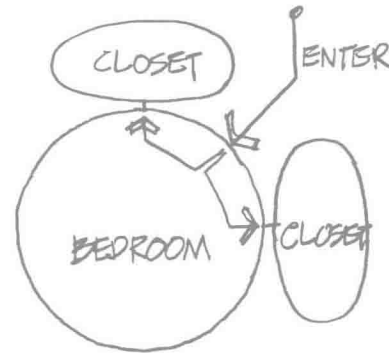
Figure 1-1 This book covers the design of houses using a basic room-by-room approach.

design of individual rooms (again, a building-block approach) so that the reader will have the core information required to understand the design of these individual spaces. This basic informational approach may bring up questions about the role of the interior designer versus the role of the architect. Clearly, the design of the totality of the structure is the role of the architect (or engineer); however, in many cases, the interior designer is taking an increasingly larger role in the design of rooms and spaces.

Interior designers engaged in renovation work can take a lead role in the design of the interior architecture of a space, with a significant hand in the design of a room or many rooms. This is in contrast to notions of the interior designer as the person in charge of materials and furnishings selections only.

The authors believe that interior designers and design students must be well versed in the aspects of residential design covered in this book. For example, readers will note that the detailed kitchen and bathroom information contained in this book is applicable to remodeling as well as to new construction.

AN OVERVIEW: QUALITY AND QUANTITY

Readers may note that, throughout this book, the authors mention the evolution of the use of rooms, room sizes, and the growth of the overall size of the American home. It's worth noting that the authors have a bias toward careful consideration of the *quality* of design rather than the *quantity* of space in a given

home. We hope to make clear that the successful design of space requires careful consideration of the real needs of clients measured against budgetary, code, climate, and site restrictions—all of which require careful development of a project program prior to the beginning of the actual design of the project.

The last hundred years have brought dramatic changes related to the public perception of the design, furnishing, and size of the American house. According to the National Association of Home Builders (NAHB), the "typical" American house built in 1900 was between 700 and 1200 square feet (65 and 111 m²), with two or three bedrooms and one or no bathrooms. The average home built in 1950 was 983 square feet (91 m²), with 66 percent of homes containing two bedrooms or fewer. These earlier homes are quite a contrast to the 2736-square-foot (245-m²) average found in new single-family homes completed in the first quarter of 2015 (Figure 1-2).

The authors argue that a larger house is not necessarily a better house and that designing a house that works well on a functional level is more important than mere size in creating a useful and pleasant environment. Additionally, large single-family homes are currently out of the financial reach of many citizens, driving many into the rental market. Furthermore, such large single-family homes are seen by some as wasteful in a time when issues of sustainability are increasingly engaging many across the globe.

Consideration of housing size and use of related resources is not unique to this publication. Architect Sarah Susanka's book *The Not So Big House* has proven very popular, helped many people consider quality over quantity of space, and had an impact on the design of many homes (1998). *A Pattern Language*, by Christopher Alexander and colleagues, an earlier book considered seminal by many, has at its core the notion that spaces should be designed for the way people really live and that good design can be accessible for all (1977).

The notion of seeking quality of design rather than quantity of space is shared by many, and yet larger and larger houses continue to be built to house very small family groups. This dichotomy suggests that two opposing popular views of space exist. Although the architect Philip Johnson was once quoted as saying "architecture is the art of wasting space," clearly that was a bit tongue-in-cheek, and we concur more with Walt Whitman's notion that "every cubic inch of space is a miracle"—or should be.

Tiny Houses

While the average home in the United States has reached a new high in terms of square footage, the "tiny house" movement is gaining momentum. Roots of this approach can be found in the work of Jay Shafer, author of *The Small House Book*. Marianne Cusato, designer of the Katrina Cottages, has also been instrumental in igniting this movement. Cusato's Katrina Cottages were 308 square feet (28.6 m²) and designed as an alternative to the FEMA trailers used to house people who had lost their homes in Hurricane Katrina. The financial crisis of 2007–08, the limited affordability of housing, and a growing interest in sustainability and energy efficiency have combined to create a wave of interest in micro-homes.

