

BARRIER FREE HOUSING FOR MARRIED
STUDENTS ON OKLAHOMA STATE
UNIVERSITY CAMPUS

By

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CHAPTER I

INTRODUCTION

Statement of the Problem

A recent article has shown that:

A person who is severely impaired never knows his hidden sources of strength until he is treated like a normal human being and encouraged to shape his own life. The starting point for solving the housing problems of the disabled and the elderly is to treat them like normal human beings; to see them as people with disabilities, not as disabled people; to see them as people who are aging, not as aged people; to see them as people who are mentally retarded, not as mentally retarded people; to see their essential humanity, their need to love and to be loved, their vitality, their potential for growth and accomplishment. It is essential to realize that their housing problems are inextricably intertwined with the housing problems of the entire population and can be solved only as the problems of all others are solved, not separately, but through integration within normal housing (Laurie, 1977, p. 1).

The field of barrier free architecture has rapidly become an area of great concern. Housing conditions of handicapped people are receiving widespread attention and are the focus of much current research due to the increasing numbers of handicapped persons. Gutman (1968) states that:

At present, at most 20 per cent of our citizens may be considered among the disabled, with two million more to be added in the next decade in the class of traumatic paraplegics alone. In

addition, the startling prediction of leading authorities is that by 1980, for every able-bodied individual, there will be one person with a disability, chronic or otherwise (p. ix).

People with handicaps often are confronted with architectural barriers. An "architectural barrier" can be a high curb, a step, platform or steep slope which prevents a wheelchair user from crossing a street or entering a building, a door too narrow for him to enter, or a table too low to permit a wheelchair to slide under. Architectural barriers can prevent the physically disabled from entering or using a building. These same kinds of barriers may prohibit the attainment of a college education for the physically disabled. The relationship between architectural barriers and educational problems comes into more meaningful perspective when one realizes that a college education is becoming more and more important to youth today. Education is very important to the able-bodied, but it is more important for those who have a physical disability.

It is logical that on competitive jobs they might be passed over unless their training is superior to the able-bodied. This may be true even when the disability would not be an occupational handicap (Tucker, 1963, p. 311).

Society also has an economic need for the education of the physically handicapped. Ayers (1962, p. 282) states that "whether these people become a financial liability or an asset to the community may depend upon their opportunity to attend college." Experience has proven that physically

disabled persons can make valuable contributions to society when given the opportunity. Aside from the economic factors involved in the provision of higher education for the physically disabled, the values of our culture demand that such an opportunity be made available (McGregor, 1968, p. 5). Rusalem (1962, p. 11) expressed this value: "Any individual who meets college standards of intellectual ability, motivation, and personality adjustment has a right to attend an institution of higher learning."

The number and percentage of physically disabled youths seeking entrance into college will increase rapidly. College and University administrations may not reject these physically disabled students, but the presence of architectural barriers on the campus may prohibit their attendance. Thus, all architectural barriers on campus should be removed, including those related to living facilities.

In addition, McGregor (1968) states that:

It was concluded that living facilities surveyed have limited utilization. Circulation space was available, but requirements for desk, dressers, mirrors, and closet rods were not met and thus represent barriers. Activities area within the dormitories surveyed also lacked full utilization, in that the Kerr-Drumond Complex lounge was accessible only with difficulty and considerable inconvenience.

Cafeterias in the dormitories present barriers that make independent utilization impossible.

. . . .

It was found that the bathrooms in these facilities provided showers but that there were no bathtubs available for student use. The showers did not meet the specifications that insure

independent use and are usable only with extreme difficulty and danger by most persons in a wheelchair (pp. 50-51, 54).

McGregor (1968) identified architectural barriers for wheelchair students, examined the significance of architectural barriers on campus in relation to the student's pursuit of the curriculum and campus activities, and suggested modifications of the examined facilities to meet the needs of wheelchair students at Oklahoma State University. There has been no research at this university to emphasize and develop housing for the disabled students on the Stillwater campus, nor off campus.

Purpose of the Study

This study is primarily concerned with designing interior spaces for the physically disabled in housing on campus used by disabled students at Oklahoma State University. The purposes of this study are to identify architectural barriers in housing, suggest ways of converting the one-story married-student housing into barrier free housing and recommend interior plans which meet the criteria for mobility of disabled students.

Procedure

The procedure of this study will be: (1) review of literature, (2) observation of a handicapped unit of elderly housing in Ponca City, Oklahoma, and (3) selection of a floor plan of one-story married student housing at

Oklahoma State University and the rearrangement of it into a barrier free housing unit for disabled students.

CHAPTER II

REVIEW OF THE LITERATURE

The Netherlands' Society for Rehabilitation (1973) has reported that:

With regard to buildings, dwellings and recreation centres it must be considered which category or categories of disabled people might want to reach the building in question, seek access to use its facilities, and what requirements the special arrangements--particularly the sanitary equipment--will have to fulfill. According to the nature and extent of the disability, the following distinctions can be made:

Group 1. Ambulant disabled people, whose power of movement and locomotion are not, or not seriously, impaired and who can move about without external aids.

Group 2. Semi-ambulant disabled people (stick users), whose powers of locomotion are impaired to such an extent that they have to use external walking aids: stick, elbow crutches, armpit crutches, tripods or wheeled frames.

Group 3. Non-ambulant disabled people (wheelchair user), whose locomotion is so impaired that they are unable, or scarcely able, to walk and stand by themselves. They can move about in and around the building:

- a. Independently--in a wheelchair propelled by means of hand-rims, if the person retains sufficient functional capacity in his arms, or, in an electric wheelchair if there is still only a little residual capacity.
- b. With an attendant--seated in a special car chair or in an ordinary wheelchair (pp. 6, 7).

This study is directly concerned with the disabled persons in Group 3a: non-ambulants who can move independently in a wheelchair. As described in Chapter I, the number and percentage of disabled citizens is acknowledged to be increasing rapidly. Nugent (1960) attributed this increase in the number of the physically disabled to the following:

1. Increase in the use of motor vehicles resulting in increased accident rates.
2. Increase in leisure time for activities such as water sports, which account for many major accidents.
3. Life saving advancements in science and medical technology that saves lives but leaves many individuals with permanent handicaps (pp. 51-52).

However, disabled persons are not automatically handicapped persons; whether or not there are handicaps depends on the nature of the individual's impairment and the circumstances in which they are placed. A chairbound person, for example, is not handicapped if what he wishes to do can be managed from a wheelchair without difficulty. On the other hand, there can be handicap where there is no medically identifiable impairment. A physical disability is a handicap only where it constitutes a barrier to the achievement of specific goals.

With the increase in the number of physically disabled young people has come a realization of their abilities and their needs. Thus, the necessary educational opportunities for physically disabled people should be provided.

Ayers (1962, p. 24) reports that the lack of educational opportunities was due, not to the unwillingness of the administration to accept disabled students, but rather to the inadequacy of the campus facilities to accommodate their needs.

The basic goal is the achievement of an environment in which all students--able-bodied and disabled--may be independent in their pursuit of all aspects of campus life. The University of Illinois required that all students be completely independent. This program has been expanded to include a limited number of students whose disabilities make it impossible for them to be completely independent.

Other colleges put less emphasis on independence. Some colleges provide centralized living facilities while others strongly discourage any grouping of the disabled in the interest of integration with the larger community of the able-bodied (File, 1960, p. 22). These examples illustrate differences in philosophies concerning the degree of independence that the student should be forced, or encouraged, to attain. However, it is agreed that integration into the total college program is a goal for which all should strive.

For living facilities, housing should be provided for the disabled students besides the dormitories. Laurie (1977) states that:

Housing is not a farm house or a townhouse or an apartment or a flat. Housing is the total environment--the people who share the housing,

the neighbors, the neighborhood, the shops, the recreation, the employment, and the transportation. Housing is the focus of the human need for security and shelter, for privacy and independence, for the approval of friends, and neighbors (p. 1).

"Mobility Housing" is the name given housing which is practical, ordinary housing which ought to be designed so that it is suitable for disabled people to move about and live in. Goldsmith (1974) states that mobility housing involves three principal requirements:

1. that entrances to dwellings are accessible to people who use wheelchairs;
2. that internal planning allows for easy movement by ambulant handicapped people, including those who have wheelchairs but are not totally chairbound;
3. that the bathroom, watercloset and at least one bedroom are at entrance level. In the bathroom and watercloset the critical factor is not only the width of the door but also whether space inside could accommodate a wheelchair with the door closed behind (p. 43).

