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# The Intersection of Universal Design and Sustainable Living [title]

Accessibility and sustainability come together in kitchen and laundry spaces that combine established design principles with proper appliance selection. [subtitle]

Provided by (exactly how the sponsor would like their name to appear): **Whirlpool Corporation**

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# Learning Objectives (4-5 LOs required):

After reading this article, you should be able to:

1. Identify and recognize the ways that universal design is important and needed in residential design.
2. Distinguish between the various components of sustainability in building design.
3. Explore the ways to design kitchens to achieve successful integration of universal design and sustainability.
4. Demonstrate the ways that kitchens, laundry rooms, and appliances can be accessible to all users while using water and energy efficiently.

**General formatting comments– highlighted in yellow**

**CASE STUDIES – highlighted in Pink – SEE PAGE 11-12**

**Quiz Answers - highlighted in green – SEE PAGES 13-15 for Quiz / answer key.**

**PHOTOS, TABLES, and FIGURES – locations highlighted in red below – SEE PAGES 16-19 for referenced photos with credits and captions**

**Cover Photo**

*Text Begins Here*

New and renovated residential buildings, among other things, need to be designed to meet current standards or code requirements for handicapped accessibility and energy use. Specifically, multi-family buildings are required to meet code requirements for at least a portion of units to be handicapped accessible following national standards while energy codes and standards require energy conservation in buildings overall and in equipment and appliances in particular. Increasingly, however, single family homes and multi-family units are also being voluntarily designed to think beyond “code minimums” and achieve a higher level of design. Living units often follow the approach of “Universal Design” meaning that the living spaces are universally accessible by all people. Buildings and appliances that carry certification labels reflecting sustainability such as ENERGY STAR®, LEED, or others have become not only a marketing edge, but a mainstream expectation. Both of these areas of sustainability and Universal Design have become quite well developed and sophisticated in recent years with many professional and trade resources available. A key consideration is that design professionals can incorporate both of these design areas in ways that work together with each other creating the best outcomes for the users or residents of the building. The techniques to do this have also advanced to the point where aesthetics and overall design do not need to be compromised by either one. All of the sustainability and accessibility approaches affect the design of a total living unit, but perhaps most notably in kitchen areas and related laundry areas. Accordingly, this article will look at the ways the general principles of Universal Design and sustainability can work together in residential buildings and focus on some specific ways to apply them in the design of kitchen and laundry areas.

**Universal Design Section\_Head**

Everyone involved in the design of buildings is certainly aware of the national standard for accessibility, namely, ICC A117.1 “Accessible and Usable Buildings and Facilities.” The latest version of this standard is included by reference in the family of building codes produced by the International Code Council and adopted in various forms around the country. Originally only a publication of the American National Standards Institute, it has since been fully codified and is generally in agreement with the building provisions of the landmark Americans with Disabilities Act enacted in 1990. Fundamentally, these all prescribe specific requirements to accommodate people with physical disabilities.

Universal Design, by contrast, involves designing spaces holistically so they can be used by a full range of people with many different capabilities. Universal Design looks beyond code and regulatory requirements for accessibility by recognizing that there is a wide spectrum of human abilities either between different people or between different periods in someone’s life. Everyone, whether able-bodied or not, experiences childhood restrictions, adult capabilities, periods of temporary illness, physical injury, and limitations of old age. The differences at these different periods can be found in physical, perceptual and cognitive abilities, as well as different body sizes and shapes. By recognizing this diversity of experiences that affect all people, environments can be designed that are easier for all people to use. A good example can be found in curb cuts at sidewalks that were initially designed and constructed primarily for people who use wheelchairs. It didn’t take long to recognize that they could also be used by pedestrians with strollers or rolling luggage, thus adding functionality and convenience to everyone as part of a universal population.

In addition to convenience, health and wellness in general are common topics of concern by many individuals, organizations, and institutions. It is commonly understood by most of them that preventive, pro-active measures are preferable to treating symptoms and conditions after the fact. Mary Jo Peterson, a nationally known expert on universal kitchen and bath design has noted that Universal Design has been emerging as just such a proactive approach to supporting health and wellness. She has observed that “by allowing people to function in their own home environment, they can remain more independent, avoid unnecessary healthcare stays and help promote their own longevity”.

**Photo #1**

As part of this health and wellness perspective, there are several groups of people in particular that have given rise to the popularity of Universal Design. The first is the approximately 75 million “baby boomers” who are approaching or entering retirement age. With a keen interest in staying active and independent, the concept of “aging in place” has become a strong design interest. This approach is intended to allow people to remain in their own homes as their physical capabilities change over time. Typically, people in this group have sought a housing design that suits a current active lifestyle but readily accommodates anticipated future restrictions in mobility or capabilities. Another group of people with a similar but inverted order of needs is returning war veterans who are undergoing rehabilitation with the anticipation of improving capabilities. In this case, they seek a housing design that can accommodate their current compromised capabilities now while still allowing for them to remain in the house when capabilities increase. Then there is the case of an increased number of multi-generational households where family members or others of different capabilities are living in a household all at the same time. This multi-generational group seeks a housing solution that can accommodate all of their different needs simultaneously.

Incorporating Universal Design approaches in a residential design allow for the various needs of all different types of residents to be met. It also allows for the building to have a longer period of usefulness to the owner reducing the need to move or relocate due to changing capabilities. This is one way that Universal Design is also more sustainable.

**Sustainable Living and Universal Design Section\_Head**

It is well understood that the design of sustainable residential units requires attention to a variety of issues. Energy efficiency is appropriately the first one that commonly comes to mind and is the most heavily weighted in green building rating systems such as LEED and the primary focus of the ENERGY STAR® program. However, most of us are aware that other issues are important too. Water conservation is becoming as important as energy savings particularly in many areas of the country where water shortages are becoming critical. As part of a healthy indoor environment, indoor air quality is a concern particularly in regard to the chemical make-up of many building materials and products used in buildings. But an indoor environment is also affected by other things too such as the acoustics and noise generation in a space or the ability to incorporate daylight and views from all areas.

Many of these sustainability attributes are also consistent with Universal Design attributes, meaning designing buildings to incorporate both does not mean that they need to be thought of as exclusive and separate things, particularly in terms of overall health and wellness of occupants. Turning again to Mary Jo Peterson, we can learn that “Universal Design has always had a focus on the health of the environment including healthy air, elimination of allergens, and the way the quality, direction, and amount of light affect the occupants of a space. The same is true of sound quality and the control of noise in the home.” This connection between Universal Design and sustainable design is fairly obvious in that both are concerned with the ultimate health and wellness of the occupants as much as they are with the physical design of the spaces.

**Photo #2**

Looking at the bigger picture, if an entire home or a kitchen is created to be flexible and to respond to the differences in the people who will use it, then the home will last longer and be inherently more sustainable. Taking that a step further if we use the best products and materials we can afford, those that will last the longest, then we can have the least potential long term impact on the environment. Mary Jo Peterson sums it up nicely: “For a living space to be sustainable, it needs to be usable equally by all inhabitants, and this is what the combination of sustainability and Universal Design is all about.”