Current building and zoning codes can create obstacles to inhabiting these micro-homes. Most building codes require a residence to meet minimum square footage requirements, but micro-homes are often well under this size. Placing the structure on wheels allows the home to meet the legal definition of a recreational vehicle or camper. However, many communities have zoning regulations or laws prohibiting long-term occupation of campers on residential lots. Additionally, some RV parks do not welcome tiny homes. Currently there is an absence of clear legal status of these tiny homes, or legal limitations on their use. Given the growing interest in the concept and issues with affordability and efficiency of traditional homes, the legal landscape may change to become more accepting of this type of dwelling.

The remainder of this chapter covers issues that relate to housing and serve as an introduction to the concepts that are covered in each chapter. In addition, basic interior design graphics are covered as an introduction to chapter illustrations.

HUMAN BEHAVIOR AND HOUSING

Environmental designers—including interior designers—benefit from gaining an understanding of human behavior as it relates to privacy, territoriality, and other issues connected to

1950	1970	1990	2007	2015
983 SQ. FT. (91 m²)	1,500 SQ. FT. (139 m²)	2,080 SQ. FT. (193 m²)	2,521 SQ. FT. (234 m²)	2,736 SQ. FT. (254m²)

Figure 1-2 The average new home in the United States has grown in size over time—despite the fact that family size has grown smaller. However, larger is not necessarily better, and well-planned spaces need not be excessively large. Given land and construction costs, as well as environmental concerns, smaller houses may be a necessity in the future. Numbers for square footage shown do not include garage spaces.

the built environment studied. Privacy can be defined as the ability to control our interactions with others.

According to Jon Lang, "The ability of the layout of the environment to afford privacy through territorial control is important because it allows the fulfillment of some basic human needs" (1987). Lang goes on to say that the single-family detached home "provides a clear hierarchy of territories from public to private."

Lang also states that "differences in the need for privacy are partially attributable to social group attitudes." He continues, "Norms of privacy for any group represent adaptation to what they can afford within the socioeconomic system of which they are a part." From Lang's comments, we can learn that the need for privacy is consistent but that privacy norms vary based on culture and socioeconomic status.

The notion of territory is closely linked to privacy in terms of human behavior. There is a range of theoretical work concerning the exact name and number of territories within the home. One, developed by Clare Cooper, describes the house as divided into two components: the intimate interior and the public exterior (1967). Interestingly, Cooper (now Cooper Marcus) later wrote *House as a Mirror of Self: Exploring the Deeper Meaning of Home* (1995), which traces the psychology of the relationship we have with the physical environment of our homes, and in which she refers to work being done by Rachel Sebba and Arza Churchman in studying territories within the home. Sebba and Churchman have identified areas within the home as those used by the whole family, those belonging to a subgroup (such as siblings or parents), and those belonging to an individual, such as a bedroom, a portion of a room, or a bed (1986). Figures 1-3a and 1-3b illustrate various theoretical approaches to territory and privacy.

The term *defensible space* was coined by Oscar Newman in relation to his study of neighborhood safety and refers to "a range of mechanisms—real and symbolic barriers . . . that combine to bring an environment under the control of its residents." Defensible space, as described by Newman, includes *public, semipublic, semiprivate*, and *private territories* (1972). Newman's work includes studies of various forms of housing (single-family attached, detached, high-rise, etc.) and the influence of the building type and design on territoriality and safety.

While there is variety based on housing type, Newman defines public spaces as streets, sidewalks, and those areas near or adjacent to the dwelling not possessed by any individual. Semipublic spaces include those areas that may be publicly owned but are cared for by homeowners, such as planted parkways adjacent to sidewalks. Semiprivate spaces can include yards or spaces owned in association. (Some theoreticians include porches and foyers in this category.) Private territory is the interior of a home, fenced areas within a yard, or the interior of a student's dorm room. Private interiors are seen as distinct from private exteriors in Newman's work. In addition, Newman pointed to the need for some type of buffer between the public world and private interior.

In the years since Newman's original work defining defensible space and related territories, his theories have come under some criticism; however, his work continues to have implications for planners, architects, and interior designers because taking these concepts into account in designing homes can help to create spaces in which residents feel safe and have genuine control over their immediate environment. See Figures 1-3a and 1-3b.

