

Universal Design and Overview of Center for Universal Design at North Carolina State University

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Introduction

The Center for Universal Design is a national research, information, and technical assistance center that evaluates, develops, and promotes accessible and universal design in housing, buildings, outdoor and urban environments and related products. Part of the College of Design at North Carolina State University (NCSU), Raleigh, NC, the Center promotes the concept of universal design in all design, construction, and manufacturing disciplines through research, design assistance, and training. The Center collaborates with builders and manufacturers on the development of new design solutions. It also develops publications and instructional materials, and provides information, referrals and technical assistance to individuals with disabilities, families, and professionals around the state and elsewhere. The Center is an initiative within Research, Extension and Engagement at the College of Design, North Carolina State University.

Center staff works closely with students, faculty and staff at NCSU, particularly at the College of Design and maintain frequent contact with faculty, professionals, consultants and consumers around the state. Center staff have conducted research, demonstration projects, or educational activities in every part of the state: Currituck, Columbus, Alamance, Buncombe, Mecklenburg, Pitt, Northampton, and many other counties. In addition, the Center has fielded questions provided technical assistance to academicians, professionals and households around the state, and has disseminated thousands of pieces of our renowned publications to North Carolina residents.

Universal Design History

Changing demographics

At the beginning of the 20th century, older adults and people with disabilities were true minorities. The average human lifespan was only 47 years, and people

who received spinal cord injuries had only a 10% chance of survival. Most people with chronic conditions lived in nursing institutions. People are living longer today. The average lifespan has increased to 76, largely due to healthier living, better medicine, and vaccines and sanitation that have virtually eliminated many killer infectious diseases (*The Denver Post*, 1998). Nearly 80% of the population now lives past the age of 65. Projections based on US Census Bureau estimates indicate that the number of persons ages 65 and over will grow to almost 40 million by the year 2010 (Jones and Sanford, 1996). In 2005, 4 million people in the US were over the age of 85 and about 60,000 topped age 100. By 2020, the Census Bureau estimates that 7 million to 8 million people will be over age 85 and 214,000 will be over age 100. By contrast, at the end of WWII, only 1 in 500 made it to age 100 (*The Denver Post*, 1998).

In addition, more people are now living with disability. Two world wars created a huge population of veterans with disabilities, and antibiotics and other medical advances enabled people to survive accidents and illnesses which were previously fatal. At the end of 1994, 53.9 million people in the United States (20.6% of the population) had some level of disability, and 26.0 million (9.9%) had a severe disability. 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 (ADLs) and 4.1 million needed personal assistance of some kind (McNeil, 1997).

These demographic changes result in a population that is older and more disabled than many realize, and these trends continue. The limitations imposed by products and environments designed and built without regard to the needs and rights of all American citizens are significant but often unrecognized.



Research group examining barrier-free environment

(Center for Universal Design)

Public acknowledgment of people with disabilities and progress toward universal design has developed in the last few decades along three parallel tracks of activities: legislation fueled by the disability rights movement, the barrier-free design to universal design movement, and advances in rehabilitation engineering and assistive technology.

Federal legislation

The Civil Rights Movement of the 1960s inspired the subsequent Disability Rights Movement that greatly influenced the legislation of the 1970s, 1980s, and 1990s. These new laws prohibited discrimination against people with disabilities and provided access to education, places of public accommodation, telecommunications, and transportation.

The barrier-free movement in the 1950s began a process of change in public policies and design practices. The movement was established in response to demands by disabled veterans and advocates for people with disabilities to create opportunities in education and employment rather than institutionalized health care and maintenance. Physical barriers in the environment were recognized as a significant hindrance to people with mobility impairments.

Efforts of the Veterans Administration, The President's Committee on Employment of the Handicapped, and the National Easter Seals Society, among others, resulted in development of national standards for 'barrier-free' buildings. In 1961, the American Standards Association (later known as The American National Standards Institute, or ANSI), published the first accessibility standard titled, 'A 117.1—Making Buildings Accessible to and Usable by the Physically Handicapped.' These standards were not enforceable, however, until adopted by state or local legislative entities.

A number of states responded with their own accessibility standards, and by 1966, 30 states had passed accessibility legislation; by 1973, the number was up to 49 states. Individual federal agencies attempted to provide minimum access through additional regulations and standards. This resulted in numerous, often differing accessibility guidelines. An attempt to 'standardize' these federal guidelines occurred in 1984 when the ANSI specifications were incorporated into the Uniform Federal Accessibility Standard (UFAS).