Research

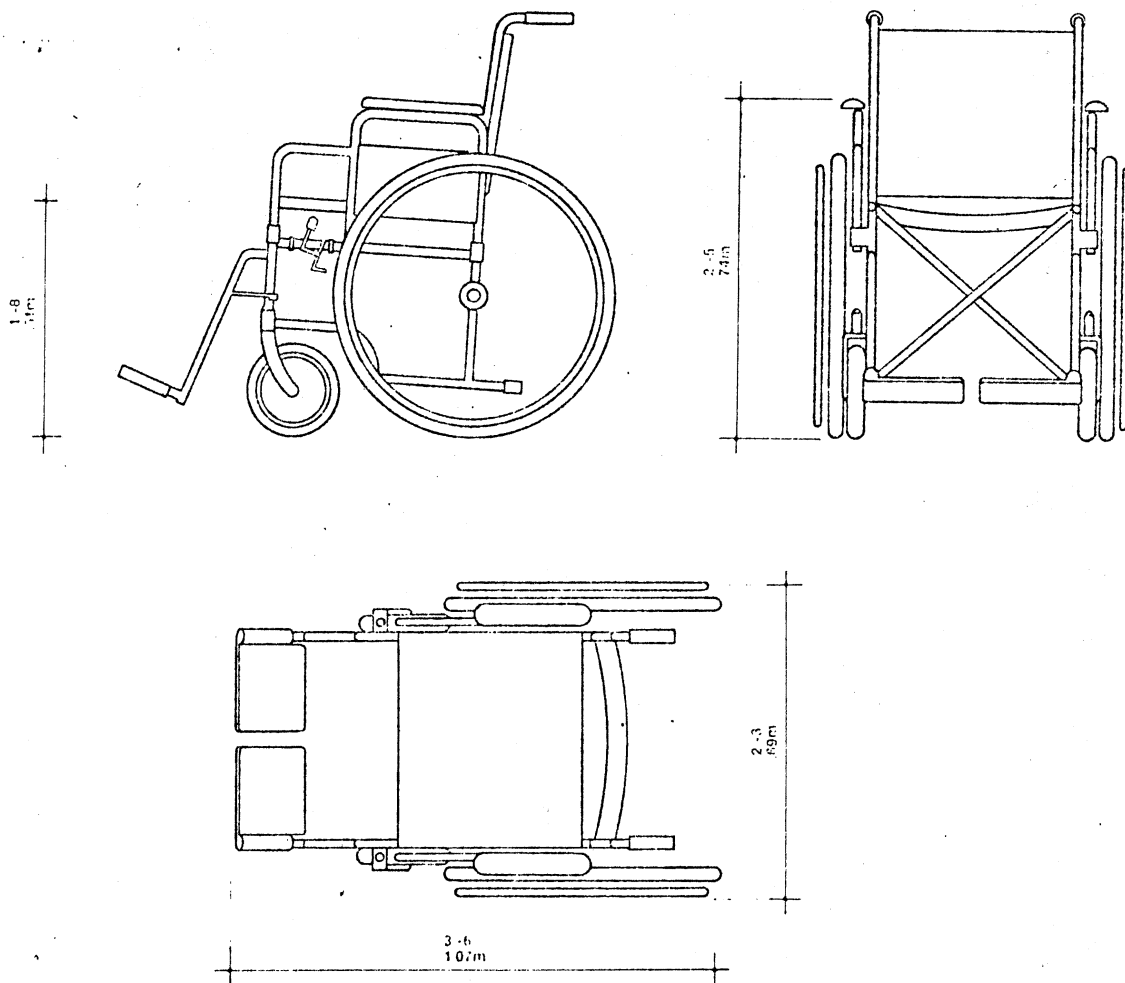
The chairbound are people who depend upon wheelchairs for mobility. The dimensions of spaces for mobility are based on the requirements of the chairbound. With increased interest in, and understanding of the chairbound, a new module of design has begun to emerge. Research has sought to establish the general and specific architectural needs of those who are physically disabled. Many of the architectural guidelines thus established have been

concerned primarily with the needs defined by the wheelchair and its user. Explanation for this consideration is given by the State University of New York Construction fund (1967):

The wheelchair, with its different mode of movement, requires the most stringent standards with respect to clear spaces, grades, the size of openings, and the accessibility of equipment and conveniences. Therefore, the criteria set forth in this publication are largely devoted to the needs of wheelchair users, not meaning to create an effortless atmosphere for them or for other handicapped but rather to provide environmental assistance (p. 11).

A basic assumption made in all research is that a standard wheelchair will be used and that the person will be unassisted. The new principles established, therefore, have begun with space requirements defined by the following: (1) the wheelchair, (2) the movement of the wheelchair, and (3) the average dimensions of reach of an individual using a wheelchair. For a person who is confined to a wheelchair, the chair becomes almost an extension of his own body. As such, the person's width, depth, height, and maneuverability are greatly altered. This height is decreased by one third and his width is doubled (Jorgensen, 1975, p. 5) (see Figure 1).

In the United States most wheelchair manufacturers make what is called a standard Universal Model (see Figure 2). It is a collapsible model of tubular metal construction with plastic upholstery and hard rubber tires. The large propelling wheels are located in the back with small,



Wheelchair: adult size
with removable arms
3/4" = 1'0"

Figure 1. Adult Size Wheelchair

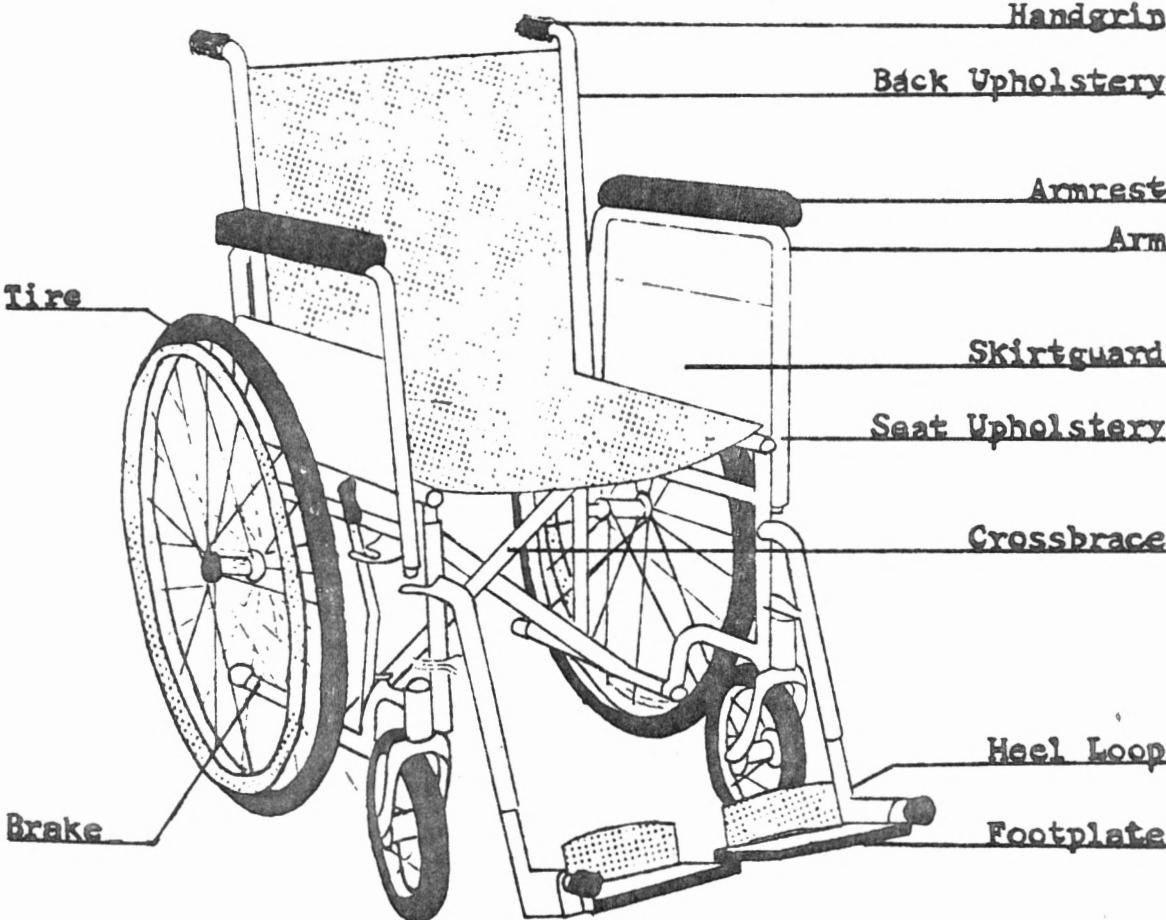


Figure 2. Wheelchair and Mobility Aids

five eighths inch casters in the front. Figure 1 gives the basic dimensions of the chair. When the chair is collapsed its width is 11 inches (Jorgensen, 1975, p. 5). The area of reach of a chairbound person is within the low to middle range of a standing person (see Figure 3). Therefore, necessary elements such as control buttons and mechanisms, countertops, and important shelves should be located within this common range.

