Facilitating Change in the Housing Industry Toward Universal Design

Brittnie Miller
University of Nebraska-Lincoln

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FACILITATING CHANGE IN THE HOUSING INDUSTRY

TOWARD UNIVERSAL DESIGN

by

Brittnie L. Miller

A THESIS

Presented to the Faculty of

The Graduate College at the University of Nebraska

In Partial Fulfillment of Requirements

For Master of Science

Major: Architecture

Under the Supervision of Professor Betsy Gabb

Lincoln, Nebraska

December 2014
The intent of this thesis is to provide an introductory guide for interior designers, homeowners, builders, and those interested in the concepts of universal design. It is tailored to the target markets of interior design and those within the housing industry, but leaves an open conversation to create a relationship between the housing industry and homeowners.

Looking at the history of universal design and how it has evolved through the years will give readers a beginning point to start a comparison of the residential design standards and universal design measurements. Using the comparison, case studies will be reviewed and similarities will be found to show that universal design measurements and details can be implemented successfully. A compilation of measurements and recommendations begins the conversation between homeowners, designers, and others within the housing industry.

Incorporating universal design into spaces can ensure a level of safety and accessibility to everyone. Laying out guidelines that are the standard and comparing them to the universal design measurements will connect the two to show how uncommon universal design is and can be within a person’s home. Universal design guidelines can benefit all people regardless of the geographic region they live, their age or physical abilities.
Acknowledgments

Thanks to my interior design friends, who I consider my second family, for continuously pushing me to my highest potential and knowledge of this design niche.

Thanks to my family for pushing me to finish and having patience as I completed this goal.

Special thanks to Betsy Gabb for telling me that I’m my own worst enemy and reminding me that it’s not as bad as it seems, and for also answering all my questions and keeping my complicated, simple.

Very special thanks to my mother, who became as involved in this undertaking as I did. She continuously read this paper and reminded me of my ‘why’ when I forgot.
Table of Contents

Introduction to Review of Literature .................................................................1
Introduction ............................................................................................................2
History ..................................................................................................................4
Definitions ............................................................................................................8
A comparison of Guidelines ..................................................................................13
  Bedroom ..............................................................................................................13
  Kitchen ...............................................................................................................15
  Bathroom ..........................................................................................................31
  Living Room .....................................................................................................45
  Entry ..................................................................................................................46
  Miscellaneous Spaces .......................................................................................46
Economic Feasibility ............................................................................................49
Methodology ........................................................................................................51
  Three-Story Bungalow ......................................................................................51
  6 North Apartments ..........................................................................................57
  Lindsay Home ..................................................................................................60
  Conclusions ......................................................................................................69
Proposed Recommendations ................................................................................70
Conclusions and Implications .............................................................................73
References ..........................................................................................................75
List of Multimedia Objects

Figure 1  A G-shaped kitchen layout ................................................................. 16
Figure 2  An L-shaped kitchen layout ................................................................. 16
Figure 3  A kitchen designed on one wall ........................................................... 16
Figure 4  A corridor kitchen ............................................................................. 17
Figure 5  A U-shaped kitchen ............................................................................ 17
Figure 6  Bathroom layout option ..................................................................... 32
Figure 7  Bathroom layout option ..................................................................... 32
Figure 8  Bathroom layout option ..................................................................... 32
Figure 9  Bathroom layout option ..................................................................... 32
Figure 10 Bathroom layout option ............................................................... 32
Figure 11 Bathroom layout option ................................................................... 32
Figure 12 Baldwin Master Bathroom ............................................................. 53
Figure 13 Baldwin Master Bathroom ............................................................. 53
Figure 14 Baldwin zero-entry .......................................................................... 54
Figure 15 Baldwin open layout ........................................................................ 54
Figure 16 Baldwin reading space ...................................................................... 55
Figure 17 6 North Apartment Floor Plan Option ........................................... 58
Figure 18 6 North Apartment Floor Plan Option ........................................... 58
Figure 19 6 North Apartment Bath/Laundry .................................................... 59
Figure 20 6 North Apartment Kitchen ............................................................ 59
Figure 21 Lindsay Home Front Door ............................................................... 60
Figure 22 Lindsay Home Entry ................................................................. 60
Figure 23 Lindsay Home Kitchen ..................................................................... 61
Figure 24 Lindsay Home Kitchen ..................................................................... 62
Figure 25 Lindsay Home Kitchen ..................................................................... 62
Figure 26 Lindsay Home Kitchen ..................................................................... 63
Figure 27 Lindsay Home Laundry Room .......................................................... 64
Figure 28 Lindsay Home Master Bathroom .................................................... 64
Figure 29 Lindsay Home Master Bathroom .................................................... 65
Figure 30 Lindsay Home Walk-in Closet ......................................................... 65
Introduction to Review of Literature

The housing industry is one industry that will not disappear in future years. Taking a closer look at the housing industry, a home can be designed with spaces that can maximize functionality for any user.

One way to maximize functionality is the incorporation of universal design and aging in place concepts. A commonly accepted definition of universal design is from the late Ron Mace of North Carolina State University, “Universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design” (The Principles of Universal Design at Center for Universal Design, n.d.). The overall 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, maximizing the functionality for any user. Universal design guidelines can benefit all people regardless of the geographic region they live, their age or physical abilities.
Introduction

“It used to be that designers made an object and walked away. Today the emphasis must shift to designing the entire life cycle.” – Paul Saffo (n.d., Futurist Paul Saffo on Design - Corporate Design Foundation)

“In 2011, in communities across the country, the leading edge of the Baby Boom generation reached age 65. By 2030, more than 70 million Americans—twice the number in 2000—will be 65 and older. At that time, older adults will comprise nearly one in five Americans” (Lipman, 2012). The Baby Boom generation is continuously growing, and is one of the more important parts of the housing industry. “Nearly 90 percent of people over age 65 want to stay in their home for as long as possible, and 80 percent believe their current residence is where they will always live. However, for older adults to age in place, their physical and service environment must be accommodating” (Aging in Place: A State Survey, n.d.). With an increase in an aging population, universal design can become an important design concept in housing.

According to Ron Mace, “Universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design” (North Carolina State University, n.d.). The universal design concept is important within the housing industry, not just within commercial spaces. Utilizing universal design and aging in place can provide a space that offers invisible transitions allowing any user to take advantage of the space, disabled or not, young or old. Utilizing concepts of universal design ensure the home will fit the lifestyle of any user with little to no modifications.
An example of how a space can ensure it will fit the lifestyle of the user with little to no modifications would be the living room. A living room could be designed for a younger couple that needs the space to entertain friends and family. As they age within their home, this younger couple could have children and need to have the space for their children’s activities around the home. As they progress to the empty nester stage or retirement, this room could need space for wheelchair accessibility or for space for another disability. If the younger couple chose to move or a major life event happened, this home that was designed universally would be open to a new user with little to no need for modifications. Universal design gives not only small details to a home but a big picture as well. As the aging population looks to stay in their homes, creating homes with well-designed spaces and the support necessary for a person’s lifestyle on any level will encourage aging in place.

This thesis will serve as an introductory guide for interior designers, homeowners, builders, and those interested in the concepts of universal design. It is tailored to the target markets of interior design and those within the housing industry, but leaves an open conversation to create a relationship between the housing industry and homeowners. These guidelines will provide a simple, yet descriptive path to achieve universal design concepts within a home, without sacrificing functional space for the user.
History

People are living longer today and the average lifespan has increased due to better technology and medicine. “By 2050 the 65+ population is expected to grow from 40 million today to more than 88 million. In other words, one in every five Americans will be over 65” (Lipman, n.d.).

It is estimated that among the population 6 years and over, 8.6 million people had difficulty with one or more activities of daily living and 4.1 million needed personal assistance of some kind (McNeil, 1997). This shows that there is a need for a design that is for all people to utilize no matter their day-to-day life.

In an ever-changing environment, an evolving home and community accommodates a person’s lifestyle. The evolving environment ensures an ever-changing design to entertain the lifestyles of more than one user of a space. Universal design’s evolvement has been strong and can be influential to the evolvement of an environment a person’s lifestyle is found within.

Legislation from the Americans with Disabilities Act (ADA) has evolved now accommodating for the needs of the housing industry as well as commercial spaces. The three primary pieces contributing to the legislation were the Disability Rights Movement, the barrier-free design to universal design movement, and advances in rehabilitation engineering and assistive technology. These three pieces fueled the progress of the Americans with Disabilities Act (ADA).

The Disability Rights Movement influenced legislation from the 1970s until the 1990s. According to the Center for Universal Design, laws were created through the years prohibiting discrimination against people with disabilities and providing access to
places of public accommodation, transportation, and education (The Center for Universal Design - Universal Design History, n.d.).

The barrier-free movement was the beginning of change in public policies and design practices. Disabled veterans and those advocating for the disabled began to press for better opportunities in education and employment rather than health care and maintenance. The biggest hindrance that was recognized was physical barriers around spaces and entrances. Recognizing these hindrances, national standards for ‘barrier-free’ buildings were developed (The Center for Universal Design - Universal Design History, n.d.).

Numerous states developed their own accessibility standards and by 1984, an attempt to ‘standardize’ these guidelines occurred when The American National Standards Institute (ANSI) specifications were incorporated into the Uniform Federal Accessibility Standard (UFAS). According to ANSI, their mission is “to enhance both the global competitiveness of U.S. business and the U.S. quality of life by promoting and facilitating voluntary consensus standards and conformity assessment systems, and safeguarding their integrity. The United States Access Board, the Uniform Federal Accessibility Standards (UFAS) outlines “uniform standards for the design, construction and alteration of buildings so that physically handicapped persons will have ready access to and use of them in accordance with the Architectural Barriers Act…” (United States Access Board, n.d.). A combination of these two forces not only influenced the legislation of the ADA but ensures a space that is designed for everyone.
The following timeline taken from The Center for Universal Design (n.d.) showcases significant federal legislation that was passed starting in the 1960s and continuing to the late 1990s:

- **1968**
  - The **Architectural Barriers Act** was an act that mandated the removal of the physical design of the buildings that was the most significant obstacle for people with disabilities. The Act required all buildings designed, constructed, altered, or leased with federal funds to be made accessible.