**Integrated Kitchen Design Section\_Head**

With an understanding of the principles of integrating Universal Design and sustainable design, let’s focus on what is arguably the most complex room of a living unit to design, namely the kitchen. The National Kitchen & Bath Association (NKBA) is a great resource and the recognized trade association for developing planning and design guidelines for residential kitchens and bathrooms. In 2012, they worked with John Wiley and Sons to publish “Kitchen Planning Guidelines with Access Standards” to provide designers with good planning practices that consider the needs of a wide range of users. For general issues, these standards reference the 2012 International Residential Code® (IRC®) and the International Plumbing Code® while for accessibility the reference is ICC A117.1-2009 Accessible and Usable Buildings and Facilities. This publication offers 31 different kitchen planning guidelines that address kitchen layouts, circulation, reaching distances, work areas, and many other details of creating a good, accessible, kitchen design. More importantly, it epitomizes the concept of Universal Design in that it shows how to design for all people.

**Photo #3**

From a sustainability standpoint, there are many great resources to draw from including LEED for Homes or ENERGY STAR®. Essentially, however, kitchens need to meet the same general criteria as the rest of the building in terms of healthy, appropriate construction that allows for light, fresh air, and energy efficient thermal comfort. But there are some things specific to kitchens to focus on as well. Notably, the appliances in the kitchen require energy and in some cases water that should be used efficiently or only as needed. Appliances can also contribute to unwanted noise when they are running if not acoustically controlled. Additionally, the kitchen is a common place to provide trash receptacles which means that from a sustainability view, receptacles for recycling are also needed. Some of these sustainable design elements will affect the amount of space required and some will affect the selection of materials and equipment.

Pulling this all together, a kitchen that is truly sustainable and universally accessible is also efficient in its use of space such that it doesn’t make the living unit bigger than really needed in the first place. Single floor living is the usual overall starting point suggesting that the kitchen is integrated into the main living level. Access into the kitchen from other areas will require an accessible path not only through adjacent spaces, but also leading from a garage or entry door following level floors or acceptably sloped surfaces at 1:12. The circulation and flow into and through the kitchen also needs to avoid interfering with the functionality and flow of the kitchen. It also needs access paths that can accommodate people walking, using wheelchairs, or both.

The functionality of a kitchen is commonly broken down into five explicit zones for storage, preparation, cooking, serving/eating, and clean-up. Each of these zones need to be addressed as an integrated part of an overall kitchen design that allows for accessibility and sustainability. We can look at these five zones in more detail as follows.

**Storage Zone Section\_SubHead1** One of the primary functions of a kitchen is to keep or store food, cooking implements, dishes, and other related items. The Universal Design key, of course, is that everything being stored is easily placed and reachable by everyone. The trend in kitchen storage design is evolving notably to do exactly that. Upper wall cabinets are being used less frequently since they are difficult to reach by many average height standing adults and even more so by anyone sitting, as in a wheelchair. Hence, a trend has been observed that these cabinets are being replaced with lower height, open front shelves that provide ready access and display of things like dishes, glassware, etc. Similarly, instead of lower cabinets with doors concealing fixed shelves that may be difficult to reach down into, drawers are emerging as a preferred option. It is clearly easier for anyone to pull out a drawer to view and access the contents but it can be particularly better for anyone who has trouble bending or kneeling down.

**Photo #4**

Storage also includes the need to refrigerate or freeze perishable food. That means an appliance to refrigerate and/or freeze food is part of this storage zone. We are all aware that there are many different choices in such appliances, but there are certainly some that meet sustainability and accessibility better than others. From an energy standpoint, refrigerators have typically been cited as the most energy intensive household appliance because they operate 24 hours a day, every day, all year. Improvements in the mechanical portion of the refrigerator, the ability to control it, and the insulation used all have helped to reduce the amount of energy consumed. When selecting a refrigerator, the decision should be based on choosing one that is as energy efficient as possible, which is made easier by looking for the blue and white ENERGY STAR® label associated with the appliance. ENERGY STAR® is a federal program of the U.S. Environmental Protection Agency (EPA) that allows manufactured appliances to earn that designation by providing evidence that they perform better than the current federal minimum standards for comparable appliances. In 2015, refrigerators were required to operate at least 9 percent more efficiently than minimum standards in order to be ENERGY STAR® rated.

Generally, it is usually less costly and more energy efficient to run one larger refrigerator / freezer appliance rather than two smaller ones. If a single refrigerator/ freezer appliance does not appear to meet the food storage needs of a user, then there are two fundamental options - either increase the size to a larger unit or add supplemental refrigeration appliances. For design situations that call for a variety of notably different refrigeration needs including different temperature settings for significant quantities, then multiple units may be a logical choice. This may be the case in a large multi-generation household for example where a larger built-in refrigerator only unit is supplemented by a similar but separate freezer only unit. From a design standpoint, locating these units as part of the storage zone makes the most sense. However if smaller supplemental refrigeration is needed, such as for storing wine only or for a separate area for serving, then a small, dedicated unit set to the appropriate temperature may make sense.

From an accessibility standpoint, refrigerators could be looked at as a big cabinet. That means placing freezer or refrigeration drawers in the middle or lower section of the appliance that can be pulled out for easy access will be easier than only relying on swinging doors. Nonetheless, since most use swinging doors of one type or another, the selection should be based on the ease of use, both from a standing position and from a wheelchair. Side by side refrigerator / freezers are one option for full height access to both. However, French door style appliances can provide full access to the refrigeration portion which may be the most actively used portion and they do so with minimum impact on clear floor space by reducing the space needed for the door-swing. Chest style freezers that are very deep are generally difficult to reach into and use by most people and particularly for those in a wheelchair or those with difficulty bending, so they are not the best choice here. Common swing door refrigerators with a freezer on top can also prevent some people from accessing them easily, which is why a freezer drawer below the refrigerator can be more universally accessible.

Accessibility guidelines call for adequate approach areas to refrigeration such that a clear space of 30 by 48 inches is available in front of the appliance. That access space should be offset by no more than 24 inches from the centerline of the refrigerator on the handle side. There is also the requirement that a “landing” area is located immediately adjacent to the refrigerator or within 36 inches of it on a nearby counter top. The purpose is to allow for an item to be set down on the counter freeing up both hands to open or close the refrigerator door.

**Preparation Zone Section\_SubHead1** When it comes time to prepare food or a meal, a horizontal work surface is needed, recommended to be adjacent to a sink for rinsing or cleaning food. Acknowledging Universal Design in creating this work zone means acknowledging that the people using that work surface may have different abilities to stand for extended periods or not at all. Therefore, a work surface that can accommodate standing or sitting is called for. That can translate into different surfaces that are different heights ranging from 29 to 36 inches or an adjustable surface that can raise and lower within that range to suit a person’s needs. It also presumes that a chair, whether with wheels or not, or a stool can be placed appropriately with leg room under the work surface, not with a base cabinet in the way.