In *A Pattern Language*, Christopher Alexander and his colleagues describe territories as falling along an *intimacy gradient*, which is a sequence of spaces within the building containing public, semipublic, and private areas. The bedroom and bathroom are the most private, and the porch or entrance space the most public. Alexander writes, "Unless the spaces in a building
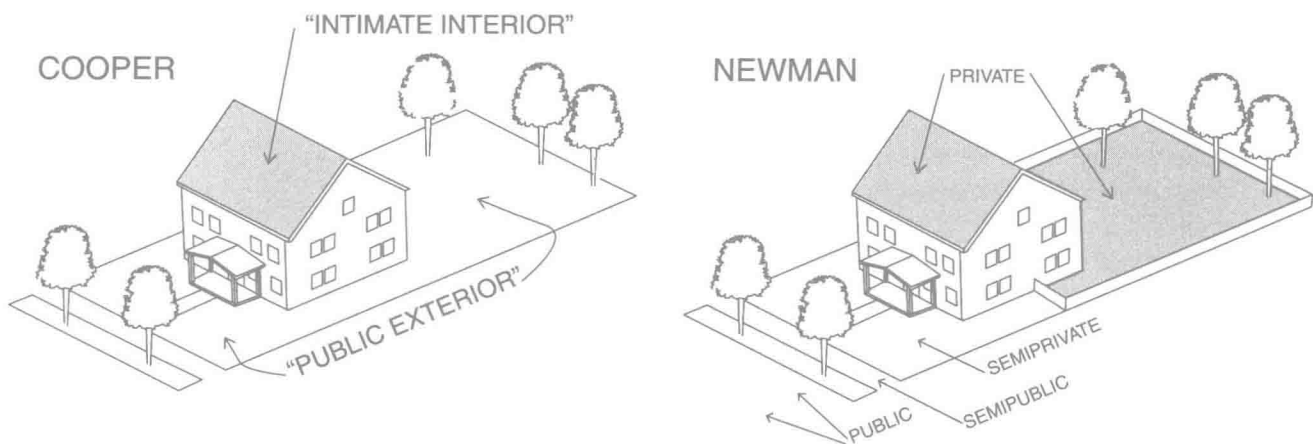
Figure 1-3a An illustration of territories as identified by theoreticians. Cooper identifies a public exterior and an intimate interior. Newman identifies public territories, which are not possessed or claimed; semipublic territories such as sidewalks, which are not owned but are seen as being possessed nonetheless; semiprivate territories, which are shared by owners or seen as being under surveillance by neighbors, such as front yards or shared swimming pools; and private territories, such as the private interior of a house or a fenced-in backyard.

NEWMAN
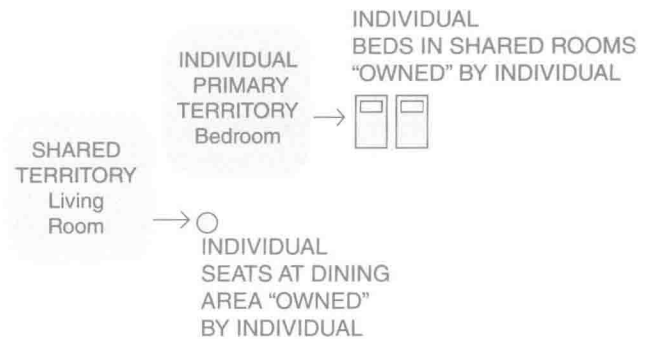
ALEXANDER et al.
INTIMACY GRADIENT

ENTRANCE   PUBLIC   SEMIPUBLIC   PRIVATE

SEBBA AND CHURCHMAN
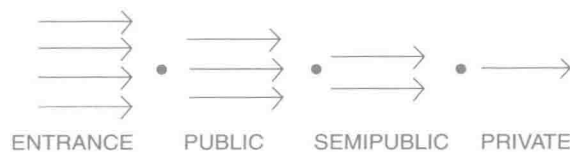
Figure 1-3b An illustration of territories related to interior space. Oscar Newman described the need for some type of buffer between the public world and private interior territories. Sebba and Churchman describe areas within a home that are used by all as "shared territory," with limited privacy; "individual primary territories" are those seen as belonging to individuals, such as a bedroom, which becomes the private sanctuary of the individual. Alexander et al. describe an intimacy gradient, with the most public spaces related to the entrance leading to a sequence of increasingly private spaces.

are arranged in a sequence which corresponds to their degrees of privateness, the visits made by strangers, friends, guests, clients, family will always be a little awkward." The intimacy gradient is shown in Figure 1-3b. Chapter 2 provides additional information about public and private spaces as they relate to entry spaces.