- **1973**
  - Section 504 of the **Rehabilitation Act** was the first civil rights law for people with disabilities. The act made it illegal to discriminate on the basis of disability. By 1977 regulations were established as a result of protest demonstrations when the regulations were stalled in the process.

- **1975**
  - The **Education for Handicapped Children Act** was an act that guaranteed a free education for children with disabilities.

- **1988**
  - The **Fair Housing Amendments Act** extended to the coverage of families with children with disabilities. It also required accessible units to be created, both public and private, and not just those that received federal funds.
• 1990
  - The Americans with Disabilities Act (ADA) was one that made the public aware of the rights of those that are disabled. Discrimination and physical barriers are diminished with this act. In this time, guidelines for accessible design were drawn up and issued.

• 1996
  - The Telecommunications Act took on the technology sector where services and equipment are designed to be accessible to and usable by individuals with disabilities. It is applicable to all telecommunication devices from telephones to televisions to computers.
Common Definitions Related to Universal Design

There are definitions to be aware of while implementing universal design into a home. Each has its own description as well as their own set of guidelines. The combination of definitions and guidelines set the tone of the universal design conversation and the implementation in spaces.

Universal Design

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. Ron Mace stated, “Universal design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design (n.d.).” Universal design has a list of principles that make up the guidelines of what the design should include.

Principles of Universal Design

According to the College of Design at North Carolina State University (n.d.), the Seven Principles of Universal Design, with a short description after, are as follows:

1. Principle One: Equitable Use

   The design is useful and marketable to all sorts of people with diverse abilities. Providing an invisible line between disabilities allows for the same environment for all users and makes it appealing to anyone who may use the space.

2. Principle Two: Flexibility in Use
This principle accommodates to left- or right-handed people and begins to give adaptability to the user of the space. The flexibility of the space also provides more than one activity to occur without conflict.

3. Principle Three: Simple and Intuitive Use

The designs start to become easy to understand and do not confuse the user of the environment, no matter their experience, knowledge, language skills, or current concentration level. This allows for multiple spaces to occur within one space and create a cohesive, understandable space.

4. Principle Four: Perceptible Information

Necessary information is effectively received by all users of the space. A space begins to maximize the efforts as to which the information is shown in the space, creating different sensory techniques but not limiting. Providing information in several different manners allows for different users, young or old, with a disability or not.

5. Principle Five: Tolerance for Error

Accidents are prone to happen but this principle adequately provides safe havens in times of distress. In case of emergencies, proper help and safety is provided through this principle.
6. Principle Six: Low Physical Effort

A user of the space should not become tired out from utilizing the space. To maneuver through a space should not tire an individual and utilizing flush thresholds and open spaces will help lower the effort needed.

7. Principle Seven: Size and Space for Approach and Use

Giving enough space no matter the user’s body size, posture or mobility is important in any space.

**Aging in Place**

Aging in place is a term used to describe a person living in the residence of their choice, for as long as they are able, as they age. This includes being able to have any services (or other support) they might need over time as their needs change.

To be clear: the act of aging in place takes place during a period of time in an elderly person’s life where they can have the things that they need in their daily life, while maintaining their quality of life.

**Inclusive Design**

Inclusive design aims to remove the barriers that create undue effort and separation. It enables everyone’s participation equally, confidently and independently in everyday activities. “This term was coined to describe products or environments that maintain quality of life and independent living for an aging population and because assistive or medical devices had become expensive, stigmatizing, and undesirable” (Nussbaumer, 30). Inclusive design builds off of universal design by helping create
environments that allow all people to utilize the entire environment. Inclusive design also has a set of principles that a design should be based off of:

**Five Principles of Inclusive Design**

1. **People**
   - The design should encompass people and include them from the beginning of the process. This design considers people to be placed at the heart of the design process.

2. **Diversity**
   - Diversity within the design relates to various ages, abilities, and limitations. A successful design can be created if barriers are identified early in the design process.

3. **Choice**
   - Choices are necessary within a design. One single design solution cannot accommodate all users or address everyone’s needs.

4. **Flexibility**
   - Adaptation of products and environments allow for toddlers to those in wheelchairs to utilize. This adaptation allows for flexibility within the space.

5. **Convenience**
   - Design buildings and environments that are convenient and enjoyable to use for everyone. This design would incorporate the walkways, entrances, roads and other routes. Not only modes of
transportation, but also signage, lighting, materials, and visual contrast.
Residential Design Standards versus Universal Design Standards

The basic residential design standards are a place to start when looking at universal design. These design standards give the base of what universal design standards can potentially evolve into. To evolve, like the legislation, looking at the beginning shows how the standards can change to incorporate universal design measurements. Developing a set of standards for universal design, the definitions and principles of universal design and inclusive design are taken into consideration.

The following measurements and recommendations show the first measurement as the basic, residential design standard, followed by, if any, a universal design measurement, in bold.

Bedroom

Main differences between the general and universal design standards include the circulation being 36” wide in the universal design measurements. In the standard measurements, the major circulation paths could function at 30”, while the minimum is at 24”. The universal design measurements require six more inches, allowing any user to have optimum functionality in this space. A 5’-0” wide turning radius is found in these guidelines. This allows for someone who might be in a wheelchair to have full access to the space as well.

The following present a comparison of standards with universal design standards in bold following each accepted residential standard:

- Thirty inches are required for major circulation areas, the areas in which one moves around a space. The minor circulation areas can function comfortably
at 24”. The minimum functionality is at 22” and the bare minimum to maneuver around spaces is 18”.

- The optimum circulation is 36 inches of clear space.
  - The major circulation areas should be at 36” wide.
  - There should be 36” on two sides of the bed.

- The thresholds between spaces in the openings should be minimum to zero.

- The door openings should be between 34” - 36” wide, with 32” being the minimum.

- A minimum of 18” should be found on the pull (latch) side of the door.

- There should be a 5’-0” wide turning radius.

- Closets should be walk-in or roll-in with 36” sliding doors and adjustable shelving and varied shelving heights.
  - Provide a minimum 18” x 48” space for wheelchair access through the door.

- Provide various lighting controls and technology outlets.
### Accepted Residential Design Measurements

- 30” required for major circulation areas
  - Minor circulations can function at 24”
  - The minimum functionality is 22”, and the bare minimum is 18”

- There should be a 5’-0” turning radius.

### Universal Design Measurements

- Major circulation areas should be at 36” wide.

- The universal design measurements are met through the accepted residential design measurement.

- There should be 36” on two sides of the bed.

- Thresholds between spaces in the openings should be minimum to zero.

- The door openings should be between 34” - 36” wide, with 32” being the minimum.

- A minimum of 18” should be found on the pull (latch) side of the door.

- Closets should be walk-in or roll-in with 36” sliding doors and adjustable shelving and varied shelving heights.
  - Provide a minimum 18” x 48” space for wheelchair access through the door.

- Provide various lighting controls and technology outlets.

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**Kitchen**

The spatial standards for the kitchen vary, but there are multiple questions to ask while designing. Among those questions are: knowing the number of cooks there will be on average in the kitchen is important and will determine if certain areas need more space. Two more questions to ask are how many meals are served in the kitchen and the frequency of meals prepared. This will give information as to the amount of time spent in the kitchen. Noting any other additional functionality needed in the kitchen will provide additional information for the user. There should be a floor plan that is unobstructed and maximizes work flow for the single user or multiple users. The layout generally resembles a U- or L-shaped layout. A 5’-0” turning radius should be included in any
layout of a kitchen and each work space should have a 30” x 48” area to maneuver around (Nussbaumer, Inclusive Design, 111).

There are several types of layouts of a kitchen, but a few are more common than others. Shown in Figures 1-5, the main layouts can be seen.

![Diagram of a G-shaped kitchen and an L-shaped kitchen](image)

**Figure 1 and 2** A G-shaped kitchen (left) and an L-shaped kitchen (right)

![Diagram of a kitchen designed on one wall](image)

**Figure 3** A kitchen designed on one wall.

The National Kitchen and Bath Association (NKBA) provides a set of guidelines that include the standard as well as the accessibility guideline (2012). These guidelines detail measurements that can be designed for a functional kitchen. The basic guidelines provide an efficient space but designed for people without the mindset of universal design. The universal design additions are stated in bold.

1. The clear opening of a doorway should be at least 32” (813 mm) wide.
   This would require a minimum 2’ 10” (864 mm) door.

   a. The clear opening of a doorway should be at least 33” This would require a minimum of a 3’-0” door.

2. No entry door should interfere with the safe operation of appliances, nor should appliance doors interfere with one another.
a. Adding to the standard, the entry doors should include a clear floor space for maneuvering, which varies according to the type of door and direction of approach.

3. In a kitchen with three work centers, a space that is used frequently such as the sink, refrigerator, or range, the sum of the three traveled distances should total no more than 26’ (7.9 m), with no single leg of the triangle measuring less than 4’ (1.2 m) or more than 9’ (2.7 m).
   a. When the kitchen plan includes more than three primary appliance/work centers, each additional travel distance to another appliance/work center should measure no less than 4’ (1.2 m) nor more than 9’ (2.7 m).
   b. Each part of the work triangle is measured from the center-front of the appliance/sink.
   c. No work triangle leg intersects an island/peninsula or other obstacle by more than 12” (305 mm).

4. A full-height, full-depth, tall obstacle should not separate two primary work centers. A properly recessed tall corner unit will not interrupt the workflow and is acceptable.

5. No major traffic patterns should cross through the basic work triangle.

6. The width of a work aisle should be at least 42” (1067 mm) for one cook and at least 48” (1219 mm) for multiple cooks. Measure between the counter frontage, tall cabinets, and/or appliances.
a. In addition, A clear floor space of at least 30” x 48” should be provided at each kitchen appliance. Clear floor spaces can overlap

   i. Include a wheelchair turning space with a diameter of at least 60”, which can include knee and toe clearances.

   ii. A wheelchair turning space could utilize a T-shaped clear space, which is a 60” square with two 12” wide x 24” deep areas removed from the corners of the square.

7. The width of a walkway should be at least 36” (914 mm).

   a. If two walkways are perpendicular to each other, one walkway should be at least 42” wide.