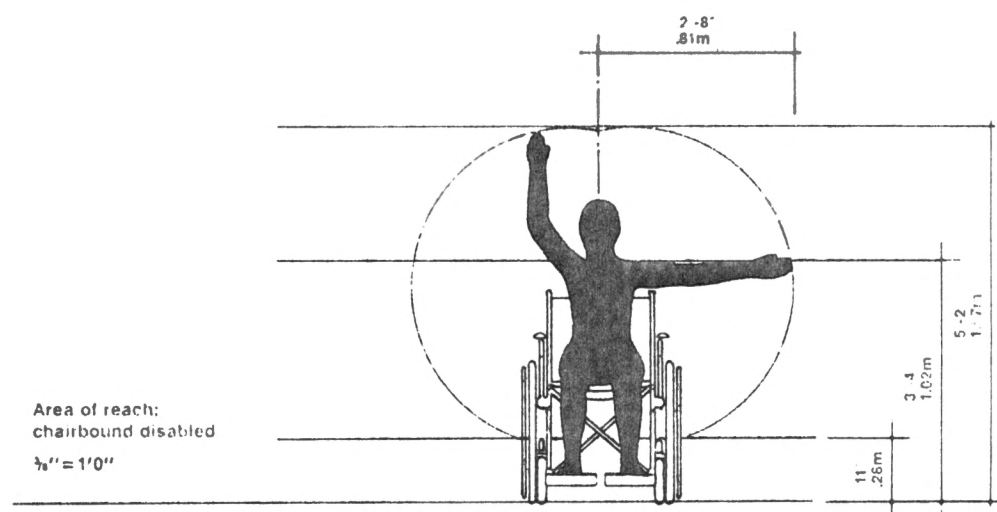


Figure 3. Chairbound Area of Reach

Basic dimensional requirements are given under Section three of the American Standard Specifications for Making Buildings and Facilities Accessible to and Usable by the Physically Handicapped (American Standards Association, 1961, p. 85). It also includes very minimum standards for accessibility and utilization by wheelchair users. A comparison of the American Standard's specifications and Goldsmith's indicates that Goldsmith's study is much more comprehensive and detailed than the American Standard study.

The area of homemaking for the disabled received much early attention. A review of the research literature pertaining to the homemaker confined to the wheelchair reveals several outstanding publications relating to specification for kitchen planning. McCullough and Farnhom (1960) have done extensive research on the requirements for wheelchair kitchens. The results were presented in an Illinois Experiment Station Bulletin in 1960 and an Experiment Station Circular in 1961. Another extensive study concerning kitchen requirements was conducted at the New York University Medical Center Institute of Physical Medicine and Rehabilitation and was reported by Wheeler (n.d.).

The Functional Home for Easier Living is another result of research conducted at the Institute of Physical Medicine and Rehabilitation of the New York University Medical Center (Rusk, n.d.). This publication presents housing specifications with emphasis on the needs of persons using wheelchairs.

Summary

A review of the literature reveals that physically disabled people are beginning to be recognized by the public. The elimination of architectural barriers is receiving more interest. Many actions have been taken in an effort to create an environment in which physically disabled persons can enjoy their rights and responsibilities as members of society. An increase in educational opportunities is noted. Many college administrations have realized their responsibilities and have programs to eliminate architectural barriers on their campuses. Housing for disabled students needs to be provided.

The review of research publications concerning specifications for the prevention of architectural barriers reveals that there are common basic requirements, but differences of specific details. The principle concern is with the provision of accessibility and utilization as based on the demands of the standard wheelchair and the person using it.

Much progress has been made in educating the public, establishing standards, and eliminating architectural barriers to suit the needs of the disabled. Many of the findings from this study can be applied to public buildings, dwellings or recreation centers.

CHAPTER III

STANDARDS

The review of the literature in Chapter II portrays a composite of the architectural barriers that must be eliminated if housing is to be made accessible to persons in wheelchairs. Accessible housing can be attained by application of standards developed from the foregoing recommendations.

In addition, Goldsmith (1974) states that:

There are three essential design criteria if ordinary housing is to achieve mobility standards:

1. The entrance must have a ramp or level approach and a flush threshold.
2. Entrances and principle rooms (living room, dining room, kitchen and at least one bedroom) must have 900 mm. (3 feet) doorsets and circular spaces serving these rooms must be at least 900 mm. (3 feet) wide.
3. Bathroom and water closet must be at the same level as the entrance (p. 44).

The following sections in this chapter present criteria which were also recommended as minimum functional standards.

Exterior

Ramps

Any ramp to be used by wheelchair persons should not

be too steep to prevent a person in a wheelchair from propelling himself independently. The gentlest (desirable) slope for self-propelling is a one foot rise in 20 feet (5%); the most often recommended slope is a one foot rise in 12 feet (8.3%) (Laurie, 1977, p. 13). The surface of the ramp should be fireproof and nonslip. The platform at the door should be at least three feet deep if the door swings in and five feet deep if it swings out; the open area at the bottom of the ramp should be at least six feet deep (Laurie, 1977, p. 13).

Walks

Walks must have an even, nonslip surface and width of five or six feet (Harkness and Groom, 1976, p. 28). The six foot width allows two wheelchairs to pass each other and one wheelchair to make a tight 180 degree turn without having to reverse when making the turn.

Curbs

The edges of the curb should be sloped rather than cut sharply or protected by a planting strip so that pedestrians will not trip over an edge and fall.

Parking Spaces

Reserved parking spaces should be made available close to housing. A 12 foot wide space should be provided with direct access to walkways (Salmon, 1966, p. 32).

Interior

Doors

Door openings, design, and closer resistance frequently are definite barriers for wheelchair students. A 34 inch clear opening width is required for the movement of a wheelchair through a door. Although this is more than is needed for the wheelchair to pass through the opening, less space requires greater precision in the wheelchair operation and restricts the space needed by the person's arms and hands in turning the wheels (Harkness and Groom, 1976, p. 28). The wheelchair needs more room if turns have to be made. A level space or platform at least five feet wide should extend a minimum of one foot on either side of a doorway to allow the disabled to maneuver the wheelchair while opening or closing the door. The best arrangement is a minimum of 15 inches to 24 inches of unobstructed area next to the handle side of the door (McGregor, 1968, p. 29).

Sliding or folding doors are preferred for interior partitions. Side-hinged doors are satisfactory if they have an additional pulling handle on the hinged side of the door. This allows the person in a wheelchair to close the door without being forced to position the wheelchair in the path of the swing of the door when reaching for the door handle. Door handles must be placed about 36 inches to 39 inches from the floor (Goldsmith, 1967, p. 80).

Lever or pull handles are easier to use than conventional door knobs. The resistance of door closers must not exceed eight to nine pounds. A kickplate at the bottom of a door should be provided to protect the door from the impact of the footrest of the wheelchair. Thresholds should be eliminated. Where they are essential, the maximum height should be one inch to permit easy passage of a wheelchair (Hammerman and Duncan, 1974, p. 16).

Floors

Floors should have flat, non-skid surfaces and should be of a texture to minimize resistance to the movement of a wheelchair. The carpet should be fitted to the floor. Padding or deep pile carpets should be avoided as they cause great resistance to the wheels and make passage difficult for the chairbound.