Significant federal legislation began to be passed in the late 1960s, including the following: The Architectural Barriers Act of 1968 mandated the removal of what was perceived to be the most significant obstacle to employment for people with disabilities: the physical design of the buildings and facilities they had to use on the job. The Act required all buildings designed, constructed, altered, or leased with federal funds to be made accessible. Section 504 of the Rehabilitation Act of 1973 was the first civil rights law for people with disabilities. This Act made it illegal to discriminate on the basis of disability and applied to federal agencies, public universities, federal contractors, and any other institution or activity receiving federal funds. The promulgation of regulations was initially stalled by the U.S. Department of Health, Education and Welfare. In protest, disability rights advocates held numerous demonstrations. As a result, regulations were finally issued in 1977.

The Education for Handicapped Children Act of 1975 (now called the Individuals with Disabilities Education Act, or IDEA) guaranteed a free, appropriate education for all children with disabilities. This Act had an effect on educational programs as well as on the facilities in which they were conducted.

The Fair Housing Amendments Act of 1988 expanded the coverage of the Civil

Rights Act of 1968 to include families with children and people with disabilities. The Act required accessible units be created in all new multi-family housing with four or more units, both public and private, not just those that received federal funds. Accessibility Guidelines were issued by the Department of Housing and Urban Development in 1991 to facilitate compliance.

The Americans with Disabilities Act of 1990 (ADA) awakened public awareness of the civil rights of people with disabilities. Discrimination in employment, access to places of public accommodation, services, programs, public transportation, and telecommunications is prohibited by this law. Physical barriers that impede access must be removed wherever they exist. The ADA has a uniform nationwide mandate that ensures accessibility regardless of local attitudes. The Architectural and Transportation Barriers Compliance Board (Access Board) issued Accessibility Guidelines for accessible design in 1991. These guidelines were adopted with modifications by the Department of Justice and became the enforceable ADA Standards for Accessible Design.

The Telecommunications Act of 1996 mandates that telecommunications services and equipment and customer premises equipment be 'designed, developed, and fabricated to be accessible to and usable by individuals with disabilities, if readily achievable.' It applies to all types of telecommunications devices and services, from telephones to television programming to computers.

Federal legislation began as requirements for minimum accessibility to small percentages of facilities and features, which lawmakers felt was sufficient. It has progressed to providing full access to public and private programs and facilities and has begun to affect devices and services in the home.

Barrier-free to universal design

Early on, advocates of barrier-free design and architectural accessibility recognized the legal, economic, and social power of a concept that addressed the common needs of people with and without disabilities. As architects began to wrestle with the implementation of standards, it became apparent that segregated accessible features were 'special,' more expensive, and usually ugly. It also became apparent that many of the environmental changes needed to accommodate people with disabilities actually benefited everyone. Recognition that many such features could be commonly provided and thus less expensive, unlabeled, attractive, and even marketable, laid the foundation for the universal design movement.

Rehabilitation engineering and assistive technology

Rehabilitation engineering and assistive technology emerged in the middle of the 20th century. Efforts to improve prosthetics and orthotics intensified with the return of thousands of disabled veterans from World War II in the 1940s. During the 1950s, engineering research centers sponsored by the Veterans Administration and other federal organizations were established to address other technological problems of rehabilitation, including communication, mobility, and transportation. Rehabilitation engineering centers expanded during the 1960s and 1970s. Rehabilitation engineering became a specialty that applied scientific principles and engineering methodologies to these problems. The label, 'assistive technology,' was applied to devices for personal use created specifically to enhance the physical, sensory, and cognitive abilities of people with disabilities and to help them function more independently in environments oblivious to their needs.

Intersecting paths

Though coming from quite different histories and directions, the purpose of universal design and assistive technology is the same: to reduce the physical and attitudinal barriers between people with and without disabilities.

Universal design strives to integrate people with disabilities into the mainstream and assistive technology attempts to meet the specific needs of individuals, but the two fields meet in the middle. In fact, the point at which they intersect is a gray zone in which products and environments are not clearly 'universal' or 'assistive,' but have characteristics of each type of design. A number of products have enjoyed crossover success, often starting as assistive devices and becoming mainstream products, such as the kitchen utensils with thick grips popularized by Oxo International in their 'Good Grips' line. A few products have moved the other way, typically conceived as high-tech devices for small markets that find new application in the rehabilitation arena, such as voice recognition software.

The potential benefit of cooperation between professionals in both fields is exciting but mostly untapped. Commercial designers have much to learn from rehabilitation technologists familiar with the ergonomics of disability and aging. Rehabilitation technologists and their clients can benefit from designers' expertise in creating products and environments that are functional, safe, attractive, and marketable for a wide diversity of users.