Personal space is a term introduced by Robert Sommer in the 1960s. According to Sommer, "personal space refers to an area with an invisible boundary surrounding the person's body into which intruders may not come" (1969). See Figure 1-4a.

A similar-sounding term, *personal distance*, expresses a different concept and comes from work done by Edward Hall, an anthropologist who coined the term *proxemics*—for the "interrelated observations and theories of man's use of space as a specialized elaboration of culture" (1966). Hall identified four distinct body distances or boundaries that people will maintain in varying social situations: *intimate* (0 to 18 inches [0 to 0.5 m]), *personal-casual* (1½ to 4 feet [0.5 to 1.2 m]), *social-consultative* (4 to 12 feet [1.2 to 3.7 m]), and *public* (12 feet [3.7 m] and beyond). Each of the four types of boundaries has a close phase and a far phase, as shown in Figure 1-4b. Hall found that while actual spatial boundaries vary based on cultural differences, the concepts of intimate, personal, social, and public distances are consistent cross-culturally.
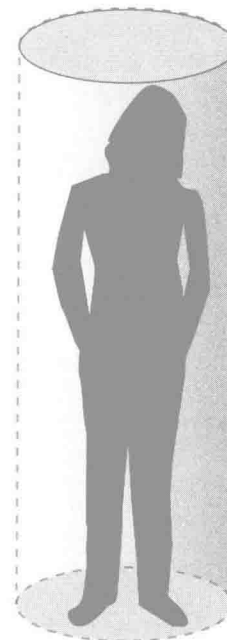
Figure 1-4a Sommer's personal space, which "refers to an area with an invisible boundary surrounding the person's body into which intruders may not come."

Hall's term *personal distance* refers to the distance maintained between friends and family members for discussion and interaction, whereas Sommer's term *personal space* refers to the invisible, territorial boundary around each person. Similarly, Hall's *intimate space* is a "bubble" of space around a person that can be entered only by intimates, whereas *social-consultative spaces* are those in which people feel comfortable engaging in routine social interaction for business or in conversation with strangers. *Public space* is that where there is little interaction and people are generally comfortable ignoring one another; this distance also allows one to flee when danger is sensed.

Considering Hall's spatial boundaries can be useful for designers in planning living spaces. For example, most casual social interaction takes place within personal distances. Later portions of this book focus on specific room-related dimensional information for encouraging interaction and creating privacy. It is also worth noting that in designing public and commercial spaces that encourage interaction and help users attain privacy, the designer will find it helpful to reference the work of social scientists such as Hall, Newman, Lang, and others. For those seeking additional information about environmental psychology and the related work of other social scientists, the references at the end of this chapter include related bibliographic information.

Figure 1-4b Hall's personal boundaries or body distances. Hall identified four distinct body distances or boundaries that people will maintain in varying social situations:

Intimate: 0 to 18 inches (0 to 0.5 m); *close phase* 0 to 6 inches (0 to 0.2 m), *far phase* 6 to 18 inches (0.2 to 0.5 m)
Personal-casual: 1½ to 4 feet (0.5 to 1.2 m); *close phase* 1½ to 2½ feet (0.5 to 0.8 m), *far phase* 2½ to 4 feet (0.8 to 1.2 m)
Social-consultative: 4 to 12 feet (1.2 to 3.7 m); *close phase* 4 to 7 feet (1.2 to 2.1 m), *far phase* 7 to 12 feet (2.1 to 3.7 m)
Public: 12 feet and beyond (3.7 m and beyond); *close phase* 12 to 25 feet (3.7 to 7.6 m), *far phase* 25 feet (7.6 m) and beyond

AN OVERVIEW OF CHAPTER TOPICS

Generally, the remainder of this first chapter is organized in a manner that is similar to most of the following chapters covering individual rooms and spaces. This chapter serves as an introduction to the definitions, concepts, and organizing principles that will be used throughout this book. Topics are as follows:

Accessibility, universal design, and visitability

Sustainability (also listed in relationship to specific items as necessary and not covered in detail in rooms that do not present specific challenges)

Ergonomics and required clearances

Organizational flow

Related codes and constraints

Electrical and mechanical

Lighting (while lighting is clearly part of the electrical system, it is separated here for purposes of organization)

INTRODUCTION TO ACCESSIBILITY NOTES

Throughout this book, content related to accessible design is treated visually similarly to this section in order to make it easy to reference.