8. In a seating area where no traffic passes behind seated diner, allow 32” (813 mm) of clearance from the counter/table edge to any wall or other obstruction behind the seating area.

   a. If traffic passes behind the seated diner, allow at least 35” (914 mm) to edge past.

   b. If traffic passes behind the seated diner, allow at least 44” (1118 mm) to walk past.

   c. In a seating area where no traffic passes behind a seated diner, allow 36” of clearance from the counter/table edge to any wall or other obstruction behind the seating area.
d. If traffic passes behind the seated diner, plan a minimum of 60” to allow passage for a person in a wheelchair. This will be impacted by the depth of the knee space.

9. Kitchen seating areas should incorporate at least the following clearances:
   a. 30” high tables/counters: allow a 24” wide x 18” deep knee space for each seated diner at least 18” of clear knee space
   b. 36” high counters: allow a 24” wide x 15” deep knee space for each seated diner and at least 15” of clear knee space
   c. 42” high counters: allow a 24” wide x 12” deep knee space for each diner and 12” of clear knee space
   d. The kitchen seating areas should be 28”-34” high and 30-36” wide by 17”-25” deep to better accommodate people of various sizes or those using a mobility aide. Recommended minimum of a knee space at a table or counters is 36” wide x 27” high x 17” deep.

10. If a kitchen has only one sink, locate it adjacent to or across from the cooking surface and refrigerator.
   a. Plan knee spaces at the sink to allow for a seated user.
      Recommended minimum size of a knee space is 36” wide x 27” high x 8” deep, increasing to 17” deep in the toe space which extends 9” from the floor. Insulation for exposed pipes should be provided.
i. The sink should be no more than 34” high or adjustable between 29” and 36”.

ii. Exposed water supply and drainpipes under sinks should be insulated or otherwise configured to protect against contact. There should be no sharp or abrasive surfaces under sinks.

11. Include at least a 24” wide landing area to one side of the sink and at least an 18” wide landing on the other side.

   a. For a parallel approach for a person using a wheelchair, allow a minimum of 24” of countertop frontage from the centerline of the sink to the returning counter.

12. Include a section of continuous countertop at least 36” wide x 24” deep immediately next to a sink for a primary preparation/work area.

   a. There should be at least one 30” wide section of counter, 34” high maximum or adjustable from 29” to 36”. Cabinetry can be added under the work surface, provided it can be removed or altered without removal or replacement of the work surface, and provided the finished floor extends under the cabinet.

13. Locate nearest edge of the primary dishwasher within 36” of the nearest edge of the cleanup/prep sink.

   a. In addition, raise dishwasher 6” to 12” when it can be planned with appropriate landing areas at the same height as the sink.
b. Provide at least 21” of standing space between the edge of the dishwasher and countertop frontage, appliances and/or cabinets, which are placed at a right angle to the dishwasher.

   i. A clear floor space of at least 30” x 48” should be positioned adjacent to the dishwasher door. The dishwasher door in the open position should not obstruct the clear floor space for the dishwasher or the sink.

14. Include at least two waste receptacles. Locate one near each of the cleanup/prep sink(s) and a second for recycling either in the kitchen or nearby.

15. At least 3” of countertop frontage should be provided on one side of the auxiliary sink, and 18” of countertop frontage on the other side, both at the same height as the sink.

   a. For the auxiliary sink, plan a knee space at, or adjacent to, the auxiliary sink. Also refer to #6 for knee clearance specifications.

16. Include at least:

   a. 15” of landing area on the handle sink of the refrigerator
   
   b. 15” of landing area on either side of a side-by-side refrigerator
   
   c. 15” of landing area which is no more than 48” across from the front of the refrigerator
d. 15” of landing area above or adjacent to any undercounter-style refrigeration appliance

e. A clear floor space of 30” x 48” should be positioned for a parallel approach to the refrigerator/freezer with the centerline of the clear floor space offset on the handle side 24” maximum from the centerline of the appliance.

17. Include a minimum of 12” of landing area on one side of a cooking surface and 15” on the other side. If the cooking surface is at a different countertop height than the rest of the kitchen, then the 12” and 15” landing areas must be at the same height as the cooking surface.

a. Lower the countertop to 34” maximum height and create a knee space beneath the appliance. Refer to #6 for knee clearance specifications.

b. When a forward-approach clear floor space is provided at the cooktop, it should provide knee and toe clearance, and the underside of the cooktop should be insulated or otherwise configured to prevent burns, abrasions, or electric shock.

c. Where the clear floor space is positioned for a parallel approach, the clear floor space shall be centered on the appliance.

d. The location of cooktop controls should not require reaching across burners.
18. For the cooking surface clearance, allow 24” of clearance between the cooking surface and a protected noncombustible surface above it.

19. For cooking surface ventilation, provide a correctly sized, ducted ventilation system for all cooking surface appliances. The recommended minimum is 150 cubic feet per minute.

   a. Ventilation controls should be placed 15” to 44” above the floor, operable with minimal effort, easy to read, and with minimal noise pollution. Plan storage of frequently used items 15” to 48” above the floor.

20. For Cooking Surface Safety:

   a. Do not locate the cooking surface under an operable window.

   b. Window treatments above the cooking surface should not use flammable materials.

   c. A fire extinguisher should be located near the exit of the kitchen away from cooking equipment.

   d. Commercial cooking appliances are not to be installed in residential kitchens.

   e. Place fire extinguisher between 15” and 48” off the finished floor. Select cooking appliances with the controls located so that there is no need to reach across burners to operate.

21. For microwave oven placement, locate the microwave oven after considering the user’s height and abilities. The ideal location for the bottom of the microwave is 3” below the principle user’s shoulder but no
more than 54” above the floor. If the microwave oven is placed below the countertop the oven bottom must be at least 15” off the finished floor.

a. Locate the microwave controls no higher than 46” to 48” depending on approach and reach range.

22. For the microwave landing area, provide at least 15” landing area above, below, or adjacent to the handle side of a microwave oven.

a. Provide landing area in front of or immediately adjacent to the handle side of the microwave.

23. The oven landing area should include at least a 15” landing area next to or above the oven. At least 15” landing area that is not more than 48” across from the oven is acceptable if the appliance does not open into a walkway.

24. When combining two landing areas that are adjacent to one another, determine a new minimum for the two adjoining surfaces by taking the longer of the two landing area requirements and adding 12”.

25. When determining countertop space, a total of 158” of countertop frontage, 24” deep, with at least 15” of clearance above is needed to accommodate all uses, including landing area, preparation/work area, and storage. Built-in appliance garages extending to the countertop can be counted towards the total countertop frontage recommendations but they may interfere with the landing areas.

a. At least two work-counter heights should be offered in the kitchen, with one 28” to 36” above the finished floor and the other 36” to 45” above the finished floor.
26. When choosing countertop edges, specify clipped or rounded corners on all counters, rather than sharp edges.

27. When determining storage,

a. The total shelf/drawer frontage is:
   i. 1400” for a small kitchen (less than 150 sq. ft)
   ii. 1700” for a medium kitchen (151 to 350 sq. ft.)
   iii. 2000” for a large kitchen (greater than 350 sq. ft.)

b. The totals for wall, base, drawer, and pantry shelf/drawer frontage can be adjusted upward or downward as long as the recommended total stays the same.

c. Do not apply more than the recommended amount of storage in the miscellaneous category to meet the total frontage recommendation.

d. Storage areas that are more than 84” above the floor must be counted in the miscellaneous category.

28. Of the total recommended wall, base, drawer, and pantry shelf/drawer frontage, the following should be located within 72” of the centerline of the main cleanup/prep sink:

a. At least 400” for a small kitchen.

b. At least 480” for a medium kitchen

c. At least 560” for a large kitchen.

d. Plan storage of frequently used items 15” to 48” above the floor.
29. At least one corner cabinet should include a functional storage device. This guideline is not necessary if there are no corner cabinets.

30. For electrical receptacles, ground-fault circuit-interrupter protection is required on all receptacles serving countertop surfaces within the kitchen.

31. In addition to general lighting required by code, every work surface should be well illuminated by appropriate task lighting

    a. Lighting should be from multiple sources and adjustable.

To have a visual comparison, a table with the comparison follows:

<table>
<thead>
<tr>
<th>Accepted Residential Design Measurements</th>
<th>Universal Design Measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Clear opening of a doorway should be at least 32” wide.</td>
<td>- The clear opening of a doorway should at least be at least 33”. This would require a minimum of a 3’-0” door.</td>
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<td>- Minimum 2'-10” door is required.</td>
<td>- The universal design measurements are met through the accepted residential design measurement.</td>
</tr>
<tr>
<td>- No entry door should interfere with appliances, nor should appliance doors interfere with one another.</td>
<td>- The universal design measurements are met through the accepted residential design measurement.</td>
</tr>
<tr>
<td>- The entry doors should include a clear floor space for maneuvering, which varies according to the type of door and direction of approach.</td>
<td>- The universal design measurements are met through the accepted residential design measurement.</td>
</tr>
<tr>
<td>- In a kitchen, the sum of the three traveled distances between work centers should total no more than 26’, with no single leg of the triangle measuring less than 4’ or more than 9’.</td>
<td>- The universal design measurements are met through the accepted residential design measurement.</td>
</tr>
<tr>
<td>- A full-height, full-depth, tall obstacle should not separate two primary work centers. A properly recessed tall corner unit will not interrupt the work flow and is acceptable.</td>
<td>- The universal design measurements are met through the accepted residential design measurement.</td>
</tr>
<tr>
<td>- Major traffic patterns should not cross through the basic work triangle.</td>
<td>- The universal design measurements are met through the accepted residential design measurement.</td>
</tr>
<tr>
<td>- The width of a work aisle should be at least 42” for one cook at least 48” for multiple cooks. Measure between the counter frontage, tall cabinets, and/or appliances.</td>
<td>- A clear floor space of at least 30” x 48” should be provided at each kitchen appliance. Clear floor spaces can overlap.</td>
</tr>
<tr>
<td>- Major traffic patterns should not cross through the basic work triangle.</td>
<td>- Include a wheelchair turning space with a diameter of at least 60”, which can include knee and toe clearances. It could utilize a T-shaped space, which is 60” square with two 12” wide by 24” deep areas removed from the corners of the square.</td>
</tr>
<tr>
<td>- The walkway should be at least 36”.</td>
<td>- Two perpendicular walkways should have one walkway at least 42” wide.</td>
</tr>
</tbody>
</table>
- Allow 32” of clearance from the counter/table-edge to any wall or other obstruction behind the seating area.
- If traffic passes behind the seated diner, allow at least 35” to edge past.
- If traffic passes behind the seated diner, allow at least 44” to walk past.