Changing economics

The economic downturn of the 1980s had a negative impact on funds for rehabilitation engineering research and the removal of environmental barriers. At the same time, product manufacturers were beginning to recognize the market-broadening potential of more accommodating products.

In 1988, New York City's Museum of Modern Art exhibit, 'Designs for Independent Living,' featured products selected for their beauty as well as their consideration of the needs of older adults and people with disabilities. Selections included products from the US, Denmark, England, Italy, Netherlands, and New Zealand. It was clear that the commercial world was beginning to acknowledge aging individuals and people with disabilities as viable customers.

In 1990, Oxo International introduced its Good Grips kitchen utensils for people who were limited by arthritis. These upscale products immediately found an enthusiastic audience, even though their advantages over utensils with oversized handles sold through assistive technology suppliers were primarily aesthetic. Oxo International grew at a 40% to 50% annual rate from 1990 to 1995, to \$20 million a year. Other companies quickly copied their approach.

Another emerging economic trend is the increasing 'globalization' of the marketplace. Consumer businesses hoping to remain successful in the coming decades must recognize the opportunities and challenges inherent in global competition. While the size of potential customer markets is growing, the diversity of the consumer base is expanding at the same time to include differences in language and culture, customs, experiences, and historical design precedents. All of these increase the need for design that is sensitive to individual abilities and preferences.

Because reasonable cost is a fundamental issue in any design and production process, universal design has become a very marketable approach, since it addresses the diverse needs of a majority of consumers.

Changing social climate

Throughout history, community attitudes and physical barriers in the built

environment have prevented people with disabilities from fully participating in society. Access to education, employment, housing, recreation, cultural events, and transportation has been denied many people. Along with the growth in the disabled population, the quest for independence and equal rights has grown, as well.

Buyers of assistive technology now demand that products be designed with concern for their impact on the image, as well as the function, of the user. Devices are expected to be appropriate for use at the office or school, at home, in the community, and on vacation.

Similarly, aging members of the baby-boom generation (those born between the years 1946 and 1964) have begun to see the usefulness of products conceived for people with limitations. In a 1990 issue of *Capturing Customers*, Peter Francese noted, 'As more Americans age, products that offer youthfulness without denigrating aging will do well. These consumers are not like their parents—they don't feel that older is ugly' (American Association of Retired Persons, 1992).

Future

At the end of the 20th century, the world is very different than 100 years ago. People are living longer and surviving better. Potential consumers of design who may be functionally limited by age or disability are increasing at a dramatic rate. These populations are no longer an insignificant or silent minority.

The current generation of children, baby boomers entering middle age, older adults, people with disabilities, and individuals inconvenienced by circumstance, constitute a market majority. All of these constituencies and indeed, all consumers, deserve to be recognized and respected. Facilities, devices, services, and programs must be designed to serve an increasingly diverse clientele.



Barrier-free entrance at local super market, easy-access for wheel-chair users (Center for Universal Design)

The demographic, legislative, economic, and social changes that brought us to this point are increasing the momentum that will propel us into a 21st century that will need to be more accommodating of individual differences. Universal design provides a blueprint for maximum inclusion of all people.

Universal Design Principles

The authors, a working group of architects, product designers, engineers and environmental design researchers, collaborated to establish the following Principles of Universal Design to guide a wide range of design disciplines including environments, products, and communications. These seven principles may be applied to evaluate existing designs, guide the design process and educate both designers and consumers about the

characteristics of more usable products and environments.

Principle 1: Equitable use

The design is useful and marketable to people with diverse abilities.

- Provide the same means of use for all users: identical whenever possible; equivalent when not
- Avoid segregating or stigmatizing any users
- Provisions for privacy, security, and safety should be equally available to all users
- Make the design appealing to all users

Principle 2: Flexibility in use

The design accommodates a wide range of individual preferences and abilities.

- Provide choice in methods of use
- Accommodate right- or left-handed access and use
- Facilitate the user's accuracy and precision
- Provide adaptability to the user's pace



Scissors for both right- and left-handed users

(Center for Universal Design)

Principle 3: Simple and intuitive

Use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level.

- Eliminate unnecessary complexity
- Be consistent with user expectations and intuition
- Accommodate a wide range of literacy and language skills
- Arrange information consistent with its importance
- Provide effective prompting and feedback during and after task completion

Principle 4: Perceptible information

The design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.

- Use different modes (pictorial, verbal, tactile) for redundant presentation of essential information
- Provide adequate contrast between essential information and its surroundings
- Maximize 'legibility' of essential information
- Differentiate elements in ways that can

be described (i.e., make it easy to give instructions or directions)

- Provide compatibility with a variety of techniques or devices used by people with sensory limitations

Principle 5: Tolerance for error

The design minimizes hazards and the adverse consequences of accidental or unintended actions.