**Photo #5**

The standards for accessibility have established accessible work heights, but the NKBA guidelines go further in demonstrating different heights for different capabilities. Specifically, they suggest that at least one 30 inch wide section of countertop be provided either without a base cabinet underneath within the height ranges above, or that a removable cabinet be provided in the event that a seated access is needed in the future.

**Cooking Zone Section\_SubHead1** This area of the kitchen is typically very appliance centered which can include a single integrated appliance or more commonly multiple cooking appliances. In order to address Universal Design needs, appliances are being placed and located at heights that are comfortable and usable for everyone rather than limit them to traditional locations and heights. Microwave ovens, for example, need to be readily accessible at a height suitable to people who are standing or sitting. As such, they can be located independently from other appliances or as part of a cooking center with multiple options. Either way, they can be placed to be reachable at counter height, below counters, or slightly above the counter as may best suit the overall design. Allowing for the microwave to be moved offers the most flexibility using shelves at different heights that can receive the microwave oven. In terms of efficiency, while microwave ovens are a known and expected time saver they also generally use one-half to two-thirds less electricity than a conventional oven, particularly when used for reheating small portions. Because less heat is generated in the kitchen, residual savings may accrue from reduced air conditioning loads in the unit.

**Photo #6**

Turning to conventional ovens, certain free standing ranges are being manufactured with two oven cavities, typically a smaller one above a larger one. This provides convenience in cases where two separate dishes are being cooked at the same time but which require different temperatures. However, it is also more energy efficient because the oven cavities are smaller than a comparable free standing range with just one oven large cavity. Hence each individual cavity requires less energy to heat up to temperature while heating up faster in the process. Models that provide a smaller top oven cavity, where a vast majority of meals could be cooked, use less energy overall than the traditional larger single cavities. This also means that the upper cavity is easier to access from both a standing and sitting position.

Separate built in wall ovens can achieve the same convenience if they are raised up to an accessible height. This makes it easier to put things into and out of than a lower conventional oven that requires bending or lifting but may or may not be as energy efficient. Choices in features and types will impact energy performance, but they also offer other options to suit the lifestyle of the occupants. Convection ovens for example save time by using an internal fan to move heat inside the oven. They can average 20 percent more energy efficiency than standard ovens because the heated air is continuously circulated around food meaning heat is distributed more evenly, and cooking time can be decreased. In any version, some ovens are self-cleaning which requires energy to heat up the appliance to a very high temperature and burn off any soil inside. Some have innovative coatings on the cavity wall which make it harder for soils to stick while some use lower cleaning temperatures all in the interest of saving energy.

Cooking surfaces for pots, pans, etc. can be accommodated by cooktops that are part of a range appliance with an oven or are separated out as a stand-alone appliance. Separating out the cooktop from the ovens allows for different types of cooking functions to occur in different specific locations, which may be appropriate for high use kitchens. It also allows for ovens to be located separately for the most convenient access for everyone. For a fully universal access, the controls for cooktops, ranges, and ovens need to be easy to reach, read, and use without stretching arms over a hot surface. That usually means that the controls are toward the very front of the appliance or on the side, but not the rear.

When considering fuel type for cooking, there are usually two fundamental choices – electric or natural gas. It makes good sense to determine the best performing energy source for a specific cooking appliance although in some cases, it may also be problematic or expensive to provide natural gas. Fortunately, many improvements in electrical cooking appliances can actually favor them over gas-fired kitchen appliances. A particularly innovative technology in this regard is the use of electric induction elements in cook-tops and range tops. The difference between conventional electric cooking and induction cooking is dramatic. Conventional appliances use large electric resistance coils to produce raw heat that radiates up to a pan above thus heating it and the surrounding surfaces at the same time. By contrast, induction elements use electromagnetic energy that is focused directly on the pan, placing heat specifically where it is needed and not on the cooktop surface. When the pan is removed, there is little or no lingering heat on the cook-top because it was never heated up in the first place. As a result, induction cooking is not only safer for people using it, it is very energy efficient requiring significantly less energy than other standard cooking elements. In fact, in a comparison of different types of cooking systems, induction cooking was found to be notably more efficient than typical radiant electric and gas cooking appliances.

**Photo #7**

Of course, many people who cook often indicate that they like the quick response to adjusting temperatures with natural gas. However, it turns out that induction cooktops or ranges are actually more responsive than natural gas. Heat levels can be instantly adjusted from a delicate simmer up to a high setting that can boil water in as little as 90 seconds. Further, since the surface doesn’t get hot, it can be cleaned up quickly and easily in case of spills. Electric induction cooking appliances are easy to work into residential designs since they don’t require any special electrical work - they can be connected to a standard electric range outlet or junction box. They are equally easy for users since no special cooking utensils are needed – most ferrous metallic pots or pans works just fine.

Regardless of the oven or cooking appliance used, landing areas on either side are needed similar to the ones described earlier for refrigeration. In this case the intent is to provide a place to set pans, utensils, food, etc. on a countertop adjacent to the cooking appliance either to open or close an oven door or to access needed tools or ingredients while cooking. The recommended minimum landing area size varies by appliance, but generally a minimum area of 15 by 16 inches is needed adjacent to one side of an oven. On cooktops or range tops one is needed on each side, although one can be reduced to 12 by 16 inches. Further, a landing area 9 inches deep behind a cooktop is recommended on an island or when it is otherwise not located against a wall.

**Serving and Eating Zone Section\_SubHead1** Once food is prepped and cooked, it’s time to serve it up and eat of course. A nearby table with enough chairs for the household and adequate clearance to access it is a common and flexible approach. It also allows chairs to be removed in the event someone wheels up in their own. Beyond that, it is common in many kitchen designs to provide a built in eating area with fixed serving and eating surfaces. This latter approach is more permanent in nature, so it is important that it is designed properly the first time to allow for the most usability for a variety of people. Designed properly, it can be a space saver and allow for more open area in the kitchen for maneuvering.

One of the first things to consider in a fixed seating area, is its location within the kitchen. The NKBA guidelines point out the need to locate it adjacent to the primary work areas, but with access that does not require travel through those work areas. Commonly, this means that a counter top is extended on the back of a work zone. The location is important, though, since the access to the seating area needs to accommodate a variety of people who might need to walk by, edge past, or wheel by. That means that the nearest obstruction, such as a wall or furnishings needs to be at least 36 inches or preferably 60 inches away to allow space for a chair or stool plus space for someone else to pass behind them.

**Photo #8**

A key variable for such a serving / eating surface is its height. Some designs will call for it to be the same height as a countertop (36 inches above floor) making it easy to extend out accordingly. However, that height requires a higher seated position on a stool or in a wheel chair that can raise up. Many parents aren’t keen on the idea of young children seated higher up either, so it is also common to use, instead, a lowered surface of approximately 30 inches, which is more consistent with typical table height. At the other end of the spectrum, some people prefer to have a higher surface either to make it easier to access while standing or to simply sit on a higher stool. Hence, a 42 inch high surface is often used with the added benefit of providing a bit of a visual screen to whatever is on the surface on the other side. The NKBA standards address all 3 of these heights and the associated clearances for each. First they indicate that kitchen seating areas should be 30 to 36 inches wide and 17 to 25 inches deep to better accommodate people of various sizes or those using a mobility aid. There are variations in this formula such that a 30 inch eating height requires at least 18 inches of knee space, a 36 inch high surface only requires 15 inches of knee space, and the taller 42 inch height requires the least knee space of 12 inches. It may also be possible to justify narrower widths on the order of 24 inches per seated person.