- Kitchen seating clearances:
  - 30” high tables/counters: allow a 24” wide x 18” deep knee space for each seated diner at least 18” of clear knee space
  - 36” high counters: allow a 24” wide x 15” deep knee space for each seated diner and at least 15” of clear knee space
  - 42” high counters: allow a 24” wide x 12” deep knee space for each diner and 12” of clear knee space

- The kitchen seating areas should be 28”-34” and 30”-36” wide by 17”-25” deep to better accommodate people of various sizes or those using a mobility aide. Recommended minimum of a knee space at a table or counters is 36” wide x 27” high x 17” deep.

- If a kitchen has only one sink, locate it adjacent to or across from the cooking surface and refrigerator.

- Include at least a 24” wide landing area to one side of the sink and at least an 18” wide landing on the other side.

- Include a section of continuous countertop at least 36” wide x 24” deep immediately next to a sink for a primary preparation/work area.

- The primary dishwasher should be located within 36” of the nearest edge of the cleanup/prep sink.
- Provide at least 21” of standing space between the edge of the dishwasher and countertop frontage

- Locate nearest edge of the primary

- The universal design measurements are met through the accepted residential design measurement.

- Include at least one 30” wide section of counter, 34” high maximum or adjustable from 29” to 36”. Cabinetry can be added under the work surface, if it can be removed or altered without removal or replacement of the work surface, and provided the finished floor extends under the cabinet.

- The sink should be no more than 34” high or adjustable between 29” and 36”.
- Exposed water supply and drainpipes under sinks should be insulated or otherwise configured to protect against contact. There should be no sharp or abrasive surfaces under sinks.

- The universal design measurements are met through the accepted residential design measurement.

- Raise dishwasher 6” to 12” when it can be
- Dishwasher within 36” of the nearest edge of the cleanup/prep sink.
  - Provide at least 21” of standing space between the edge of the dishwasher and countertop frontage, appliances and/or cabinets, which are placed at a right angle to the dishwasher.
  - Planned with appropriate landing areas at the same height as the sink.
  - A clear floor space of at least 30” x 48” should be positioned adjacent to the dishwasher door. The dishwasher door in the open position should not obstruct the clear floor space for the dishwasher or the sink.

- Include at least two waste receptacles. Locate one near each of the cleanup/prep sink(s) and a second for recycling either in the kitchen or nearby.
  - The universal design measurements are met through the accepted residential design measurement.

- At least 3” of countertop frontage should be provided on one side of the auxiliary sink, and 18” of countertop frontage on the other side, both at the same height as the sink.
  - For the auxiliary sink, plan a knee space at, or adjacent to, the auxiliary sink. Also refer to #6 for knee clearances.

- Include at least:
  - 15” of landing area on the handle sink of the refrigerator
  - 15” of landing area on either side of a side-by-side refrigerator
  - 15” of landing area above or adjacent to an undercounter-style refrigerator appliance.
  - A clear floor space of 30” x 48” should be positioned for a parallel approach to the refrigerator/freezer with the centerline of the clear floor space offset on the handle side 24” maximum from the centerline of the appliance.

- Include a minimum of 12” of landing area on one side of a cooking surface and 15” on the other side. If the cooking surface is at a different countertop height than the rest of the kitchen, then the 12” and 15” landing areas must be at the same height as the cooking surface.
  - Lower the countertop to 34” maximum height and create a knee space beneath the appliance. Refer to #6 for knee clearance specifications.
  - When a forward-approach clear floor space is provided at the cooktop, it should provide knee and toe clearance, and the underside of the cooktop should be insulated or otherwise configured to prevent burns, abrasions, or electric shock.
  - Where the clear floor space is positioned for a parallel approach, the clear floor space shall be centered on the appliance.
  - The location of cooktop controls should not require reaching across burners.

- For the cooking surface clearance, allow 24” of clearance between the cooking surface and a protected noncombustible surface above it.
  - The universal design measurements are met through the accepted residential design measurement.

- For cooking surface surface ventilation, provide a correctly sized, ducted ventilation system for all cooking surface appliances. The recommended minimum is 150 cubic feet per minute.
  - Ventilation controls should be placed 15” to 44” above the floor, operable with minimal effort, easy to read, and with minimal noise pollution. Plan storage of frequently used items 15” to 48” above the floor.

- For cooking safety:
  - Do not locate the cooking surface under an operable window.
  - Window treatments above the
  - Place fire extinguisher between 15” and 48” off the finished floor. Select cooking appliances with the controls located so there is no need to reach across burners to
<table>
<thead>
<tr>
<th>Requirement</th>
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</tr>
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<tr>
<td>cooking surface should not use flammable materials.</td>
<td></td>
</tr>
<tr>
<td>- A fire extinguisher should be located near the exit of the kitchen, away from cooking equipment.</td>
<td>operate.</td>
</tr>
<tr>
<td>- Commercial cooking appliances are not to be installed in residential kitchens.</td>
<td></td>
</tr>
</tbody>
</table>

- For microwave oven placement, locate the microwave oven after considering the user's height and abilities. The ideal location for the bottom of the microwave is 3” below the principle user's shoulder but no more than 54” above the floor. If the microwave oven is placed below the countertop the oven bottom must be at least 15” off the finished floor.

- Locate the microwave controls no higher than 46” to 48” depending on approach and reach range.

- For the microwave landing area, provide at least 15” landing area above, below, or adjacent to the handle side of a microwave oven.

- Provide landing area in front of or immediately adjacent to the handle side of the microwave.

- The oven landing area should include at least a 15” landing area next to or above the oven. At least 15” landing area that is not more than 48” across from the oven is acceptable if the appliance does not open into a walkway.

- The universal design measurements are met through the accepted residential design measurement.

- When combining two landing areas that are adjacent to one another, determine a new minimum for the two adjoining surfaces by taking the longer of the two landing area requirements and adding 12”.

- The universal design measurements are met through the accepted residential design measurement.

- When determining countertop space, a total of 158” of countertop frontage, 24” deep, with at least 15” of clearance above is needed to accommodate all uses, including landing area, preparation/work area, and storage. Built-in appliance garages extending to the countertop can be counted towards the total countertop frontage recommendations but they may interfere with the landing areas.

- At least two work-counter heights should be offered in the kitchen, with one 28” to 36” above the finished floor and the other 36” to 45” above the finished floor.

- When choosing countertop edges, specify clipped or rounded corners on all counters, rather than sharp edges.

- The universal design measurements are met through the accepted residential design measurement.

- When determining storage, 
  - The total shelf/drawer frontage is:
  - 1400” for a small kitchen (less than 150 sq. ft)
  - 1700” for a medium kitchen (151 to 350 sq. ft.)
  - 2000” for a large kitchen (greater than 350 sq. ft.)
  - The totals for wall, base, drawer, and...
pantry shelf/drawer frontage can be adjusted upward or downward as long as the recommended total stays the same.
- Do not apply more than the recommended amount of storage in the miscellaneous category to meet the total frontage recommendation.
- Storage areas that are more than 84” above the floor must be counted in the miscellaneous category.

- Of the total recommended wall, base, drawer, and pantry shelf/drawer frontage, the following should be located within 72” of the centerline of the main cleanup/prep sink:
  - b. At least 400” for a small kitchen.
  - c. At least 480” for a medium kitchen.
  - d. At least 560” for a large kitchen.

- Plan storage of frequently used items 15” to 48” above the floor.

- At least one corner cabinet should include a functional storage device. This guideline is not necessary if there are no corner cabinets.

- The universal design measurements are met through the accepted residential design measurement.

- For electrical receptacles, ground-fault circuit-interrupter protection is required on all receptacles serving countertop surfaces within the kitchen.

- The universal design measurements are met through the accepted residential design measurement.

- Every work surface should be well illuminated by appropriate task lighting.

- Lighting should be from multiple sources and adjustable.

Bathrooms

The commonly laid out bathroom can be designed within a 5'-0” x 8'-0” (60” x 96”) space. This space includes a toilet, tub, and a shower as well as a small vanity with sink. This can be seen in Figure 1. Some common universal design measurement recommendations include a minimum of 40” to enter that bathroom, reinforcing walls for grab bars, various lighting, and towel bars and mirrors provided at various heights.

Bathroom layouts can be diverse and be laid out many different ways to accommodate for the homeowner’s needs. The other layouts consist of a little more space, allowing room for more than one person if needed in the bathroom.
**Figure 6 (left) and Figure 7 (right)** The right bathroom layout provides a user two sinks, a separate area for the toilet, and the option of a sink or tub. The left layout provides a shower and toilet with only one sink.


**Figure 8 (left) and Figure 9 (right)** The right bathroom layout provides a user with an open layout that allows for a turning radius. The left bathroom creates a "wet room" for all of the plumbing fixtures.


**Figure 10 (left) and Figure 11 (right)** The right bathroom layout provides a user with more of an L-shaped layout while the left bathroom layout is open and smaller.

Similar to the kitchen guidelines, NKBA provides a set of guidelines that detail the standard measurements as well as the universal design measurement (2012).

1. The clear opening of a doorway should be at least 32”. This would require a minimum 2’-10” door. If the existing structure precludes changing the opening, then a minimum 2’-0” door is allowable.
   
   a. **The clear opening of a doorway should be at least 34”. This would require a minimum 3’-0” door.**

2. No entry or fixture doors should interfere with one another and/or the safe use of the fixtures or cabinets.
   
   a. **The door area should include clear floor space for**

   **maneuvering, which varies according to the type of door and the direction of approach.**

3. For the ceiling height:
   
   a. Bathrooms shall have a minimum floor to ceiling height of 80” over the fixture and at the front clearance area for fixtures.
   
   b. A shower or tub equipped with a shower head shall have a minimum floor to ceiling height of 80” above a minimum area 30”x30” at the shower head.