Switches and Controls

It is important that the chairbound be able to reach controls throughout a house without having to ask for help. Controls, such as light switches, thermostats, electrical outlets, fire alarms, air conditioner controls, emergency system, window and door hardware, drapery pulls and other devices should be easy to use and placed no higher than four feet above the floor within the area of reach that is common to both the chairbound and the ambulant disabled (Harkness and Groom, 1976, p. 36).

Living Area

There should be sufficient space in the living area readily available to turn a wheelchair through 180 degrees in a single movement. The height of the chair seat which is suitable for transferring from and to a wheelchair should be from one foot four inches to one foot eight inches above the floor.

Kitchen

In the kitchen, fixtures should be arranged in order according to the steps of working. The counter height of 30 inches to 33 inches, with under counter clearance, is preferred by most people in wheelchairs. The height of the cabinet is 21 inches above the 31 inch high work top (Wheeler, n.d., p. 21).

Bathroom

The bathtub and shower is the most versatile arrangement. An 18 inch high bathtub and a platform at the head of the tub enables a transfer to be made from the chair to the tub. Support rails are necessary and can be placed 54 inches high. A toilet should be provided with sufficient width surrounding it (minimum 54 inches) to enable a side transfer onto the water closet seat (Goldsmith, 1967, p. 153). A sliding door is suggested for convenience in opening and closing the door. Grab rails should be one

and one-half inches in diameter and have a one and one-half inch clearance from the wall (American Standards Association, 1961, p. 10). A 19 inch to 20 inch high water closet seat is necessary.

Lavatories must provide for a clearance below the apron of 30 inches by at least 18 inches deep. Insulated pipes protect against burns to those persons who have lost sensory abilities. Mirrors and other accessories must be placed with the bottom edge at the 40 inch level.

Bedroom

The principle considerations for the planning of the bedroom are: (1) adequate circulation space, especially around the bed, (2) desk or dressing table with clearance below of at least 30 inches, (3) closet rods 48 inches high, and (4) usable storage, dresser and mirror.

CHAPTER IV

PLANS FOR BARRIER FREE MARRIED STUDENT HOUSING

There are two types of married student housing on the Oklahoma State University campus: (1) single story housing and (2) two story housing. All units have a living area, two bedrooms, kitchen, and bathroom (Figure 4).

The design of the dwelling unit is practical for able-bodied students; however, when the author decided to study these units as suitable housing for handicapped persons it was found that the original plan has many obstacles for wheelchair users. Barrier free housing can be attained for handicapped students by applying the standards developed in Chapter III.

Proposed Site

The site selected for the units to be converted into accessible housing is shown in Figure 5. This is a group of single story housing units which are considered to be more practical for wheelchair students than housing with multistories. It is easier to modify the entrance to be convenient for students in wheelchairs. The installation

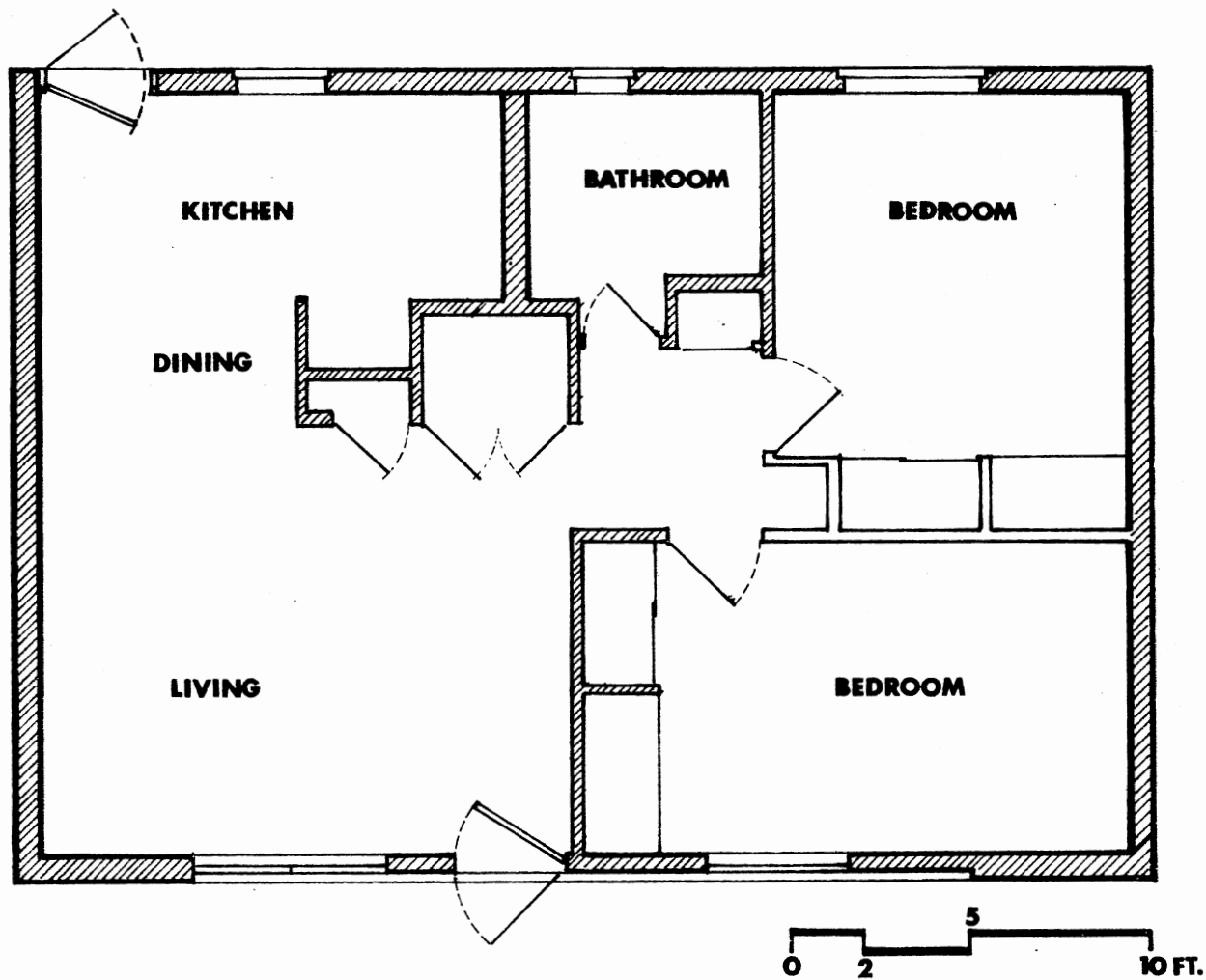


Figure 4. Floor Plan of Married Student Housing on the Oklahoma State University Campus



Figure 5. Proposed Site Selected for Units to be Converted into Accessible Housing

of ramps, curb and railings, as well as adequate parking facilities presents no difficulties (Figure 6).

In the married student housing area this site is closest to other campus facilities, including classrooms and the library. It is also near a small shopping center, theater, and restaurant.

Proposed Plan Arrangements

By comparing the ordinary housing and the wheelchair housing, it can be seen that generous spaces are needed in wheelchair housing to allow for comfortable maneuvering. Because the extra space tends to be concentrated in a specific area for wheelchair student housing, it is impossible to develop two bedrooms in the 21 foot by 30 foot plan (Figure 7).

It is proposed that the plan be rearranged into one bedroom housing with living area, kitchen, and bathroom, which are suitable for wheelchair students to live in (Figure 8). The basic planning principles for wheelchair housing are the same as for ordinary housing. The aim, given that the budget determines approximately what can be achieved, should be to maximize usable living space and to minimize sterile circulation space (Goldsmith, 1976, p. 109).