- Arrange elements to minimize hazards and errors: most used elements, most accessible; hazardous elements eliminated, isolated, or shielded
- Provide warnings of hazards and errors.
- Provide fail safe features
- Discourage unconscious action in tasks that require vigilance

Principle 6: Low physical effort

The design can be used efficiently and comfortably and with a minimum of fatigue.

- Allow user to maintain a neutral body position
- Use reasonable operating forces
- Minimize repetitive actions
- Minimize sustained physical effort

Principle 7: Size and space for approach and use

Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

- Provide a clear line of sight to important elements for any seated or standing user
- Make reach to all components comfortable for any seated or standing user
- Accommodate variations in hand and grip size
- Provide adequate space for the use of assistive devices or personal assistance



Wide ticket gate at railway station, easy-access for wheel-chair users

(Center for Universal Design)

Projects

Overview

Major changes in design requirements, both market-driven and legally mandated, are creating a new dilemma for designers. Changing demographics, attitudes, and attitudes are fueling the demand for more sophisticated products, housing, and business environments, that are accessible for people of all ages, sizes, and abilities. These changes signal a wide array of opportunities for designers to apply their creative energies to the solution of practical, social and psychological problems. They may also hurl design practitioners into a chasm of uncharted territory without the benefit of appropriate training or technical assistance.

Universal design means designing all products, buildings and exterior spaces to be usable by all people to the greatest extent possible. It is advanced here as a sensible and economical way to reconcile the artistic integrity of a design with human needs in the environment. Solutions which result in no additional cost and no noticeable change in appearance can come about from knowledge about people, simple planning and careful selection of conventional products.

As comfort, safety, and flexibility become more important key words in advertising, emerging technologies will continue to respond to the needs of people of all ages, abilities and sizes. Designers will be faced with a choice: reluctant compliance with minimum accessibility standards, or a positive, sensitive offering of universal design services.

Law and regulations

The Access Board is the federal agency which:

- Develops guidelines and requirements for standards issued under the Americans with Disabilities Act (ADA)

and the Architectural Barriers Act (ABA)

- Develops accessibility guidelines for telecommunications equipment and customer premises equipment under the Telecommunications Act
- Develops accessibility standards for electronic and information technology under section 508 of the Rehabilitation Act, etc.
- Provides technical assistance on those guidelines and standards
- Enforces the Architectural Barriers Act which requires buildings and facilities built with federal funds to be accessible

The Current standards under the ABA are the Uniform Federal Accessibility Standards (UFAS). The Board develops the minimum guidelines for UFAS and enforces compliance with the standards. The Board does not enforce the ADA.

General enforcement of the ADA is by the Department of Justice; transportation, including complimentary paratransit, is regulated by the Federal Transit Administration; employment is regulated by the Equal Employment Opportunities Commission; and the relay provisions are regulated by the Federal Communications Commission (FCC). The FCC also enforces the Telecommunications Act.

The International Code Council maintains the standard for Accessible and Usable Buildings and Facilities, CABO/ANSI A117.1, which is referenced by the three model codes. This document is maintained by the Accredited Standards Committee A117, under procedures developed by the American National Standards Institute (ANSI).

Education

The education and training activities of the Center span all ages, many audiences, and multiple modalities. From grade school classes to senior center users; from semester-long post secondary design courses to conference keynotes; from lectures to hands on experiences, Center staff communicates the essentials of accessible and universal design. Our topics include products, housing, the non-residential built environment, codes and standards, and urban design. Professional audiences include builders, industrial designers, engineers, remodelers, interior designers, architects, planners, and agency staff.

The strategies we employ enable participants to gain an awareness of the issues of all people as part of a continuum of life experiences including those who are temporarily able bodied, those with permanent and temporary disabilities, and people who are older. Participants will understand that there are design implications when meeting the needs of people with different abilities. Participants will understand the natural range of human performance that can include variances in sight, hearing, movement, and thought. Participants will also understand the importance of considering a range of ages in design problems. ■



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Mr Duncan is the Senior Project Manager at the Center for Universal Design. He serves as the Principal Investigator on a number of privately sponsored projects for the Center, including the Kate B. Reynolds Charitable Trust and Fannie Mae. He has spent over 17 years in the field of architectural accessibility and universal design in residential, public, and transportation environments. He has extensive experience in the design, costs, materials, and products in residential and non-residential settings. He is editor of *A Blueprint for Action*, a co-author of *Funding Sources for Home Modifications* and has a new publication in progress, *Costs of Home Modification Projects*.