4. Plan a clear floor space of at least 30” from the front edge of all fixtures to any opposite bath fixture, wall or obstacle.
   
   a. A minimum space of at least 21” must be planned in front of lavatory, toilet, bidet, and tub.
b. A minimum space of at least 24” must be planned in front of a shower entry.

c. For grooming, the clear 30” x 48” floor space should be centered on the lavatory.

d. For bathing and showering:
   i. Clearance in front of bathtubs should extend the length of the bathtub and be at least 30” wide.
   ii. When a permanent seat is provided at the head of the bathtub, the clearance should extend a minimum of 12” beyond the wall and 36” wide.
   iii. The clearance in front of a roll-in type shower compartment should be at least 60” long next to the open face of the shower compartment and 30” wide.

e. For toileting:
   i. When both a parallel and a forward approach to the toilet are provided, the clearance should be at least 56” measured perpendicular from the rear wall, and 60” measured perpendicular from the sidewall. No other fixture or obstruction should be within the clearance area.

5. The distance from the centerline of the lavatory to the sidewall/tall obstacle should be at least 20”.

   a. The minimum distance from the centerline of the lavatory to a wall is 15”
b. To assure a clear floor space (30”x48”), the lavatory must be a minimum 24” from the wall.

6. The distance between the centerlines of two lavatories should be at least 36”.

   a. The minimum distance between the centerlines of two lavatories should be at least 30”.

7. The height for a lavatory varies between 32” and 43” to fit the user.

   a. Lavatory controls should be within the user’s reach and operable with minimal effort.

8. Specify clipped or round corners rather than sharp edges on all counters.

9. The interior shower size is at least 36”x36”.

   a. The minimum interior shower size is 30”x30” or 900 square inches, in which a disc of 30” in diameter must fit.

b. Plan either a transfer or a roll-in shower.

c. Roll-in shower entries: For a 60” deep shower, a 32” wide entry is adequate. For a 42” deep shower, the entry must be at least 36” wide to allow for turning space.

10. For tub and shower controls:

    a. The shower controls should be accessible from both inside and outside the shower spray and be located between 38” and 48”. 
b. The tub controls should be accessible from both inside and outside the tub and be located between the rim of the bathtub and 33” above the floor.

c. **Controls should be offset toward the room and easy to grasp, as with lever or loop handle (a and b).**

d. **Hot and cold should be identified with red and blue indicators.**

e. **Provide a handheld spray at a height accessible to the user (b).**

11. In the case of water temperature safety:

a. Shower and tub/shower control valves must be one of the following:

   i. Pressure balanced

   ii. Thermostatic mixing

   iii. Combination pressure balance/thermostatic mixing valve types

b. The valve must have a high limit stop to prevent water temperatures above 120°F.

c. Hot water delivered to bathtubs and whirlpool bathtubs shall be limited to a temperature of not more than 120°F.

d. Hot water delivered to bidets shall be limited to no more than 110°F.

12. Plan a seat within the shower that is 17”-19” above the shower floor and 15” deep. The shower seat must not infringe on the minimum interior size of the shower.

   a. **Plan a seat in the shower and/or bathtub to fit the parameters of the space and the needs of the user.**
13. The wall area above a tub or shower pan should be covered in a waterproof material extending at least 3” above the showerhead rough in.

14. For the design element of grab bars:
   a. Plan grab bars to facilitate access to and maneuvering within the tub and shower areas.
   b. Tub and shower walls should be reinforced at the time of construction to allow for installation of grab bars to support a static load of 250 lbs.
   c. Grab bars should be placed at 33”-36” above the floor.
   d. Grab bars must be 1 ¼” to 2” in diameter and extend 1 ½” from the wall.
   e. Walls throughout the bathroom should be prepared (reinforced) at time of construction to allow for installation of grab bars to support a minimum of 250 lbs of force in any direction.
   f. Grab bars should be placed according to the needs and height of the user, particularly near the tub/shower and the toilet.

15. For glazing within the bathroom:
   a. Glass used in the tub or shower enclosures or partitions must be tempered or an approved equal and must be permanently marked as such.
   b. If the tub or shower surround has glass windows or walls, the glazing must be tempered glass or approved equal when the bottom edge of glazing is less than 60” above any standing or walking surface.
c. Any glazing whose bottom edge is less than 18” above the floor must be tempered glass or approved equal.

d. Consider line of sight of user when planning height of bottom of glazing.

16. Hinged doors shall open outward.
   a. Minimize thresholds at the shower entry to no more than ½”.

17. Steps should not be placed outside of a tub. If steps are used, a grab bar or handrail is mandatory.

18. Slip-resistant surfaces should be specified for the general bath flooring, shower floors, and tub/shower bottoms.

19. For equipment access:
   a. All equipment, including access panels, must be installed as per manufacturers’ specifications.
   b. All manufacturers’ instructions must be available for installers and inspectors and left for homeowners.
   c. Equipment controls should be placed between 15” and 48” above the finished floor.

20. The distance from the centerline of toilet and/or bidet to any bath fixture, wall or other obstacle should be at least 18”.
   a. A minimum distance of 15” is required from the centerline of toilet and/or bidet to any bath fixture, wall, or other obstacle.
   b. Consider user height and ability when determining toilet height.
21. The size for a separate toilet compartment should be at least 36” x 66” with a swing-out or pocket door.
   a. The minimum size for a separate toilet compartment is 30” x 60”.
   b. To maximize access, provide privacy in the toileting area without using a separate compartment.

22. Provide adequate, accessible storage for toiletries, bath linens, grooming, and general bathroom supplies at point of use.
   a. Plan storage of frequently used items between 15” and 48” above the finished floor.

23. For accessories of the bathroom:
   a. Place a mirror above or near the lavatory at a height that takes the user’s eye height into consideration.
      i. Plan a full-height mirror to provide reflection at eye level, regardless of the user’s height or stature.
   b. The toilet paper holder should be located 8” to 12” in front of the edge of the toilet bowl, centered at 26” above the floor.
      i. The toilet paper holder should be 24” to 42” off the rear wall and between 18” and 48” above the floor with a clearance of at least 1 ½” below or 12” above the grab bar.
   c. Additional accessories, such as towel holders and soap dishes, should be conveniently located near all bath fixtures.
i. Accessories should be placed between 15” and 48” above the floor, and operable with a closed fist with minimal effort.

24. All ground fault circuit interrupter (GFCI) receptacles should be located at electrical appliance points of use.

   a. At least on GFCI protected receptacle must be installed within 36” of the outside edge of the lavatory.

   b. All receptacles much be protected by ground-fault circuit interrupters.

   c. A receptacle shall not be installed within or directly over a bathtub or shower stall.

   d. Switches shall not be installed within wet locations in the tub or shower spaces or within reach while standing in the tub or shower unless installed as part of the listed tub or shower assembly.

25. In addition to general lighting, task lighting should be provided for each functional area in the bathroom.

   a. At least one wall switch – controlled light must be provided. Switch must be placed at the entrance of the bathroom.

   b. All light fixtures installed within tub and shower spaces should be marked “suitable for damp/wet locations.”

   c. Hanging fixtures cannot be located within a zone of 3’ horizontally and 8’ vertically from the top of the bathtub rim or shower stall threshold.
d. Task lighting at the vanity should be beside the mirror and at eye level, with the lamp not visible to the eye.

e. Lighting controls should be between 15” and 48” above the floor and operable with a closed fist and with minimal effort.

26. Plan a mechanical exhaust system, vented to the outside, for each enclosed area.

   a. Minimum ventilation for the bathroom is to be a window of at least 3 square feet of which 50% is operable or a mechanical ventilation system of at least 50 cubic feet per minute exhausted to the outside.

   b. Ventilation controls should be placed 15” to 48” above the floor, operable with minimal effort, easy to read, and with minimal noise pollution.

27. A supplemental heat source should be considered. All bathrooms should have an appropriate heat source to maintain a minimum room temperature of 68°F.

To have a visual comparison, a table with the comparisons is shown:

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ceiling height of 80” above a minimum area 30” x 30” at the shower head.

- Plan a clear floor space of at least 30” from the front edge of all fixtures to any opposite bath fixture, wall or obstacle.
  - A minimum space of at least 21” must be planned in front of lavatory, toilet, bidet, and tub.
  - A minimum space of at least 24” must be planned in front of a shower entry.

- For grooming, the clear 30” x 48” floor space should be centered on the lavatory.
- For bathing and showering:
  - Clearance in front of bathtubs should extend the length of the bathtub and be at least 30” wide.
  - When a permanent seat is provided at the head of the bathtub, the clearance should extend a minimum of 12” beyond the wall and 36” wide.
  - The clearance in front of a roll-in type shower compartment should be at least 60” long next to the open face of the shower compartment and 30” wide.
- For toileting:
  - When both a parallel and a forward approach to the toilet are provided, the clearance should be at least 56” measured perpendicular from the rear wall, and 60” measured perpendicular from the side wall. No other fixture or obstruction should be within the clearance area.

- Centerline of the lavatory to the sidewall/tall obstacle should be at least 20”
  - The minimum distance from the centerline of the lavatory to a wall is 15”.

- Centerlines of two lavatories should be at least 36”. The minimum distance between the edges of two freestanding or wall-hung lavatories is 4”.
  - The minimum distance between the centerlines of two lavatories should be at least 30”.

- To assure a clear floor space (30” x 48”), the lavatory must be a minimum 24” from the wall.
- The universal design measurements are met through the accepted residential design measurement.

- The height for a lavatory varies between 32” and 43” to fit the user.
- Lavatory controls within the user’s reach and operable with minimal effort.

- Specify clipped or round corners rather than sharp edges on all counters.
- The universal design measurements are met through the accepted residential design measurement.

- The interior shower size is at least 36” x 36”.
  - The minimum interior shower size is 30” x 30” or 900 square inches, in which a disc of 30” in diameter must fit.

- Plan either a transfer or a roll-in shower.
- Roll-in shower entries:
  - For a 60” deep shower, a 32” wide entry is adequate.
For a 42” deep shower, the entry must be at least 36” wide to allow for turning space.