Kitchen

The example of the wheelchair kitchen developed for married student housing using the standards mentioned in

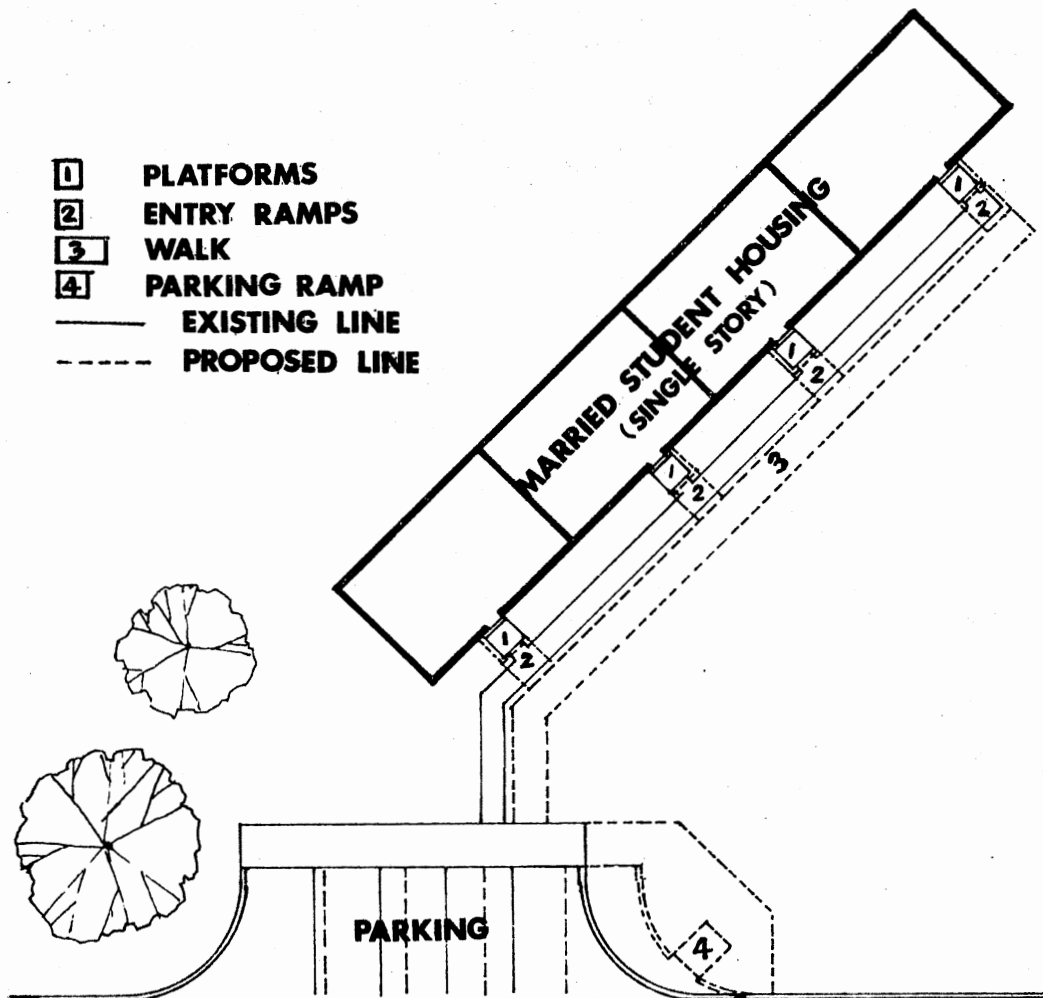


Figure 6. The Proposed Site Plan

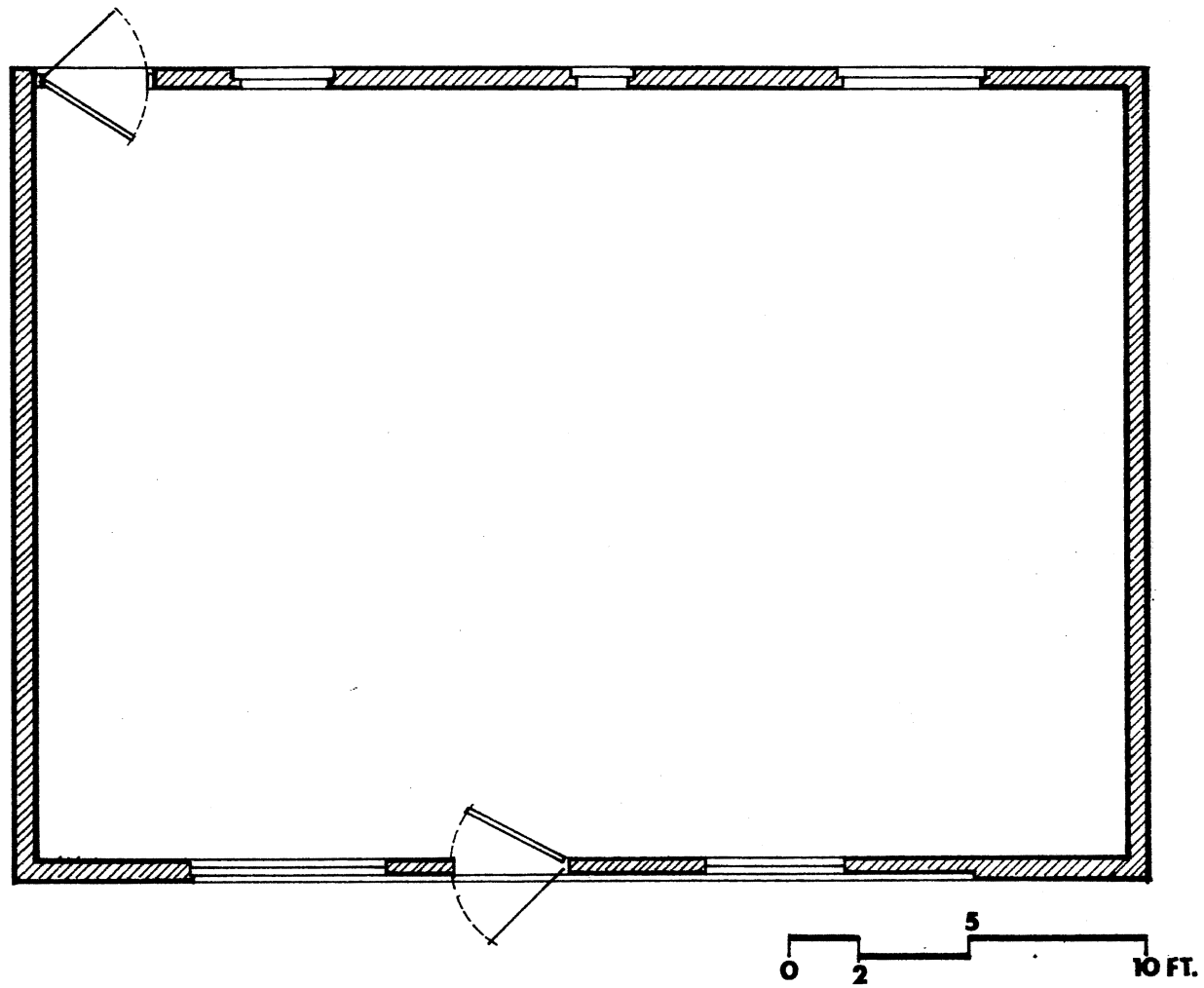
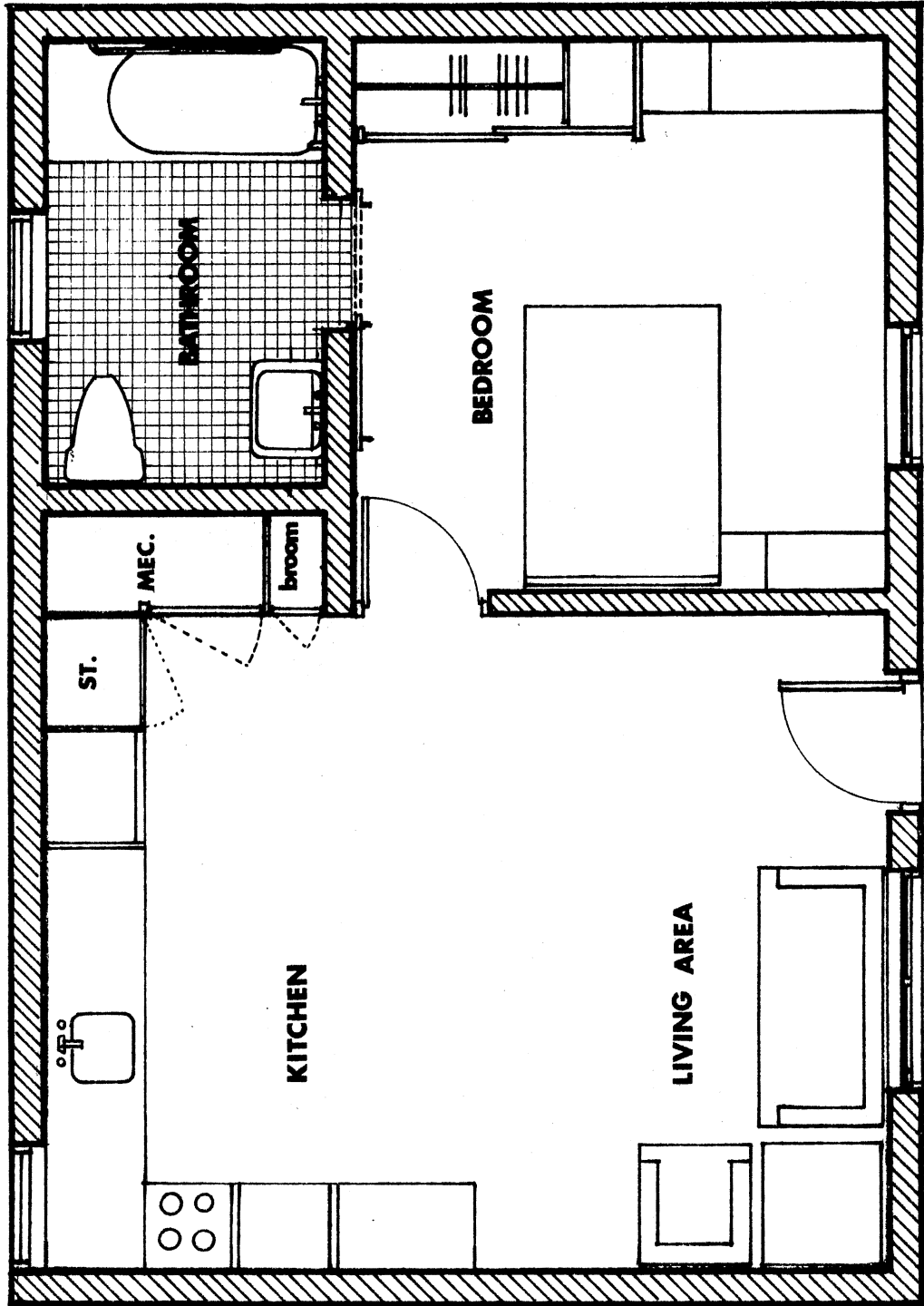