ACCESSIBILITY, UNIVERSAL DESIGN, VISITABILITY, AND USABLITY

The terms *accessible design* and *universal design* are used interchangeably by some; however, for the purposes of this book they are considered distinct. The nuances involved are discussed below.

The term *accessible* was initially used to describe environments that do not present physical barriers for people with physical limitations, such as wheelchair users. The University of Washington defines accessible design as

a design process in which the needs of people with disabilities are specifically considered. Accessibility sometimes

refers to the characteristic that products, services, and facilities can be independently used by people with a variety of disabilities.

According to Dr. Edward Steinfeld of the Center for Inclusive Design and Environmental Access (IDEA Center):

> Accessible design allows people with disabilities to demonstrate that they have capabilities—to work, manage a household, marry and raise children [—that] they can play a vital role in the community (1996).

Generally, the design of private, single-family homes is not mandated by any current accessibility regulations except as noted later in this chapter. However, many homeowners seek residences that are accessible, either because they plan to "age in place" in the home (defined as growing older in one's home without having to relocate) or because they or a family member have current needs that warrant the design of accessible spaces. These two distinct scenarios present two distinct design criteria.

In cases where current physical or other limitations create the need for accessible spaces, the design should address the specific needs of the owner or family member. For example, designing a home for a specific person who uses a wheelchair requires meeting a set of appropriate criteria and guidelines, whereas designing a home for a person with a vision impairment requires considering a different set of standards and guidelines.

In contrast, designing a home for aging in place or for general accessibility requires making design decisions based on basic accessibility standards and guidelines. These are presented throughout this book as part of the body of each chapter, set apart and identified as an Accesiblity Note (as this section is set apart). Incorporating accessibility information for each area is intended to provide readers with a comprehensive view of accessible design. Information about regulations and standards for accessibility is provided in the "Related Codes and Constraints" section of this chapter.

In cases where a home is intended to be wheelchair accessible, adequate clearance space must be provided for the chair as the user accesses items for daily activities; in addition, appropriate circulation space and turning space must be provided. See Figures 2-14b and 2-14c for specific information about wheelchair-accessible circulation and clearance requirements. Additional detailed information is provided in each room-based chapter within these Accessibility Note sections.

The concept of universal design grew, in part, out of the accessible design movement, but it is not synonymous with accessibility. Ron Mace, an architect, product designer, and educator, is credited with coining the term;

he also established what is now the Center for Universal Design at North Carolina State University. According to the IDEA Center (SUNY at Buffalo), universal design can be defined as

> an approach to the design of all products and environments to be as usable as possible by as many people as possible regardless of age, ability or situation [and that] results in better design and avoids the stigmatizing quality of accessible features that have been added on late in the design process or after it is complete.

Additional insight is provided by the Center for Universal Design at North Carolina State University:

> The intent of universal design is to simplify life for everyone by making products, communications, and the built environment more usable by as many people as possible at little or no extra cost. Universal design benefits people of all ages and abilities.

An example of universal design are lever door handles, which work well for people with limited hand strength but also work well for as many other people as possible. The lever design does not limit use but extends it to the greatest possible number of people.

One approach to universal design in the home is to provide *adaptable* elements designed to offer greater flexibility for a range of occupants. For example, counters can be made so that they are adjustable to adapt for users of varying heights (including those using seats and wheelchairs). Adaptable cabinets can be designed with fronts and bases that can be removed to create a clear area underneath for use by someone in a wheelchair. Illustrations of both of these examples can be found in Chapter 4.

Some common features to include to create a home that incorporates universal design principles are as follows: no stairs (at the entry or within the home); wide doorways to allow for wheelchairs and general ease of movement; wide hallways for wheelchairs and ease of movement; extra floor space, especially in areas such as bathrooms and kitchens and around closets and utility areas, allowing for wheelchair use as well as extra space for movement. Following the specific requirements for space for wheelchair movement included in the accessibility section of each chapter can aid in the creation of a home that meets universal design principles because it is usable by a wide range of people.

Visitability is a concept that shares some commonalities with universal design concepts; it refers to creating homes that can be visited or accessed by people with physical disabilities and is sometimes called basic home access or inclusive home design. Visitable residences must meet three important criteria:

■ At least one zero-step entrance approached by an accessible route on a firm surface no steeper than 1:12, proceeding from a driveway or public sidewalk.