- For tub and shower controls:
  - The shower controls should be accessible from both inside and outside the shower spray and be located between 38” and 48”.
  - The tub controls should be accessible from both inside and outside the tub and be located between the rim of the bathtub and 33” above the floor.
  - Controls should be offset toward the room and easy to grasp, as with lever or loop handle (a and b).
  - Hot and cold should be identified with red and blue indicators.
  - Provide a handheld spray at a height accessible to the user (b).
  - The shower controls should be accessible from both inside and outside the shower spray and be located between 38” and 48”.
  - The tub controls should be accessible from both inside and outside the tub and be located between the rim of the bathtub and 33” above the floor.

- In the case of water temperature safety:
  - Shower and tub/shower control valves must be one of the following:
    - Pressure balanced
    - Thermostatic mixing
    - Combination pressure balance/thermostatic mixing valve types
    - The valve must have a high limit stop to prevent water temperatures above 120˚F.
    - Hot water delivered to bathtubs and whirlpool bathtubs shall be limited to a temperature of not more than 120˚F.
    - Hot water delivered to bidets shall be limited to no more than 110˚F.
  - The universal design measurements are met through the accepted residential design measurement.

- Shower seat is 17”-19” above the shower floor and 15” deep - must not infringe on the minimum interior size of the shower.
  - Plan a seat in the shower and/or bathtub to fit the parameters of the space and the needs of the user.

- Waterproof material should cover the wall area above a tub or shower pan and extend at least 3” above the showerhead rough in.
  - The universal design measurements are met through the accepted residential design measurement.

- For the design element of grab bars:
  - Plan grab bars to facilitate access to and maneuvering within the tub and shower areas.
  - Tub and shower walls should be reinforced at the time of construction to allow for installation of grab bars to support a static load of 250 lbs.
  - Grab bars should be placed at 33”-36” above the floor.
  - Grab bars must be 1 ¼” to 2” in diameter and extend 1 ½” from the wall.
  - Walls throughout the bathroom should be prepared (reinforced) at time of construction to allow for installation of grab bars to support a minimum of 250 lbs of force in any direction.
  - Grab bars should be placed according to the needs and height of the user, particularly near the tub/shower and the toilet.

- For glazing within the bathroom:
  - Glass used in the tub or shower enclosures or partitions must be tempered or an approved equal and must be permanently marked as such.
  - If the tub or shower surround has glass windows or walls, the glazing must be tempered glass or approved equal when
  - Consider line of sight of user when planning height of bottom of glazing.
<table>
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<tr>
<td>The bottom edge of glazing is less than 60” above any standing or walking surface.</td>
<td>- Any glazing whose bottom edge is less than 18” above the floor must be tempered glass or approved equal.</td>
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<td>Hinged doors shall open outward.</td>
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</tr>
<tr>
<td>The distance from the centerline of toilet and/or bidet to any bath fixture, wall or other obstacle should be at least 18”.</td>
<td>- Consider user height and ability when determining toilet height.</td>
</tr>
<tr>
<td>- A minimum distance of 15” is required from the centerline of toilet and/or bidet to any bath fixture, wall, or other obstacle.</td>
<td></td>
</tr>
<tr>
<td>The size for a separate toilet compartment should be at least 36” x 66” with a swing-out or pocket door.</td>
<td>- Plan storage of frequently used items between 15” and 48” above the finished floor.</td>
</tr>
<tr>
<td>- The minimum size for a separate toilet compartment is 30” x 60”.</td>
<td></td>
</tr>
<tr>
<td>For accessories of the bathroom:</td>
<td>- Plan a full-height mirror to provide reflection at eye level, regardless of the user’s height or stature.</td>
</tr>
<tr>
<td>- Place a mirror above or near the lavatory at a height that takes the user’s eye height into consideration.</td>
<td>- The toilet paper holder should be 24”-42” off the rear wall and between 18” and 48” above the floor with a clearance of at least 1 ½” below or 12” above the grab bar.</td>
</tr>
<tr>
<td>- The toilet paper holder should be located 8” to 12” in front of the edge of the toilet bowl, centered at 26” above the floor.</td>
<td>- Accessories should be placed between 15” and 48” above the floor, and operable with a closed fist with minimal effort.</td>
</tr>
<tr>
<td>- Additional accessories, such as towel holders and soap dishes, should be conveniently located near all bath fixtures.</td>
<td></td>
</tr>
<tr>
<td>All GFCI receptacles should be located at electrical appliance points of use.</td>
<td>- The universal design measurements are met through the accepted residential design measurement.</td>
</tr>
<tr>
<td>- At least on GFCI protected receptacle must be installed within 36” of the outside edge of the lavatory.</td>
<td></td>
</tr>
<tr>
<td>- All receptacles much be protected by ground-fault circuit interrupters.</td>
<td></td>
</tr>
<tr>
<td>- A receptacle shall not be installed within or directly over a bathtub or shower stall.</td>
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</tbody>
</table>
- Switches shall not be installed within wet locations in the tub or shower spaces or within reach while standing in the tub or shower unless installed as part of the listed tub or shower assembly.

- In addition to general lighting, task lighting should be provided for each functional area in the bathroom.
  - At least one wall switch – controlled light must be provided. Switch must be placed at the entrance of the bathroom.
  - All light fixtures installed within tub and shower spaces should be marked “suitable for damp/wet locations.”
  - Hanging fixtures cannot be located within a zone of 3’ horizontally and 8’ vertically from the top of the bathtub rim or shower stall threshold.

- Plan a mechanical exhaust system, vented to the outside, for each enclosed area.
  - Minimum ventilation for the bathroom is to be a window of at least 3 square feet of which 50% is operable or a mechanical ventilation system of at least 50 cubic feet per minute exhausted to the outside.

- A supplemental heat source should be considered. All bathrooms should have an appropriate heat source to maintain a minimum room temperature of 68°F.

- Task lighting at the vanity should be beside the mirror and at eye level, with the lamp not visible to the eye.

- Lighting controls should be between 15” and 48” above the floor and operable with a closed fist and with minimal effort.

- Ventilation controls should be placed 15” to 48” above the floor, operable with minimal effort, easy to read, and with minimal noise pollution.

- The universal design measurements are met through the accepted residential design measurement.

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**Living Room**

A living room has many of the same qualities of other spaces, mainly focusing on the circulation through the space. Flush thresholds are necessary in all doorways into the space. The openings should 34” - 36” wide, while the minimum is a 32” wide opening. An 18” minimum should be located on the pull (latch) side of the door. To maneuver around the space, circulation areas should be at a width of 42” minimum. As found in other spaces, a 5’-0” turning radius should be found. Lighting for the space should be varied, including overhead lighting as well as table and floor lamps.
Entry

The entry to a home or the entrance from the garage to the house should have 3’-0” doors. On the interior and the exterior of these doors, there should be a 5’-0” x 5’-0” clear space. The threshold should be flush, with a zero-step entry into each entrance. If needed, a way to tackle the zero-step entry is to integrate a ramp into the design. Exterior lighting should be motion-sensored to turn on if there is any motion.

Laundry

Other spaces such as the laundry or an office have more design elements that show universal design concepts. Front loading washers and dryers are incorporated into the laundry room. These appliances tend to be on pedestals that take them to a taller height to relieve stress on a person’s back. Various lighting in these spaces is also important along with various controls.

Residential Guidelines Conclusion

The measurements that reflect the standard measurements and the universal design measurement show similarities and differences. Many of the universal design measurements are met by the standard residential measurement. Measurements are widely known by designers, homeowners, and others looking to utilize universal design and will find some of the measurements are already in their space.

A few of the measurements from kitchen spaces that are known are the following:

- No entry door should interfere with the safe operation of appliances, nor should appliance doors interfere with one another. (Number 2)
- In a kitchen with three work centers, a space that is used frequently such as the sink, refrigerator, or range, the sum of the three traveled distances should
total no more than 26′ (7.9 m), with no single leg of the triangle measuring less than 4′ (1.2 m) or more than 9′ (2.7 m). (Number 3)

- When the kitchen plan includes more than three primary appliance/work centers, each additional travel distance to another appliance/work center should measure no less than 4′ (1.2 m) nor more than 9′ (2.7 m).

- Each part of the work triangle is measured from the center-front of the appliance/sink.

- No work triangle leg intersects an island/peninsula or other obstacle by more than 12″ (305 mm).

- When choosing countertop edges, specify clipped or rounded corners on all counters, rather than sharp edges. (Number 26)

As the guidelines continue, bathrooms are also a prime space to add universal design measurements. There are also a few that are commonly already in place in bathrooms:

- No entry or fixture doors should interfere with one another and/or the safe use of the fixtures or cabinets. (Number 2)

- Steps should not be placed outside of a tub. If steps are used, a grab bar or handrail is mandatory. (Number 17)

- Slip-resistant surfaces should be specified for the general bath flooring, shower floors, and tub/shower bottoms. (Number 18)

- Provide adequate, accessible storage for toiletries, bath linens, grooming, and general bathroom supplies at point of use. (Number 22)
A homeowner, designer, architect or anyone else looking to implement universal design into their spaces may find that their spaces already include some of these measurements. If they are looking to create a space that can be utilized by anyone without calling out a disability or age, utilizing more universal design measurements becomes pertinent in the design process.
Economic Feasibility of Universal Design

According to Building an Affordable House, there are fundamentals of a balanced, value-engineering approach which includes affordability, marketability, and durability. Within affordability, the homeowner and builder need to start with a price target, much like a budget. Building a marketable home means striving to design the most house for your dollar. This design should match the customer’s needs and wants and essentially make that value in the home visible to the current and future homeowners. To ensure durability, one should simplify their design, check all systems that will be implemented to ensure there will not be any problems and continuously be updated with advanced construction technology.

According to architect and universal design advocate, Charles M. Schwab, “By providing a $20,000 tax credit for universal design housing, when new housing construction begins anew, the United States has a real opportunity to save hundreds of billions of dollars in long-term healthcare while encouraging long-term economic growth” (p.1). Allowing for an incentive to utilize these concepts can help implement a long-term goal of creating a standard of universal design. An excerpt from his article, “America’s First Universal Design ‘Smart’ Home” (2009):

“Today, UD and green design make more sense than ever before. Consider this: On May 11, 2009 President Obama introduced “a new foundation for the economy.” In his words, ‘As far as healthcare goes, we are currently on an unsustainable course. In the next 10 years, one-fifth of our economy will be spent on healthcare and costs will continue to climb as baby boomers continue to age.’ In addition to the aging of the Boomers, there is also an increasing number of
veterans returning home with disabilities. Additionally, we need to remember the growing numbers of children and adults who are overweight who would benefit from UD/inclusive homes.”