Figure 7. The 21' x 30' Plan for Rearranged Interior



SCALE 1/4" = 1' 0"

Figure 8. Proposed Housing Plan

Chapter II is found in Figure 9. This adapted wheelchair kitchen has been arranged in an L-shaped plan 12 feet 3 inches long and 9 feet 9 inches wide. Because this very specialized kind of kitchen planning is dependent on equipment and appliances of definite design and dimensions, the author has gathered dimensions of items which have proved useful in the design of kitchens for the disabled (Table I).

TABLE I
DIMENSIONS OF APPLIANCES AND EQUIPMENT
USEFUL IN KITCHENS OF THE DISABLED

No. in Fig. 7	Appliances & Equipment	Width	Depth	Height	Height From Floor
1	Refrigerator	31"	27"	66"	66"
2	Pull-Out Board	18"	28"	1'	27"
3	Dishwasher	24"	23"	31"	31"
4	Sink	20"	20"	6"	31"
5	Pull-Out Board w/Circular Cutout	25"	22"	1"	27"
6	Electric Range	20"	25"	7"	3"
7	Wall Oven	25"	25"	24"	55"
8	Dining Area	25"	36"	1-1/2"	27"
9	Storage Cabinet	42"	15"	12"	52"
10	Storage Cabinet	12"	15"	12"	52"

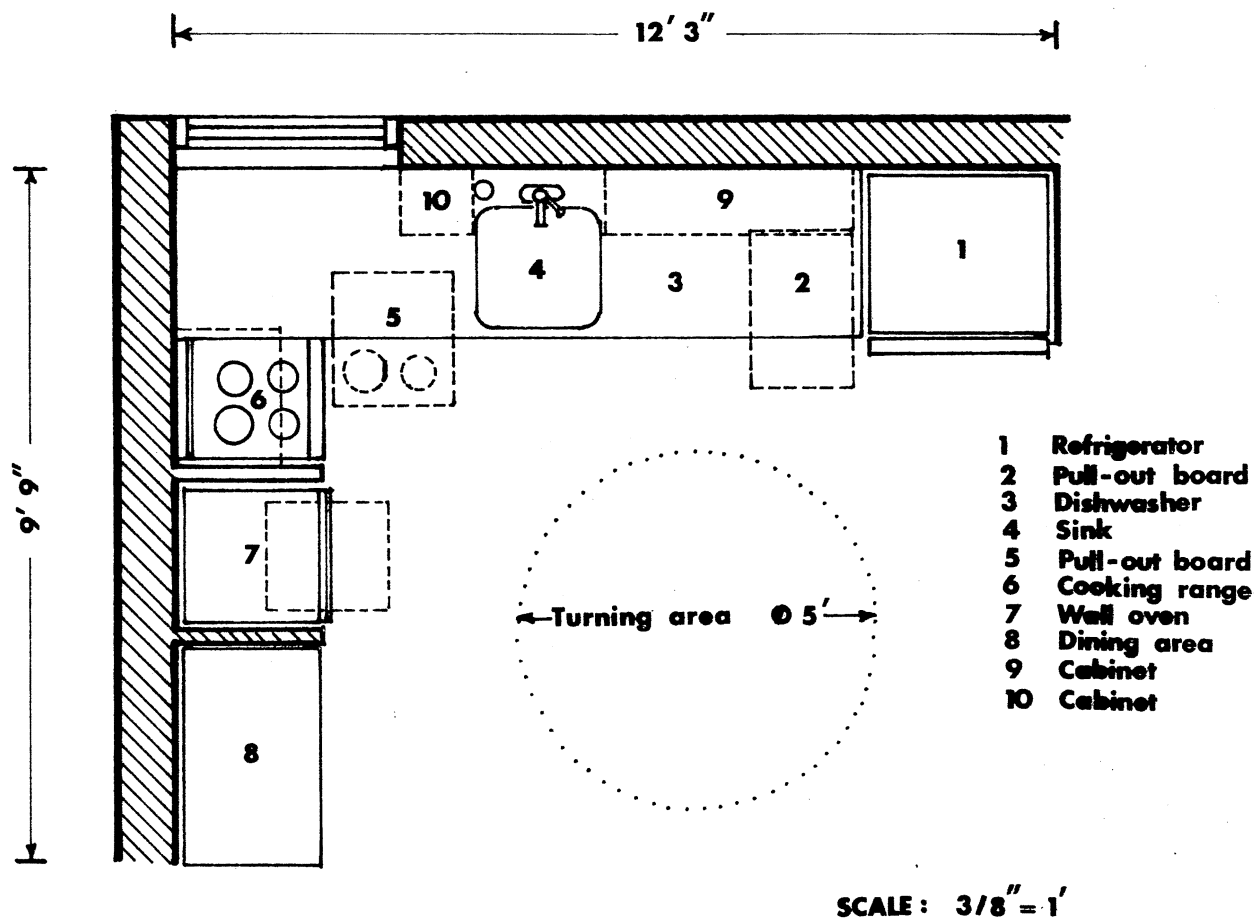


Figure 9. Kitchen Plan

Work-Top. One problem of handicapped persons in wheelchairs is the inability to get close enough to work in a regular kitchen with standard 36 inch high work-tops. Thus, the work-top should be determined by the height of the wheelchair arms. Wheeler (n.d.) stated that:

Since the arms of the standard wheelchair are 29" high, the bottom of the work-top should be at least 29-1/2" above the floor, and with the standard 1-1/2" thick tops, the lowered work surface will be 31" above the floor instead of the regulation 36" high. This 31" is as low as we can go with the work-tops, but it is still too high for a woman seated in a chair to do the heavy work of beating and stirring, chopping and slicing. So at one side of the sink we install a good, sturdy pull-out board about 28" above the floor (p. 13).