■ Wide passage doors: all main-floor interior doors, including the bathroom, must provide 32 inches (813 mm) of clear passage space.

■ At least a half bath/powder room on the main floor (a full bath on the main floor is ideal).

Eleanor Smith is a founder of Concrete Change, a group that advocates to have visitability ordinances federally mandated or adopted by various jurisdictions. To date, a number of jurisdictions, including Austin, Texas; Vancouver, British Columbia; and Pima County, Arizona, have adopted visitability ordinances. Other jurisdictions have adopted visitability ordinances for residences built using city funds. (It is worth noting, however, that Pima County and Austin allow 32-inch [813-mm] doors, providing only 30 inches [762 mm] of clear space.) While visitability is a distinct concept, its principles also can be seen as universal design because visitable spaces are intended to be used by more people than standard private housing, making them meet the definition of being "as usable as possible by as many people as possible regardless of age, ability, or situation."

Of the three criteria for visitability, the most difficult to achieve nationally is the zero-step entrance requirement. This could prove problematic in parts of the country where basements are commonplace. Typically, the main floor of a house with a basement is 18 to 20 inches (457 to 508 mm) above ground level, which could require a significant ramp for a zero-step entry. In some cases, through careful building placement and site grading, the driveway and sidewalk to the entrance can be designed with a slope of not more than 1:12 for a zero-step entry. However, recent surveys of potential homeowners and architects have shown significant interest in accessibility, and using the criteria for visitablity is a helpful first step in creating a more accessible home for both homeowner and visitors.

Usablity is a word that has meanings related to accessibility. The International Organization for Standardization (ISO) has defined usability as

> the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

Usability, also called usable design, can be tested and measured. While most often used in relation to describing electronics and communication, usability testing can be employed to test a range of products and environments. Although usablity shares goals with accessibility and universal design, usability studies do not necessarily include testing of people with a range of abilities and are not necessarily conducted for the purpose of achieving universal design. According to the University of Washington's DO-IT website (2013), if "designers apply universal design principles, with a special focus on accessibility for people with disabilities, and if usability experts routinely include people with a variety of disabilities in usability tests, more products will be accessible to and usable by everyone."

Table 1-1 Differences among Accessibility, Universal Design, Visitabiliy, and Usabillity

Term	Definition	Comment
Accessibility	The extent to which design specifically considers the needs of people with disabilities. Accessibility sometimes refers to the characteristic that products, services, and facilities can be independently used by people with a variety of disabilities.	Accessible and universal design both address the needs of users beyond those considered "average" or "typical."
Universal design	The design of all products and environments to be as usable as possible by as many people as possible regardless of age, ability, or situation.	Accessible and universal design both address the needs of users beyond those considered "average" or "typical."
Visitability	The extent to which new homes are designed so that they can be visited or accessed by people with physical disabilities.	Visitable homes incorporate concepts of universal design in that they can be used by a wider range of people than standard housing.
Usability	The extent to which products are easy and efficient to use.	While concerned with creating efficiency and ease of use, usability testing may not consider accessibility or the universal design of products because it may be focused on one specific type of user.

Introduction to Sustainability Notes

Throughout this book, content related to sustainability is treated visually similarly to this, in order to make it easy to reference. This section provides an overview, including background and historical information related to sustainability.

According to Alice Rawsthorn (2010),

> While most designers would agree that sustainability is important, they're very likely to disagree about everything else to do with it. What exactly is sustainable design? What constitutes success? And failure? On what criteria? Different designers may well give very different answers to all of those questions, and more.

As the previous quote indicates, perhaps more than any current area of design, definitions of sustainable design and green design seem to cause confusion, consternation, contradiction, and a search for clear answers. One way to understand issues of sustainability is to clearly define some commonly used terms and to outline areas of agreement and disagreement.

According to Louise Jones, writing in *Environmentally Responsible Design* (2008), "*sustainable design* suggests a macro perspective on environmental responsibility—protection of the health of and welfare of *global ecosystems*," whereas "*green design* suggests a micro perspective," related to protection of health and welfare of the people in the "built environment." And, according to Jones, *environmentally responsible design* (ERD) is "a combination of green and sustainable design."

Francis Ching (2008), an architect, educator, and author of seminal design books, has defined *sustainability* as "a whole-systems approach to development that encompasses the notion of green building but also addresses broader social, ethical and economic issues, as well as the community context of buildings."