From this, tax credits and incentives came to light for those starting to build a new home. Universal design concepts, in general, tend to be on the higher end of costs. Denise Levine, a Registered Architect and the Assistant Director at the IDEA Center, states that buildings designed to be usable by everyone from the beginning will need fewer renovations in the future. Essentially, spaces that are designed from the beginning to give access to everyone are going to last longer and will not have to be remodeled to fit future needs. Being consistent across the board with designs that accommodate everyone will save builders and homeowners time and money. Inclusivity will happen when people start to have this mindset of consistency and understanding the concept of standardizing universal design.
Methodology

Measurements are not as effective without provision of examples to how the universal design details have been implemented. Two examples are provided, a three-story bungalow, as well as an apartment building. Both are spaces that include stairs but provide everything necessary to allow for any user to access the space.

Three-Story Bungalow

The architect and owner, Emory Baldwin, had a few ambitions when designing the urban home. Baldwin's expertise lies with universal design as he specializes in building residences for aging in place. He wanted to be able to demonstrate the Principles of Universal Design and lifespan design and flexibility that allows for the changing needs of people over time. Other intentions included showing that the principles could be implemented economically and aesthetically, assuring that the typical contractor could easily build a similar type of house, and giving a model home to educate other designers, owners, and builders.

In Seattle, Washington, there is a three-story home that has taken universal design concepts and placed them in a home in a neighborhood that was established. It was designed to promote aging in place. This home is located in Green Lake neighborhood of Seattle. The home utilizes universal design features such as 3'-0" wide doors, flush thresholds, and curb-less showers.

An elevator is a common universal design feature. This home took three closets that were stacked upon one another. These closets were framed, sized and wired for a future elevator, in case it was needed for a future resident. Flexible spaces are found within the house to accommodate the changing needs of the family over time. The main
example would be creating a space designated as a mother-in-law apartment, found in the basement of the bungalow. According to Aging in Place, the Baldwin House currently uses this space as an office. Another example is a room adjacent to the kitchen which the family uses as a play room, but could be used in the future as a family or dining room.

Finishes within a space are just as important. Some added touches to the Baldwin House spaces are many windows for natural lighting and interior windows to bring shared lighting in from other spaces. Extra light fixtures provide ample lighting when needed and then provide a flexibility of lighting for certain situations.

Universal design features are utilized in rooms. Taken from the Universal Design features in AIP (2012), where the Baldwin House is featured, each of the rooms have a list of specific features incorporated to compose the bungalow.

**Bedroom**

**Kitchen**

1. Wider clearances in kitchen (5’-0” wide)

2. Loop handles on all cupboards (easy to open with closed fist)

3. Pull-out drawers in cupboards and pantry

4. Most kitchen storage in base cabinets, in drawers and pull-out shelves

5. Lower oven with racks lining up with counter top (and controls at 4’-0” A.F.F.)

6. Accessible microwave, on countertop

7. Induction cook top (electro-magnetic):
   a. Smooth surface for easy movement of pots and pans
   b. Surface does not get too hot (safe for children, the elderly, etc.)
8. Veggie sink adjacent to cook top, with pull-out spray for filling pots with water

**Bathroom**

1. “Floating” vanities in all bathrooms, supported by in-wall bracket system
2. Roll-away base cabinets on locking casters allow option for extra storage
3. TOT Washlet bidet seats on toilets, with outlets near rear of all toilets
4. Lights over all showers
5. Curb-less showers, with offset controls for caregivers
6. Hand-held showers on adjustable rods
7. Blocking in all bathroom walls for future grab bars
8. Lowered thermostats through the house, with large numbers for easy viewing

**Figure 12 (left) and Figure 13 (right)** Two views of the Master Bathroom.

**Figure 12 (left) IHCD Images. (n.d.). IHCD Images. Retrieved September 25, 2014, from**

**Figure 13 (right) IHCD Images. (n.d.). IHCD Images. Retrieved September 25, 2014, from**
Entrances, Hallways, Laundry Room

1. Level paths from both street and alley

2. Step-less entries at all exterior doors
   
   a. Good for wheelchairs, walkers, canes, strollers, and unsteady legs

3. Lever handles on all doors
   
   a. Easy to open with closed fist or while holding keys, bags, or children

4. Fold-down package shelf at front door. (This is handy when carrying bags.)

5. 3’-0” wide doors throughout (with maneuvering space beside most doors)

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**Figure 14 (left) and Figure 15 (right)** The zero-entry into the home (left) and dining area looking to the kitchen (right)


Circulation

1. Open plan layout
   
   a. Enhanced maneuverability and communication
b. Reduced hallway lengths

2. Wide hallways (42” wide and 52” wide at the two short halls that were included)

3. Low pile carpeting, with no loose carpets to reduce tripping hazards

4. Radiant floor heating
   a. Avoid obstacles, reduces burns, good for allergies and nice even heat

5. Short runs of stairs (wrapping around elevator) to reduce injuries from falls
   a. This is good for everyone, especially toddlers and elderly persons.

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**Figure 16** The reading space above the closet. Also the space that will provide the functionality of an elevator.


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**Future lifestyle needs**

1. Structure sized to allow future room to infill open space above dining room
   a. Allows future flexibility

2. Stacking closets, for future elevator
   a. Walls framed and wired per manufacturer’s recommendations
b. Floor structure of closets is removable, independent from the rest of the floor


c. Elevator pit built into foundation

This three-story bungalow has multiple universal design features incorporated, making it a home that is accessible to several users at different points in their lives with different lifestyles. Multi-purpose functions, such as the closet that can have an elevator implemented, allows for completely different users to use this home.

Creating apartments with universal design can be just as successful as the bungalow. The building is multi-level but provides an elevator for a wheelchair-bound user to be on any level. All the apartments provide a layout that is open and completely accessible to any user.
6 North Apartments

The 6 North Apartments consist of a three-story, 80-unit residential/mixed-use building in St. Louis, Missouri. According to the Center for Universal Design at North Carolina State University, “6 North is the nation’s first large-scale example of 100 percent universal design in a multifamily residential building.” All of the one- and two-bedroom apartments in this building are accessible by both disabled and nondisabled people. All of the common spaces are fully accessible as well.

Basing a design on Universal Design for apartments should be done across the board. Designs should be based around the user of the space and making it most efficient for the user. The 6 North Apartments in St. Louis are a perfect example for this design. The design for these apartments is 100% universally designed and are approximately 1,000 square feet or less. According to the report, “6 North Apartments”:

“(Richard) Baron bought into the UD concept from the beginning, encouraging the design and development team to explore a wide range of creative options to ensure that UD features were incorporated into every aspect of the project, often in ways that made them invisible to the able bodied. This open-minded attitude was an important factor in keeping the project on target, on time, and within budget.”

There are several layouts to accommodate to different needs a person may be looking for. Each of the floor plans are an open layout and providing enough space to allow for a wheelchair to maneuver around.
Universal design can potentially consist of all specific products and design concepts, but within the 6 North Apartments, standard products were used as well. Utilizing the standardized products kept costs down for this project. Planning and placement of the products took precedence over unique designs. Switches for lighting or the elevator access were placed at a lower height for those in wheelchairs and outlets were placed higher than normal. The kitchens also had an adequate amount of planning put into the space, from drain placement to appliances, to hinges and adjustable shelving. Without the proper planning for a space that is universally designed, the end goal cannot be achieved.
The 6 North Apartments have many universally designed features. The open floor plan allows for a high ease of access for anyone, with a disability or without. Planning went into these spaces to allow for the accessibility.

**Figure 19 (left) and Figure 20 (right)** A bathroom with the space under the sink open, as well as the raised laundry. The kitchen shows multi-level countertops as well as raised appliances.


Looking at previous case studies helps a person understand how universal design has been implemented and successful in the past. Previous design elements can be carried forward into current designs.

Twenty-six year old Amanda has demonstrated to the city which she resides in that universal design can be done. Amanda has cerebral palsy, limiting her circulation as well as function of her joints. Her parents remodeled their home to accommodate for Amanda’s disability as she grew older. But as a college graduate, Amanda wanted the independence of any twenty-six year old and she received just that in the home she and her parents designed.

At the entry, there is a hot pink 3’-0” door reflecting Amanda’s style. The entry of the home is zero-entry with a large space accommodating the 5’-0” turning radius needed for wheelchair accessibility.

Figure 21 (left) and Figure 22 (right) Amanda’s hot pink front door with a lowered doorbell and the entry of the home
As you move through the home to the right, the living room and stairs to the basement are found. The furniture is laid out with enough space for Amanda to maneuver throughout the space. Moving through the living room, the kitchen and dining room are found. The dining room is its own enclave to offset its presence from the kitchen. The kitchen has an island with two varied countertop heights. Within the island, drawers can be found that hold the plates and other dishes and a pull-out board from which the pots and pans hang. The appliances include a refrigerator, microwave, dishwasher, oven, and a stove top. The refrigerator and freezer are separate entities. When purchasing those appliances, they found that the side reach was too far and Amanda wasn’t able to reach to the back. The microwave and oven are side by side and at the eye level of someone in a wheelchair. The dishwasher is a single rack and lowered to the same height as the microwave and oven. The cook top is one of Amanda’s favorite parts. The cook top is on a countertop that, with the press of a button, can be moved up or down, depending on who is using the appliance at the time.

Figure 23 Oven and microwave lowered for ease of access

Figure 24 Sink and stovetop – Stovetop has buttons to lower and raise depending on user


Figure 25 Dishwasher on the right and open under counternose space

If you were to move to the left of the home, you would find an elevator, Amanda’s room, closet and bathroom. The laundry is found in this area too. The elevator is used so that Amanda has the ability to access the basement. The laundry area has the washer and dryer, as well as areas of various heights to where you could hang clothes to dry. An innovative part of the laundry room is a hole in the wall that allows Amanda to push her wheeled laundry basket from the laundry room to her closet and vice versa.