**Cleanup Zone** **Section\_SubHead1** All kitchens involve cleaning, whether of the kitchen itself or the things used in it like pots, pans, dishes, glasses, etc. Low maintenance is of course desirable, particularly for people with mobility issues. Mary Jo Peterson has observed this desire citing “antibacterial materials and finishes, cleaner lines, appliances that report trouble back to the manufacturer, self-regulating ventilation or lighting,” are all part of the ways we can streamline the care of kitchens.

Beyond these overall basics, the sink and dishwasher components become the primary focus of this zone. The NKBA standards suggest that the distance between these two components should be no more than 36 inches for convenient access plus 21 inches of minimum clearance between an open dishwasher front and the nearest obstruction. A landing area on either side of the sink of 18 to 24 inches wide and at the same height as the sink counter are recommended. They also indicate the preference for a removable sink front and leg room access beneath the sink to allow a seated person to use the sink when needed or warranted.

**Photo #9**

The dishwasher itself is recommended to be raised up 6 to 12 inches off of the floor for easier access. Mary Jo Peterson points out “It’s interesting to note that while the original reasoning behind a raised dishwasher was for use by a person in a wheelchair, today it is more often a benefit to a standing person who would choose not to bend. However, this is one of those Universal Design concepts that only works when it fits into the design. A raised dishwasher at the end of a generous counter stretch separating the kitchen views from the adjoining space might be great, but that same raised unit in the middle of a “U” shaped kitchen would be all wrong.”

Residential dishwasher design has increasingly been influenced by professional grade dishwashers to provide better performance, use less energy, less water, generate less noise, and need less time to get dishes clean. A significant portion of the energy used by dishwashers is actually the energy required for heating the water they consume, since almost all dishwashers on the market use internal booster heaters. That is actually a good thing, because it allows household domestic hot water heater temperatures to be turned down to around 120 degrees, instead of the higher temperatures usually desired for dish washing. The lower water heater temperatures mean less energy is used on an ongoing basis with the higher temperature created only for the intermittent needs of the dishwasher.

Water use in appliances has become enough of an issue that the EPA has developed a water efficiency labeling program for plumbing fixtures but not yet for appliances. Nonetheless, some ENERGY STAR® dishwashers use half as much water as others, saving hundreds of gallons of water each year and corresponding savings in energy use. Check the manufacturer’s literature for ratings and water use on different makes and models. Selecting a unit that meets or exceeds the ENERGY STAR® rating requirements for both energy and water usage will enhance the energy savings even more.

**Coordinated Laundry Design Section\_Head**

Laundry equipment can be located in a laundry room that can accommodate multiple functions or be integrated into clothes hanging or dressing areas. In either case, the first choice in laundry appliances is whether to use front loading or top loading appliances. Those appliances that operate by spinning on a horizontal-axis (hence the front loading) are generally much more efficient than conventional vertical-axis (top-loading) models. In washing machines this is attributed in large part to the fact that top loading machines with agitators need to fill the tub completely with water while the horizontal axis machines do not. Hot water heating accounts for about 90 percent of the energy consumed by a clothes washer – only about 10 percent goes to the electricity to run the washer motor. Hence, specifications for washers should clearly address both energy and hot water usage. If water efficiency is a particular concern, note that washers are rated with a Water Factor (WF) that indicates the number of gallons needed for each cubic foot of laundry. The lower the WF, the less water needed to operate.

**Photo #10**

When it comes to clothes dryers, the fundamental choice is between electric and gas-fired models. In terms of comparative energy use, gas dryers are generally less expensive to operate. However, most sources agree that there is not a lot of variation in overall energy actually used between models. Typically, it is usage and running time that dictate the amount of energy used. Therefore, controls for turning off dryers become the major consideration for energy consumption, particularly if coupled with an efficient washer that has extracted a lot of the water out of the clothes already. The fundamental controls choice is whether or not the dryer uses sensors to automatically turn off the dryer once clothes are dry. The alternative is timed drying, leaving the running time, and corresponding energy use, to the guesswork of the user. The best dryers have moisture sensors inside the drum for sensing dryness and turning off the machine. Most others only infer dryness by using temperature sensors in the exhaust air portion of the dryer, which may result in running the dryer longer than needed. Compared with timed drying, savings of about 10 percent with temperature-sensing controls and 15 percent with moisture-sensing controls are possible.

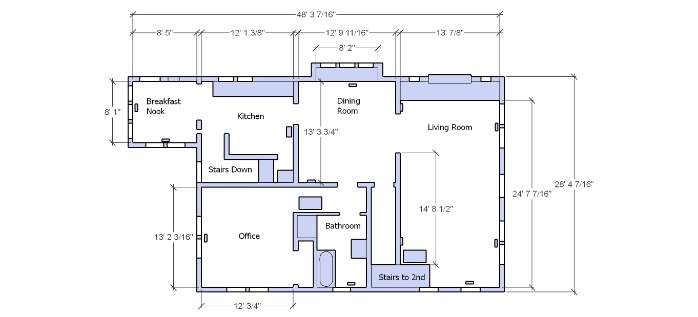
The main Universal Design concerns in the laundry have to do with front loading access and easily accessed front controls, both of which make the appliances easier to use. Originally, these appliances were placed side by side on platforms, raising them so a person using a wheelchair could open the doors on front loaders above their knees. Like so many things, standing users found that they could benefit from this arrangement by not needing to bend over to access the appliances. Some manufacturers provide a drawer in the platform to hold dispensers of detergent, so lifting heavy laundry detergent bottles is simplified. It’s also worth noting that the laundry room has become a much more important space in the home often expanding in size to accomplish many other tasks such as folding, ironing, mending, storage, and other things. The Universal Design implication here is that the whole room has to be accessible and usable by all.

**Conclusion Section\_Head**

Universal Design and sustainability are important and closely related design aspects of many buildings, particularly residential ones. This is evidenced throughout the building but quite strikingly in the design of kitchen and laundry areas. The variety of standards and resources available allow design professionals to confidently create integrated design solutions that can respond to the differences in the people who will use them, to differences that can occur in any one person’s life, or in differences over the life of the building. Allowing for this efficiency and flexibility allows buildings to last longer, and be truly more sustainable.

Approximately 5,650 words to this point

### Case Study

Images courtesy of Whirlpool corporation

**ReNEWW House**

Whirlpool Corporation and Purdue University, working with other building industry suppliers, are transforming an existing 1920s vintage home near Purdue’s campus into a world class research laboratory and sustainable living showcase. The home – called the ReNEWW House for Retrofitted Net-Zero Energy, Water and Waste – will provide valuable insights for residential builders, remodelers and designers on technologies that enable sustainable living and Universal Design. It will also leverage the world class facilities with Purdue researchers to accelerate the development of the next generation of ultra-high efficiency appliances that increase core performance while lowering their impact on the environment and cost to operate.