In Figure 9 the boards (Nos. 2, 5) are made of laminated hardwood; one of them has two circular cuts out to hold mixing bowls. This is comfortable for the heavy work in a sitting position. When using a portable electric beater in this position it is easy to rest the back end of the beater on the pull-out board while it is in operation. The continuous unbroken counter begins next to the opening side of the refrigerator and goes on to include the sink, range-top, oven and serving area, with good work spaces for food preparation and also for serving. A pull-out board below the oven can be used for food serving.

Refrigerator. There are many types of standard refrigerators today. The refrigerator with the freezer compartment at the bottom of the box, side opening, storage racks on the back of the door, and with automatic ice

cube maker and automatic defroster eliminates the hard and sloppy work of filling, carrying and replacing the ice cube trays while handling a wheelchair. The door of the refrigerator should swing away from the work area. These appliances are manufactured with hinges on either left side or right side, depending on the location of the refrigerator. In an ideal kitchen plan the refrigerator would be at one end of the continuous work-top, probably separated from the sink by the dishwasher and the 31" high work-top, but the question of which end it should be on and whether space must be left for the refrigerator door to open all the way back will depend upon which way the homemaker approaches the refrigerator and how she positions her chair while she is using it. In Figure 9, the door of the refrigerator is open at the left side which adjoins the work-top (Figures 9 and 10, No. 1). Things can be taken directly from the refrigerator to the pull-out board (Figure 9, No. 2) which can be used for a loading platform. This pull-out board has a two inch raised edge at the right. This edge acts as a back curb when the homemaker is sitting at the sink and using the pull-out board for cutting, chopping, and food preparation (Wheeler, n.d., p. 21).

Dishwasher. The dishwasher is located between the sink and the refrigerator (Figures 9 and 10, No. 3). Its best position is next to the sink. This appliance is

- | | |
|------------------|-----------------|
| 1 Refrigerator | 6 Cooking range |
| 2 Pull-out board | 7 Wall oven |
| 3 Dishwasher | 8 Dining area |
| 4 Sink | 9 Cabinet |
| 5 Pull-out board | 10 Cabinet |

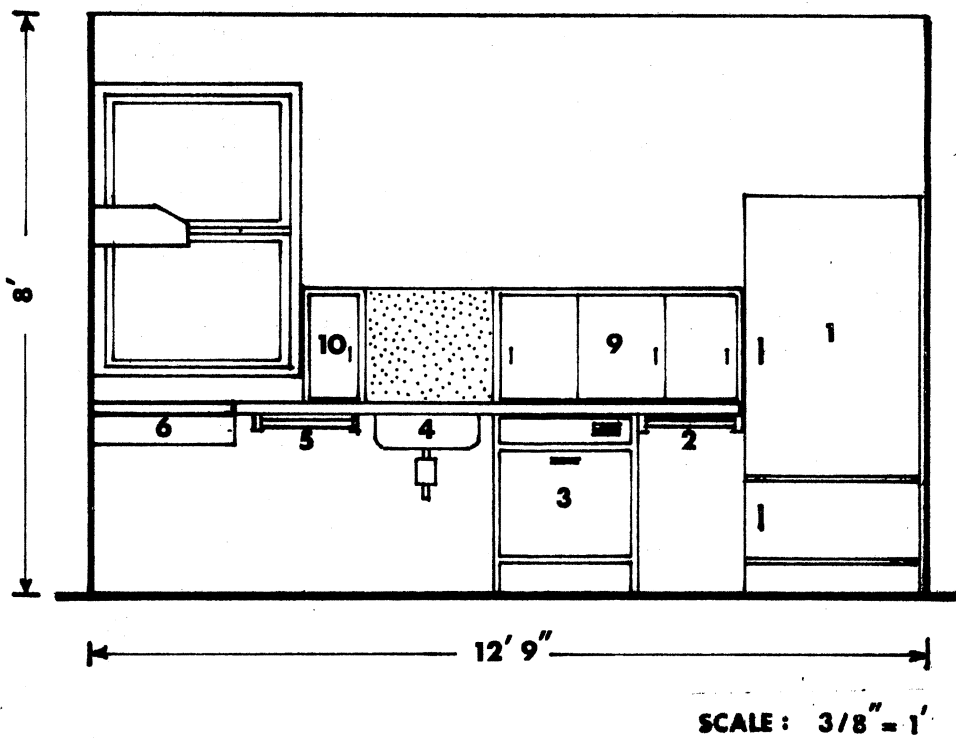


Figure 10. Kitchen Section

approximately 24 inches wide and should be a front-loading model with upper and lower racks that slide out independently of each other (Wheeler, n.d., p. 15).

Sink. A good size for the sink is 20 inches by 20 inches and 6 inches deep; stainless steel is recommended (Figure 9, No. 4). The faucets can be easily reached from a sitting position. Wheeler (n.d.) states that:

The mixer spout-and-faucet fixture, so important when the homemaker's grasp is seriously impaired, should have handles that operate at a touch without real grasp or pressure, and these handles should be low enough to reach with the outstretched arm supported on the work-top beside the sink. The single control fixtures that are often advocated for 'ease and convenience' require a better reach, grasp and control than many seriously disabled women can manage. The sink would surely be equipped with a pull-out hose-spray, because with this simple device the homemaker who cannot lift a pan full of water can fill one easily while it stands on the work-top beside the sink (p. 15).

Twenty-five inches is the comfortable knee room under this six inch deep sink set in a 31 inch high work-top (Wheeler, n.d., p. 35). The piping underneath the sink should be wrapped with insulating tape and the bottom of the sink should be shielded with panel board. This can prevent the legs from being burned by scalding hot water in the sink and drain pipe. The maximum water temperature should be set at 120 degrees Fahrenheit (Olson and Meredith, 1973, p. 22). A built-in garbage disposal is also an energy saver.

Range and Oven. Electric burners and ovens are preferable to gas since open flames can ignite clothing and

cause burns and fires. The cooking top, which is separated from the wall oven, has four burners in a square pattern (Figures 9, 10, 11, No. 6). The push button controls at the front of the cooking top are used instead of knobs. The open space for feet and chair pedals under the range is also 31 inches high. The built-in oven, 31 inches above the floor, has a side-opening door so the wheelchair can get close (Figures 9 and 11, No. 7). A microwave oven deserves consideration. A pull-out board below is used as a loading platform for food serving, either from the oven or from the cooking top.

Cabinets. Wheeler (n.d.) states that:

The homemaker's reach is so limited that the upper cabinets are out-of-bounds for her, and then because most of the space below the work-top must be left open for her leg-room, there can be very few, if any, base cabinet storage. The only solution is to make the greatest possible use of every inch of space in the middle height area at the back of the counter. This space is usually wasted in 'normal' kitchens because the depth of standard work-tops from front to back (25") is greater than any woman needs for kitchen work. A disabled woman working in a wheelchair seldom works any farther back than 16" so that in her kitchen there will be at least 8" waste space at the back of the work-top which can be used for storage. If this space is fitted with simple sliding door cabinets or carefully organized with pegboard, shelves, racks and hooks, she can keep the most commonly used foods and utensils within her easier reach (p. 22).

In Figure 9, the cabinets are made on the back space of the counter from the left of the refrigerator, except for the back space of the sink and the corner of the counter. These cabinets have clear glass sliding doors,

- | | |
|------------------|-----------------|
| 1 Refrigerator | 6 Cooking range |
| 2 Pull-out board | 7 Wall oven |
| 3 Dishwasher | 8 Dining area |
| 4 Sink | 9 Cabinet |
| 5 Pull-out board | 10 Cabinet |