Figure 26 Lowered island area, also shows multiple drawers for use

Amanda’s room is laid out in a way that has a side of her bed with the 36” minimum as well as the other side allowing for a 5’-0” turning radius. The bathroom includes a sit down tub with a shower head. The toilet has grab bars on each side and a valet dressing area. Amanda sets out her clothes the night before and then the valet dressing area next to her toilet allows her to get dressed while utilizing the toilet.
The closet is connected to the bathroom and has many shelving and hanging areas at varied heights. Amanda also has a jewelry cabinet as well as a board for necklaces to hang from that is lowered for easy accessibility.

Figure 29 Master bathroom showing the space under the sink and lowered sink

Figure 30 Walk-in closet showing varied heights of shelving and rods
The basement of the house has two bedrooms and bathrooms, as well as a separate laundry area and a full kitchen. This allows for roommates to live in the house, to become support for Amanda as well as help offset the living costs of the home. The carpet on the stairs has extra padding for Amanda to be able to crawl down them with ease in case of an emergency, without harming herself.

Amanda’s family had an open house to show others about the design details they implemented to make the home accessible. An adaptive design construction flyer has been made for the home. It includes:

1. Outside
   a. Zero Entry
   b. Cameras for security
   c. Lower garage keypad
   d. Lower doorbell

2. Entry
   a. Elevator

3. Main Floor Bathroom
   a. Level Entry Shower
   b. Grab Bars (weren’t in there)

4. Garage
   a. Lower electrical panel
   b. Longer drain (helps with snow due to lower van)
   c. Extra space for van and van ramp

5. Kitchen
a. Lower and smaller ovens (door open sideways)

b. Lower microwave and cutting board underneath to place hot items

c. Corner cabinet, lowered and brought forward

d. ADA kitchen sink, built to accommodate Amanda

e. Drawer with separators for plates and glasses

f. Cooktop that raises and lowers

g. Pots and pans drawer

h. Extra faucet at sink

i. Touch faucets

6. Fireplace

   a. Easy access and remote starter

7. Master Bedroom

   a. Plug in near bed for all chargers including the wheelchair

   b. Lower TV

8. Master Bath

   a. Walk-in tub

   b. Door opening directly in front of commode

   c. Valet rod for clothes

   d. Heated floors

   e. Extra faucet with pull-out nozzle

   f. Special place for hairdryer

   g. Tilted mirror
h. Grab bars that fold into the wall

9. Master Closet
   a. Drawers at wheelchair height
   b. Department store clothes hook
   c. “Seasonal” clothes rod
   d. “Pass through” into laundry

10. Laundry
   a. Front loader appliances
   b. Extra space for wheelchair
   c. Lower hanging rods
   d. Pullout shelf
   e. “Pass through” into master closet

11. Throughout the house
   a. Lowered light switches
   b. Raised plug ins
   c. Remote control shades
   d. Security System
   e. Light switches that can be accessed through cell phone
   f. Touch faucets
   g. Drawers where possible instead of cabinets
   h. Tile floors
Case Studies  Conclusion

The Seattle bungalow for the Baldwins was designed specifically for their home and their lifestyle. Their home is able to be modified to fit another family at a different point in their life. Instead of installing an elevator, the Baldwins utilized the spaces as a reading area and a closet, but left the opportunity to add the elevator later in life. They incorporated a walk-in/roll-in shower in the bathroom the easy wheelchair accessibility.

The 6 North Apartments provide a home for anyone that might have a disability. They are designed with a general overall concept of universal design. They are equipped to handle anyone at any point in their lifestyle. The layouts are open for accessibility and the kitchen appliances are for those in wheelchairs and those looking to relieve stress on their back.

Amanda’s home was designed with universal design concepts that are specific to Amanda’s level of cerebral palsy. The details met many of the universal design requirements and provided a home for Amanda to have a higher level of independency from her family and neighbors. This level of universal design for Amanda works well for her but might not work for another individual.

The three case studies prove that universal design is a concept that can be implemented in any situation. Whether it is specific to a certain disability, or covers the basic standards for a generalized design, a reader can gain knowledge from these case studies. This knowledge can then be used in the reader’s own space to take advantage of their spaces to their full potential.
Proposed Recommendations

The case studies provide a background of information for future designs and spaces. These scenarios give a reader insight to how universal design has been implemented and successful in a design. The case studies illustrate new and more innovative ways spaces could potentially be designed. More specific spaces and homes, such as Amanda’s or the Baldwin’s house, requires a more detailed look at the personal situation. A general overview of recommendations, not specific to any certain situation, is helpful in a design that is based on the universal design mainframe. These concepts can be implemented successfully in any home. Implementing certain universal design details can allow a level of accessibility that doesn’t just accommodate the owner of the home, but anyone who may use the space. This level of design allows for an ease of accessibility for any user.

From large, entertaining spaces to more personal, private areas, universal design can be implemented successfully. In the bedroom, designing with the 36” on each side of the bed and a 5’-0” turning radius, allows for wheelchair bound users as well as anyone that may have a disability to have the space to maneuver around the bed with ease. Allowing for that 18” on the latch side of the door ensures there’s enough space to enter and exit the room with ease. Entering and exiting the bedroom, whether to the rest of the home or a bathroom adjacent, the doorways should have a minimum to zero-threshold. The closets should be designed as a walk-in or roll-in, contain varied shelving heights, and rods to hang clothes.

Making certain there is enough space in the kitchen will allow multiple users to take advantage of the space to its maximum potential. Varied counter heights ease stress
on the backs of different heights of users. In addition to the NKBA guidelines laid out before, replacing the standard or adding in universal design details, will give the user a kitchen that is able to function at its highest capacity. Keeping a consistent work triangle within the kitchen is important for any home. The design of a kitchen may vary from home to home, but keeping a work triangle within the standard measurements will allow for an efficient work space. Designing the cabinet layout with varied heights, drawers, and accessible shelving allow for the storage of the kitchen to be maximally used.

Appliances also play a major role in a kitchen. Arranging the kitchen in a way for appliances to be lowered or raised doesn’t just relieve stress on a person’s back, it allows for any user of the kitchen to take advantage of the appliances.

Having the master bathroom universally designed is a great achievement, but at least one other bathroom on the main floor should be able to accommodate the 5’-0” turning radius needed for wheelchair accessibility. The NKBA developed guidelines for the bathroom as well, and these guidelines should be taken into account when designing a universal bathroom. These guidelines create an efficient use of the space without hindering a user’s ability. The addition of grab bars or other accessibility features can not only improve the life of a home, but also allow for many other users to take advantage of the area.

The living room is a space that doesn’t have many detailed requirements for accessibility. Keeping circulation and the turning radius in mind, accessibility details from other spaces can be implemented. The living room should have space between the main furniture spaces that allows for the passage of someone in a wheelchair and includes a 5’-0” turning radius, so that they are able to maneuver around the area with ease. Flush
thresholds and the minimum openings to enter or exit the space should be found and the main circulations should be held to a 42” width minimum. Lighting in this public space should vary, as well as the switches and outlets being lower and higher, respectively.

The entry should include the 5’-0” turning radius as well a zero-step entry. Pre-planning would ensure the threshold of the entrances. A ramp could just as easily be incorporated into a design. Exterior lighting that is motion-sensored is a way to provide light at night for users of the home.

Details in the laundry room come from the appliances as well as the heights of rods and shelving. The washer and dryer should be front loading appliances and on pedestals. Having these appliances raised relieves the stress of a person’s back and allows for the reach for someone in a wheelchair to be less. These appliances would also have the buttons on the front of the appliance for less of a reach. Various lighting and switches should be provided, just like in the other spaces. The push through space from the master closet to the laundry area in Amanda’s home is an innovative detail that can be implemented if the spaces are near each other.

All areas of a home can essentially be universally designed to accommodate all users. The recommendations may remain endless to account for a design that incorporates all design features for all disabilities. A general overview of design details touching on spaces of a home, can enforce the conversation between homeowners, designers, and others in the housing industry that has been started.
Conclusions and Implications

“In 2011, in communities across the country, the leading edge of the Baby Boom generation reached age 65. By 2030, more than 70 million Americans—twice the number in 2000—will be 65 and older. At that time, older adults will comprise nearly one in five Americans” (Lipman, 2012). This data should be taken into account with the present-day housing industry and as the industry plans to move forward to accommodate an increasing, aging population.

A combination of forces is needed to make a piece of legislation not only important but effective as well. Different disability movements, as well as technology taking leaps and bounds through the years, have helped develop acts that enforce creating spaces that are designed for everyone.

Defining the words most closely related to universal design reiterates the ‘why’ as to how a design is done. The definitions give a reader a chance to understand what universal design concepts entail and what to expect in a space.

Showcasing real homes, spaces that have been done with universal design in mind, give a reader a chance to see that universal design can be done. These case studies also show that universal design can be done successfully and give a hopeful mindset that these details could essentially be created in the reader’s home.

Creating a foundation of information of universal design is important to helping design a space for everyone. Advancing in the design process casts many questions about universal design, its worth and implementation. Informing the public of universal design’s value and how it can be beneficial can advance of the housing industry. Questions arise when delving further into the conversation:
- How can the options of universal design be shown?
- How can the value of universal design be illustrated?
- What can be done to influence the housing industry now? And later?

These questions can further the conversation already ensuing about universal design. Developing a source of information showing several options of universal will help a consumer visualize that their options are not necessarily limited. Showing the life of universal design products can provide the visual concept of value to the consumer or homebuilder.

Comparing guidelines for the basic residential measurements to the universal design recommendations show that sometimes homes may already have some guidelines in their spaces, proving that universal design is not a hard task to complete within a home. Universal design begins to embark on the journey of designing for a lifestyle, much like Paul Saffo states, “It used to be that designers made an object and walked away. Today the emphasis must shift to designing the entire life cycle” (Futurist Paul Saffo on Design - Corporate Design Foundation). The open conversation of universal design in the housing industry establishes a starting point to how homeowners, designers, and others within the housing industry can come together to design for a lifestyle, instead of just a home.
References