Some of the design aspects of transforming this 100 year old home into a modern showcase include the following:

* General layout: The original plan was, as per its era, a closed plan, difficult to maneuver in while the new plan opens the first floor making it easier for any and all to move through. This speaks to the varied needs of the people who might live in this space and it answers the specific needs of its current residents who use the home as a demonstration space, opening its doors to crowds for open houses on regular occasions. There is also a place to sit to remove shoes or boots at the door and generous use of day-lighting.
* Kitchen Storage Zone: A pantry provides storage within reach at a variety of heights. Refrigerator and freezer include doors and drawers that provide storage within reach a variety of heights. There is also a generous amount of drawer storage, which is easiest to access plus open shelves for visible storage in some places.
* Kitchen Preparation Zone: Throughout the kitchen there are multiple heights in the counters for work surfaces for cooks of varied heights.
* Kitchen Cooking Zone: An induction cooktop is used that is both energy efficient and safer for use by a cooks with varied skills and abilities. Ovens are located at more comfortable, user-friendly height for most cooks.
* Kitchen Serving/ Eating Zone: A seating area accommodates a variety of approaches and numbers of people with generous work and passage aisles.
* Kitchen Clean up Zone: There are multiple places to sit to work with easy access to the sink and dishwasher.

Approximately 6,000 words to this point

**Author Bio (to appear at end of article)**

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QUIZ

1. Universal Design addresses differences in people that can occur over their lifetime in terms of:

a. physical abilities

b. perceptual and cognitive abilities

c. different body sizes and shapes

d. All of the above

1. The connection between Universal Design and sustainable design is fairly obvious in that both are concerned with:

a. exclusively energy conservation in a living unit

b. the ultimate health and wellness of the occupants

c. only water usage, noise, and daylight in a residence

d. residential space design but not commercial design

1. Some things specific to kitchens related to sustainable design include all of the following EXCEPT:

a. the age of the residents

b. appliances that require energy and in some cases water

c. control of unwanted noise

d. the need for recycling receptacles

1. An energy efficient, easy to access refrigerator is a key part of which zone in a kitchen?

a. Serving zone

b. Storage zone

c. Clean up zone

d. Cooking zone

1. In the preparation zone, one or more work surfaces that can accommodate standing or sitting should be how high?
2. Fixed at 29 inches
3. Removable at 30 inches
4. Vary from 29 to 36 inches either with different surfaces or one adjustable surface
5. Only 36 inches

1. Free standing ranges manufactured with two oven cavities, typically a smaller one above a larger one, are more energy efficient and the upper cavity can be more accessible to people sitting or standing.

a. True

b. False

1. A type of cooking that is not only safer for people using it bit also very energy efficient requiring significantly less energy than other standard cooking elements is:

a. convection ovens

b. natural gas cooking

c. induction cooking

d. electric resistance burners

1. NKBA guidelines indicate that kitchen seating areas should be 30 to 36 inches wide and 17 to 25 inches deep to better accommodate people of various sizes or those using a mobility aid.

a. True

b. False

1. A significant portion of the energy used by dishwashers is actually the energy required for.:

a. pre-rinsing dishes

b. running the motor and sprayer

c. phantom loads from controls

d. heating the water they consume, since almost all dishwashers use internal booster heaters

1. Laundry appliances with front loading access and raised up on platforms make them easier to use not only for people in wheelchairs but for standing users too.

a. True

b. False

**Quiz Answer Key**

Question Answer

1. D  
2. B

3. A  
4. B

5. C   
6. A

7. C   
8. A

9. D  
10. A

**Photos and Captions:**

**Cover Photo:**



**Caption:** Universal Design and sustainable living come together most notably in the design of efficient, accessible kitchens. Photo courtesy of Whirlpool Corporation. Credit: The IWS Lake Forest Showhouse

**Photo #1 –**

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**Caption:** Universal Design promotes layouts that are easy to maneuver and pass through as well as aspects of functionality and convenience. Photo courtesy of Whirlpool Corporation. Credit: The IWS Lake Forest Showhouse

**Photo #2: -**

**C:\Users\Peter\Downloads\C1_JenniferGilmer_1.tif**

**Caption:** Sustainability can be achieved throughout a residential unit but there are aspects of kitchens that warrant particular attention. Photo courtesy of NKBA. Design by: Jennifer L. Gilmore, CKD