Both Ching and Jones trace the roots of definitions of sustainable design and development to the 1987 United Nations World Commission on Environment and Development. The commission, also known as the Brundtland Commission after Gro Harlem Brundtland, its chairman, defined *sustainable development* as follows:

> Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:
>
> the concept of "needs," in particular the essential needs of the world's poor, to which overriding priority should be given
>
> the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs

Internationally, in 1990 England established the Building Research Establishment Environmental Assessment Method (BREEAM), the first environmental assessment tool to be used internationally. The tool was created to be used in analysis of new and existing buildings in terms of review and improvement of office buildings. BREEAM has been used as a model for systems developed in other countries. In addition, several European countries have joined efforts to define methodology for life-cycle analysis of buildings.

The World Green Building Council (WorldGBC) is a network of international green building councils that seeks "to promote local green building actions and address global issues such as climate change."

In seeking out helpful definitions, it is worth noting that the U.S. Environmental Protection Agency (EPA, 2010) has defined *green building* as

> The practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. . . . Green building is also known as a sustainable or high performance building.

The EPA (2010) also indicates that

> Green buildings are designed to reduce the overall impact of the environment on human health and the natural environment by:
>
> Efficiently using energy, water, and other resources
>
> Protecting occupant health and improving employee productivity
>
> Reducing waste, pollution and environmental degradation

According to the EPA, important developments in the United States related to green building history include those listed in Table 1-2.

The EPA has also identified the items covered in Table 1-3 as impacts of the built environment.

As one evaluates products and design solutions, it is worth measuring their impact as indicated in Table 1-3. This means not only assessing initial product sourcing or production but also considering how the demolition (deconstruction) may impact the environment.

Reviewing history and defining terms related to sustainability can provide a context and a framework for understanding this rather complex aspect of current design practice. Based on the definitions found in the preceding paragraphs, for the remainder of this book, we will use the following definitions.

Defining Sustainability

> *Sustainability* can be seen as a "whole-systems approach to development that encompasses the notion of green building but also addresses broader social, ethical and economic issues." (Ching, 2008)

Table 1-2 Recent Green Building History in the United States

Historical Development	Year
American Institute of Architects (AIA) formed the Committee on the Environment (COTE).	1989
Environmental Resource Guide published by AIA, funded by EPA.	1992
EPA and the U.S. Department of Energy launched the Energy Star program.	1992
Executive Order 13123: Greening the Government through Efficient Energy Management.	1992
First local green building program introduced in Austin, Texas.	1992
U.S. Green Building Council (USGBC) founded.	1993
USGBC started Leadership in Energy and Environmental Design (LEED version 1.0 pilot program).	1998
First commercial-scale net-zero building project completed at Oberlin College, in Ohio.	2000
Energy Policy Act: includes building standards for federal buildings.	2005
The Energy Independence and Security Act of 2007.	2007
EPA adopted a new Green Building Strategy guide for EPA buildings.	2008
The International Code Council began development of the International Green Construction Code (IGCC), a model code jointly sponsored by AIA, ASTM International, ASHRAE, and IES.	2009
American Institute of Architects (AIA) created the 2030 Commitment, asking organizations to pledge to advance the goal of carbon-neutral buildings by 2030.	2009
2010 California Green Building Standards Code released (updated in 2013).	2010
ASHRAE (American Society of Heating Refrigerating and Air-Conditioning Engineers) released Standard 189.1: Standard for the Design of High-Performance Green Buildings. Initial draft created in 2007.	2010
The International Code Council (ICC) released the 2012 International Green Construction Code (IgCC), a model code jointly sponsored by AIA, ASTM International, ASHRAE, and IES. An updated version was approved in 2015.	2012
USGBC: Leadership in Energy and Environmental Design, LEED version approved.	2015

Table 1-3 Environmental Impacts of the Built Environment According to the EPA

Aspects of Built Environment	Consumption	Environmental Effects	Ultimate Effects
Siting (building site) Design Construction Operation Maintenance Renovation Deconstruction	Energy Water Materials Natural resources	Waste Air pollution Water pollution Indoor pollution Heat islands Storm-water runoff Noise	Harm to human health Environmental degradation Loss of resources

Green building (or green design) is the design of buildings that are efficient in the use of resources, limit the impact of building on the environment, and incorporate sustainable materials in their construction—all of which make green building part of sustainable development.

Green building standards programs include those certified by LEED, those required by the International Green Construction Code (IgCC); a variety of product standards and certification programs, including McDonough Braungart Design Chemistry (MBDC); and local, tribal, and state codes and building legislation (including CALGreen).

The U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) green building certification system is a set of green construction standards for certification that are widely recognized in the United States. In addition to setting standards that result in a building's receiving LEED certification, USGBC also grants LEED professional credentials for design and construction professionals. (This is done in conjunction with the Green Building Credential Institute [GBCI].) Additional detailed information about LEED building rating systems can be found in Appendix A.

The International Green Construction Code (IgCC) is a model code developed by the American Institute of Architects, ASTM International, and others in keeping with the American Institute of Architects 2030 Carbon Neutrality Goal. Additional information about the IgCC can be found in Appendix A.

The California Green Building Code includes *mandatory provisions for residential* and nonresidential buildings as well as voluntary standards for both residential and nonresidential buildings. Residential mandatory requirements include planning/design; water efficiency/conservation; material and resource efficiency; building maintenance and operation; environmental quality, a section containing detailed requirements for sealants, coatings (including paint), carpet (and carpet cushion), and other interior finishes and materials; interior moisture control; environmental comfort; interior air quality; and exhaust.

In some cases, states and cities have LEED-based regulations that govern new projects, while in other cases, states and cities offer incentives for green building and energy efficiency. The State of Minnesota Sustainable Building Guidelines (known as B3 Guidelines) require compliance on projects receiving state funding and can be used voluntarily on other projects.

Another approach to sustainability is known as MBDC and is based on the framework developed by William McDonough and Michael Braungart and described in their book *Cradle to Cradle: Remaking the Way We Make Things*. As indicated on the MBDC website, this framework "moves beyond the traditional goal of reducing the negative impacts of commerce ('eco-efficiency'), to a new paradigm of increasing its positive impacts ('eco-effectiveness')." This approach addresses the use of energy, water, and social responsibility; MBDC sets criteria for C2C certification of products, produces case studies, and consults with a wide range of clients.

In addition to LEED, IGCC, and MBDC, there are a number of programs that provide certification and standards for green products and materials; some of these are listed in Appendix A. Such standards are one way for designers to seek out products that meet some of the criteria set by the EPA, as follows:

Green buildings may incorporate *sustainable* materials in their construction (e.g., *reused, recycled-content*, or made from *renewable resources*); create *healthy indoor environments* with *minimal pollutants* (e.g., reduced product emissions); and/or feature landscaping that *reduces water usage* (e.g., by using native plants that survive without extra watering).

Using some type of rating or certification system, in combination with weighing what is called for in the preceding quote, can provide a method for designers to determine whether a product is, in fact, green. Measuring products against such criteria is helpful because *greenwashing*, which is defined as making misleading statements about products or practices relative to issues of sustainability, is an ongoing problem.

Another important approach to analyzing sustainability is known as *life-cycle assessment* (LCA), which is a process that involves reviewing the total impact of a product's environmental cost over the *lifetime* of the product or building. According to the EPA, LCA "is unique because it encompasses all processes and environmental releases beginning with the extraction of raw materials and the production of energy used to create the product through the use and final disposition of the product. When deciding between two or more alternatives LCA can help decision-makers compare all major environmental impacts caused by products, processes or services."

A life-cycle assessment is an evaluation of the environmental consequences associated with a product or process. According to ISO 14040.2, "The assessment is a systematic set of procedures for compiling and examining the *inputs* and *outputs* of materials and energy and the associated impacts directly attributable to the functioning of a product or service system throughout its life cycle." The term *life cycle* refers to the activities occurring in the course of the product's life span, including use of raw materials and their acquisition, production, shipping, installation, maintenance, and disposal. By evaluating all phases of a product's life span, this assessment can aid in avoiding shifting environmental impact to the future or to future generations.

Issues mentioned thus far regarding sustainability are not specific to the design of houses but rather are intended to provide clarity and background. Some programs specific to the design and construction of homes are listed in Table 1-4.

While there are not currently many *mandatory* green codes regulating private residential design, residences should not be overlooked in terms of environmental impact or indoor air quality. According to the Consumer Reports website Greener Choices, "using green building