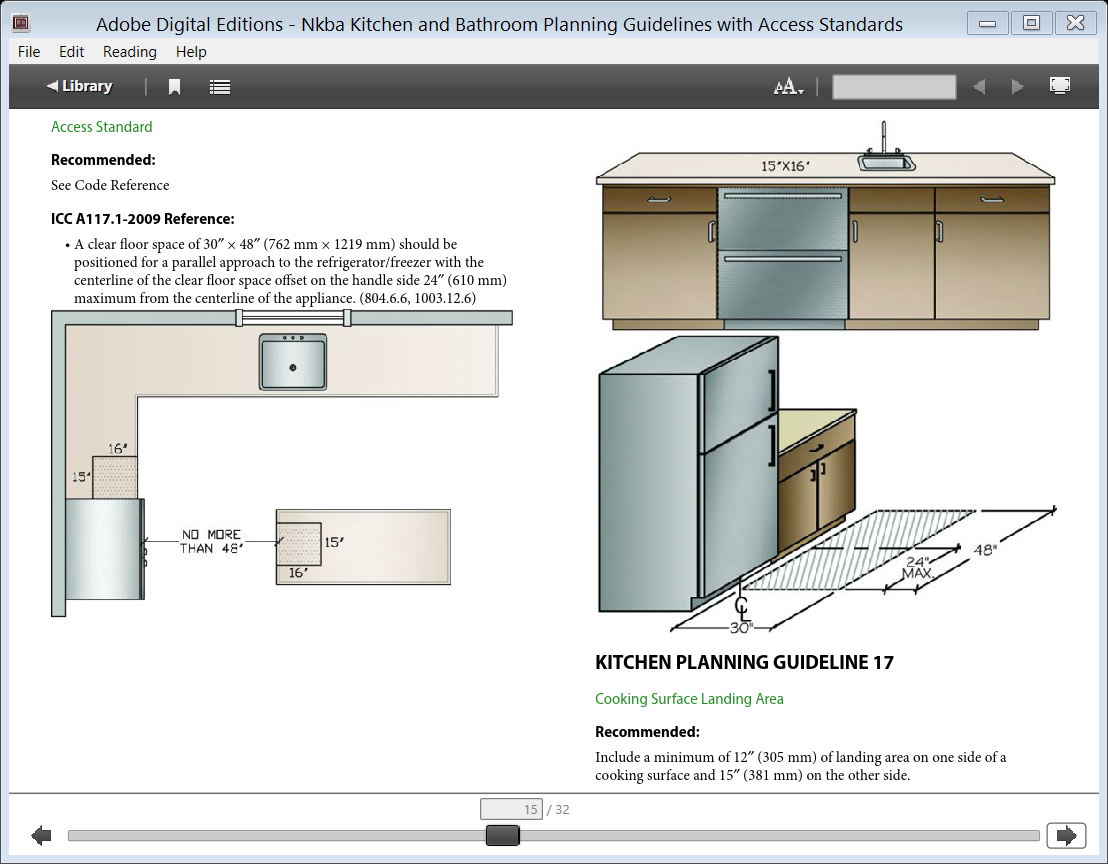
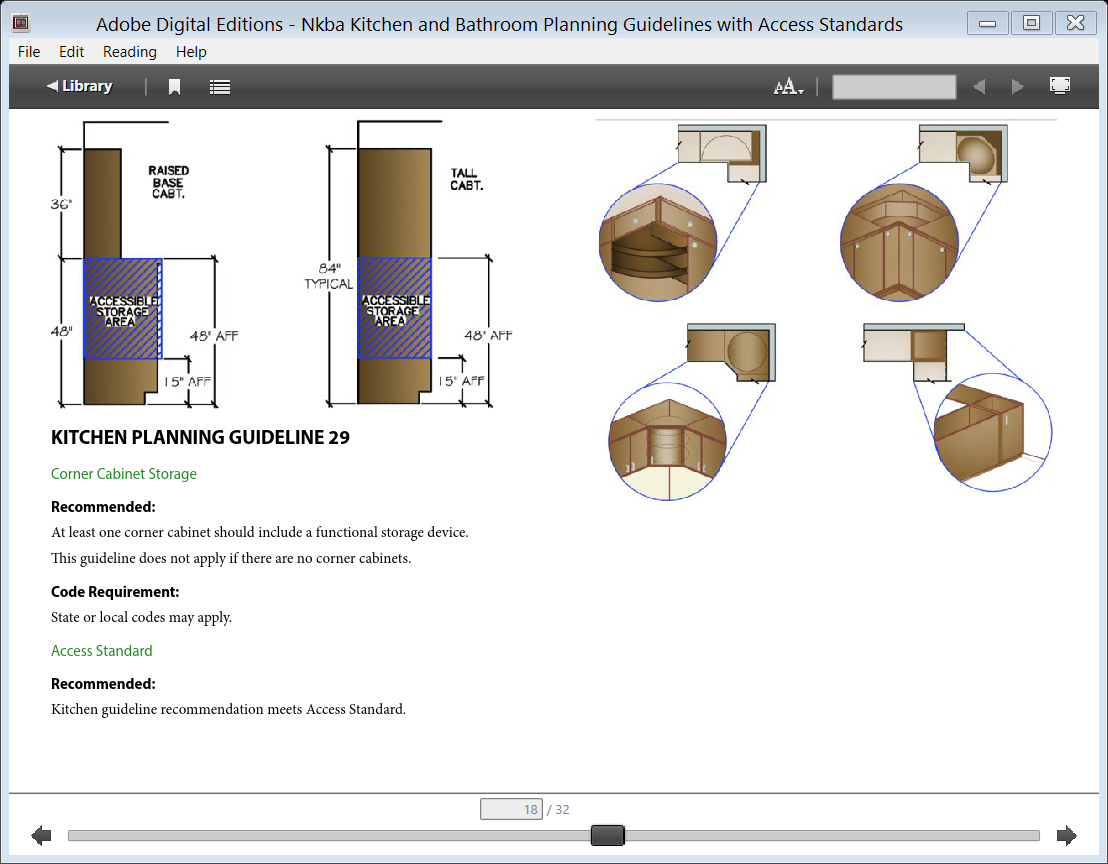
**Photo #3 - from**



Caption: The National Kitchen and Bath Association (NKBA) has authored a set of design guidelines for kitchens and bathrooms with accessibility standards included. A new, second edition is expected in January of 2016 published by John Wiley & Sons.

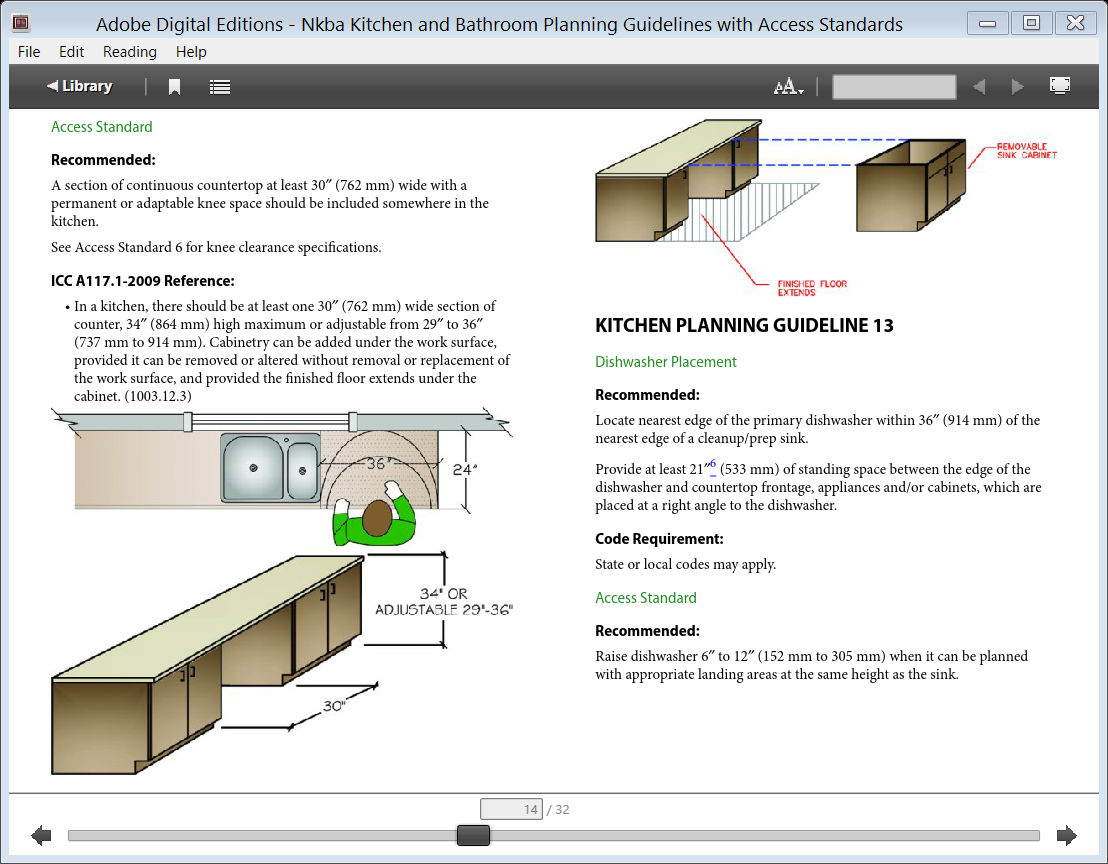
*Graphic images in the rest of this article are excerpted from the NKBA Kitchen & Bathroom Planning Guidelines with Access Standards published by John Wiley & Sons. Copyright 2012: National Kitchen & Bath Association. This material is reproduced with the permission of the NKBA.*

**Photo #4**



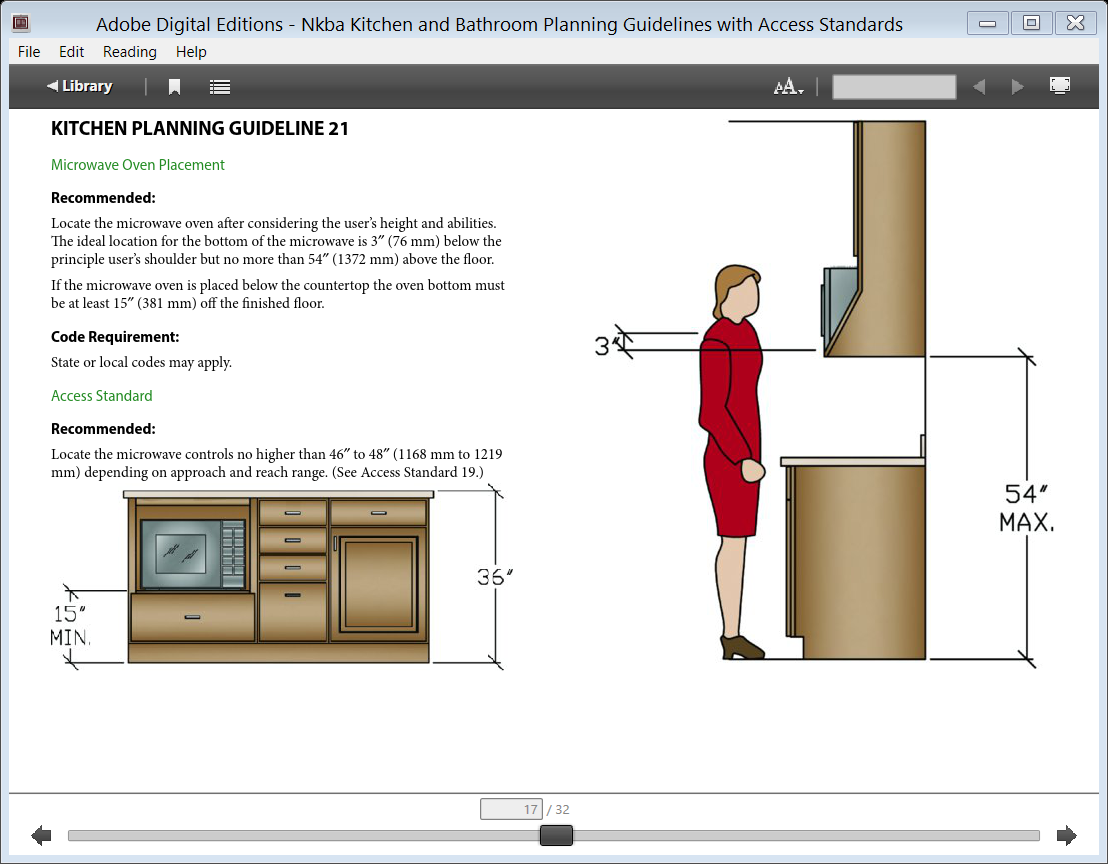
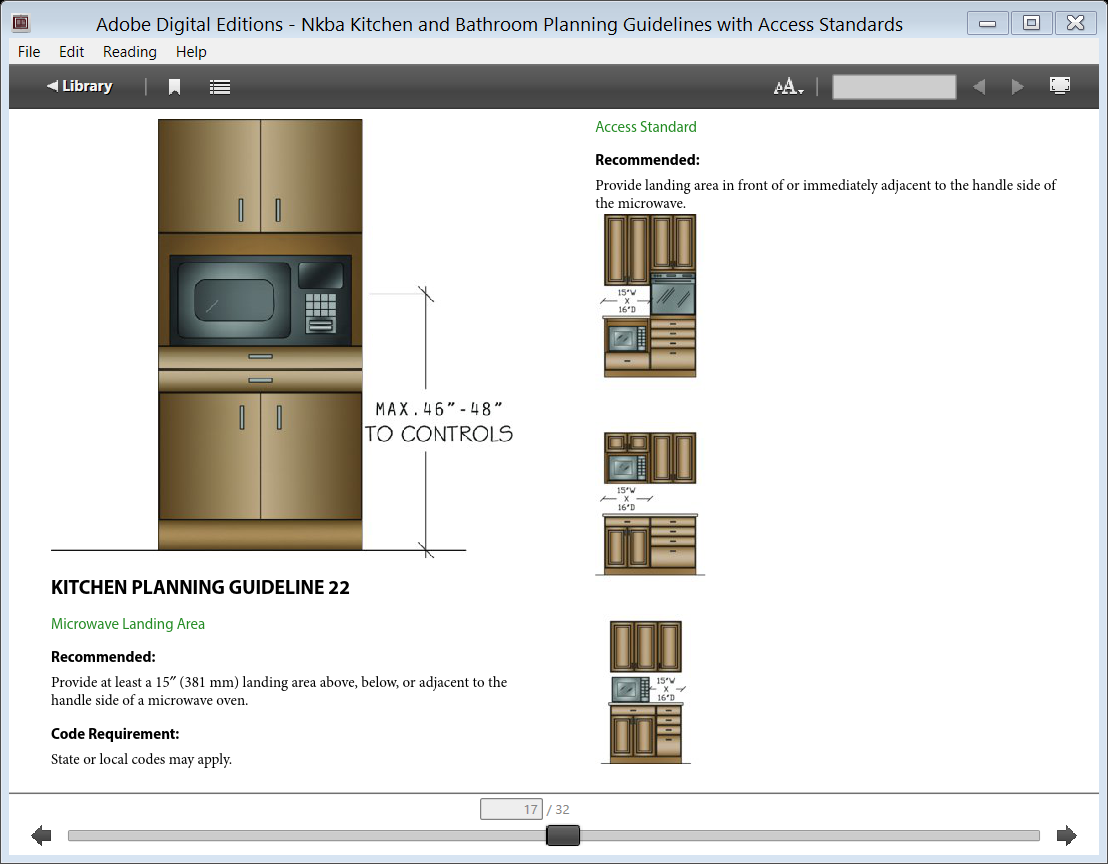
**Caption:** The storage zone of a kitchen needs to address access of shelving and cabinetry as well as refrigeration.Images *excerpted from the NKBA Kitchen & Bathroom Planning Guidelines with Access Standards published by John Wiley & Sons*

**Photo #5 – from**



**Caption:** The preparation zone should be located near a sink and provide access for either sitting or standing. Images *excerpted from the NKBA Kitchen & Bathroom Planning Guidelines with Access Standards published by John Wiley & Sons*

**Photo #6 –**

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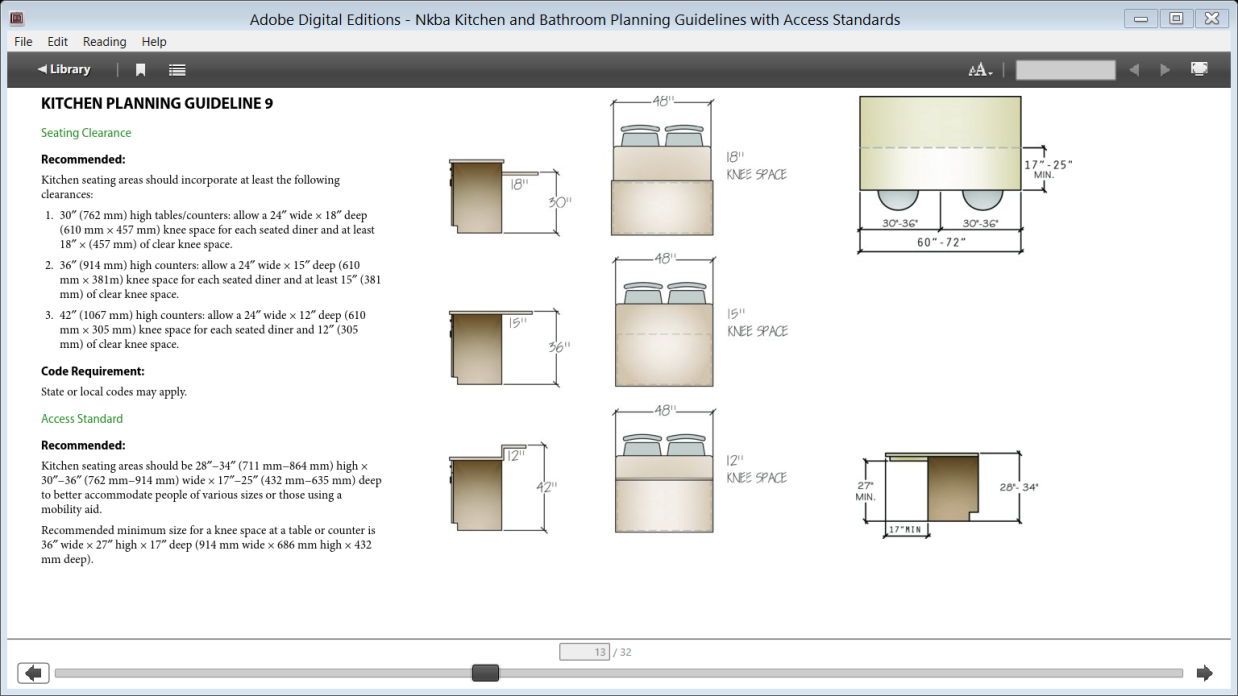
**Caption:** Cooking zones need to address appliance height as well as landing areas for placing things while doors are opened or other maneuvers done. Images *excerpted from the NKBA Kitchen & Bathroom Planning Guidelines with Access Standards published by John Wiley & Sons*

**Photo #7**



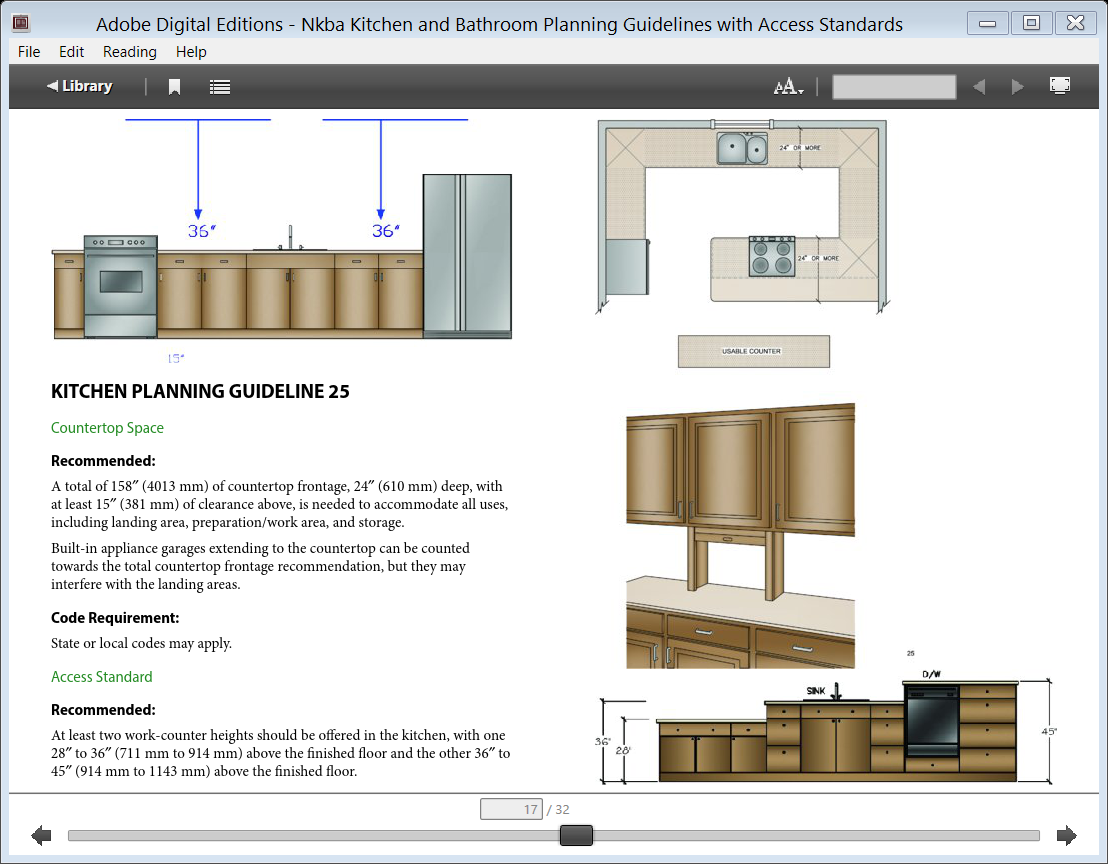
**Caption:** Electric induction cooking not only uses less energy than conventional cooktops, it is inherently safer since pans heat up while cooktops do not. Photo courtesy of Whirlpool Corporation

**Photo #8:**



**Caption:** Built-in serving and eating areas need to have proper clearances and leg room which can vary based on the height of the eating surface. Images *excerpted from the NKBA Kitchen & Bathroom Planning Guidelines with Access Standards published by John Wiley & Sons*

**Photo #9 – from**



Caption: In the clean-up zone, a raised dishwasher located next to the sink can make it easier for anyone to load and unload. Images *excerpted from the NKBA Kitchen & Bathroom Planning Guidelines with Access Standards published by John Wiley & Sons*

**Photo #10 –**



**Caption:** Front loading washers and dryers offer better energy efficiency, easier accessibility, with the option of storing detergents and laundry products more conveniently. Photo Courtesy of Whirlpool Corporation