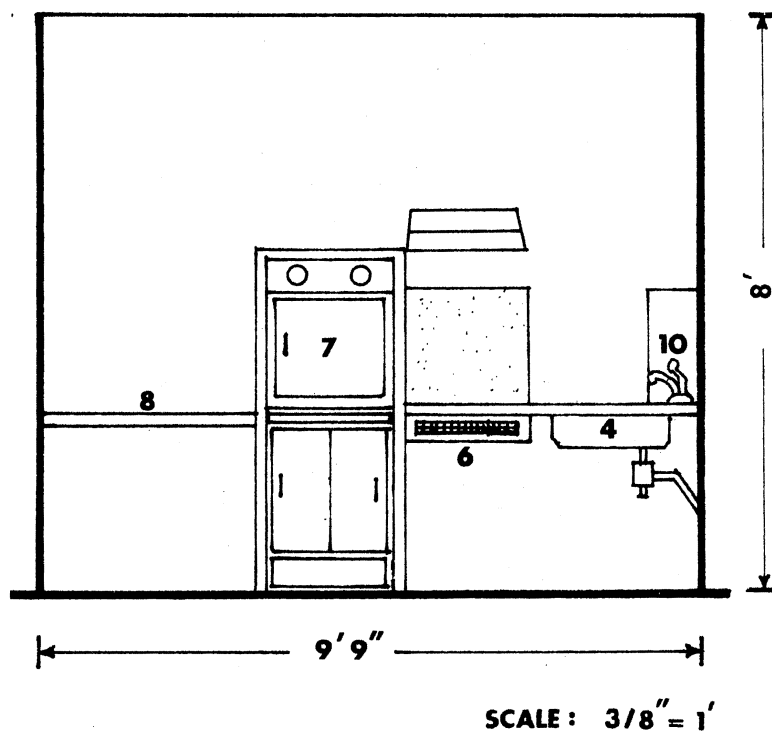


Figure 11. Kitchen Section

which is the combination of "open storage" and "covered storage." The height of these cabinets is 21 inches above the 31 inch high work-top. This is as high as a women can comfortably reach from a sitting position (Wheeler, n.d., p. 16). The utensils can be seen easily and yet stay clean. At the back-space behind the sink, a peg board is installed to hang necessary things for washing, such as: scrub brushes, mops, measuring cups, paring tools, and other sink related utensils. A peg board behind the cooking top can accommodate pots and pans and other cooking related articles.

In Figure 8, at the right of the refrigerator, there is a covered cabinet with swing-out shelves and good storage cabinet is below the oven.

Circulation in the Kitchen. For disabled persons, the working area of the kitchen must be free of interference from other traffic in the home. The kitchen shown in Figure 9 is L-shaped and has enough space for wheelchair turning. To allow for comfortable wheelchair turning inside a kitchen there should be an unobstructed space not less than four feet eight inches by four feet eight inches, where toe recesses are provided below low level fixtures, and five feet by five feet, where they are not (Goldsmith, 1976, p. 239). The plan arrangement is very convenient for working. Everything can be pushed along back and forth from refrigerator to sink, from sink to stove, and from

oven to dining table and back again, as needed. This makes it more convenient for persons in wheelchairs than carrying things with them while working.

Dining Area

A pleasant dining area is convenient for serving meals and cleaning the table without carrying anything because the work-top is continued and passes a pull-out board below the oven into this area.

Bathroom

In a wheelchair house the bathroom should be planned to suit the specific requirements of the handicapped person and should be conveniently accessible from usable bedrooms (Figure 12). The fixtures which are necessary and the dimensions suitable for a wheelchair person are listed in Table II.

Basin. The basin should preferably be 27 inches deep with a narrow apron to allow knee room underneath. A master's thesis written at the Oklahoma State University (McGregor, 1968) reported that the lavatories must provide for a clearance below the apron of 30 inches by at least 18 inches deep. Insulated pipes protect against burns to those persons who have lost sensory abilities. Maximum water temperatures should not exceed 120 degrees Fahrenheit or 49 degrees Centigrade (Harkness and Groom, 1976,

- | | |
|----------------|-----------------------|
| 1 Basin | 5 Grab bar |
| 2 Hanging rod | 6 Toilet paper holder |
| 3 Grab bar | 7 Bathub/shower |
| 4 Water closet | 8 } Grab bar |
| | 9 } |

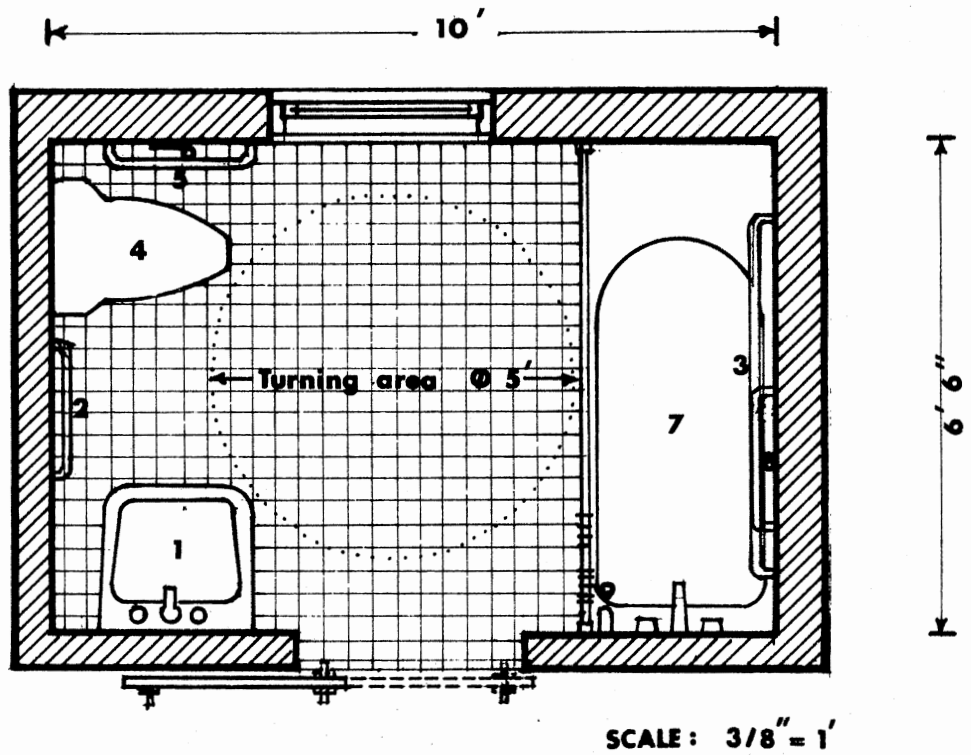


Figure 12. Bathroom Plan

p. 46). Faucets should have safety mixing valves and the single lever type is for people whose hands are weak. Mirrors and other accessories must be placed with the bottom edge at the 40 inch level (McGregor, 1968, p. 30).

TABLE II
DIMENSIONS OF BATHROOM FIXTURES
SUITABLE FOR THE DISABLED

No. in Figure	Fixture	Width	Depth	Height from Floor
1	Basin			At rim: 32-1/2" At bottom: 26"
2	Hanging Rod	φ3/4"		33"
3	Grab Bar	φ1-1/4"		24"
4	Water Closet			Seat Height: 30"
5	Horizontal Grab Bar	φ1-1/4"		33"
6	Toilet Paper Holder	Standard		
7	Bathtub and Shower	32"	78"	18"
8	Grab Bar	φ1-1/4"		27"
9	Grab Bar	φ1-1/4"		to Bottom Part

Water Closet. The planning of the water closet depends on the techniques the persons in wheelchairs use to

transfer from wheelchair to water closet. The chairbound disabled transfer from a wheelchair to a water closet seat is accomplished usually from the side or front of the wheelchair. In Figure 13 the water closet is planned for the convenience of a side and a front transfer (Figure 13, No. 4). The horizontal grab bar is attached to the side wall for both pushing and pulling up (Figures 12 and 13, No. 5). This grab bar is particularly important for balance, stability, and safety. All grab bars should be one and a half inches in diameter, installed with one and a half inch clearance between the bar and the wall, and be capable of withstanding a pulling or hanging load of 300 pounds. This bar gives people a good grip and yet the one and a half inch space is not wide enough to allow the arm to slip through, which would be hazardous (Harkness and Groom, 1976, p. 46). All protruding hardware and fixtures, such as paper holder (Figures 12, 13, and 15, No. 6) and towel bars (Nos. 2 and 3) should be strong and mounted firmly.

Bathtub and Shower. For wheelchair bathrooms the recommendation is that bathroom planning should allow for the use of a shower as well as a tub (Goldsmith, 1976, p. 287). In Figures 12-14 and 16 (No. 7), the bathtub is equipped with a shower head which is a hand shower. The shower head can be adjustable in height, and preferably, detachable with a flexible head. The water controls should be located on the side wall. The bathtub should be

- | | |
|----------------|-----------------------|
| 1 Basin | 5 Grab bar |
| 2 Hanging rod | 6 Toilet paper holder |
| 3 Grab bar | 7 Bathub/shower |
| 4 Water closet | 8 } Grab bar |
| | 9 } |

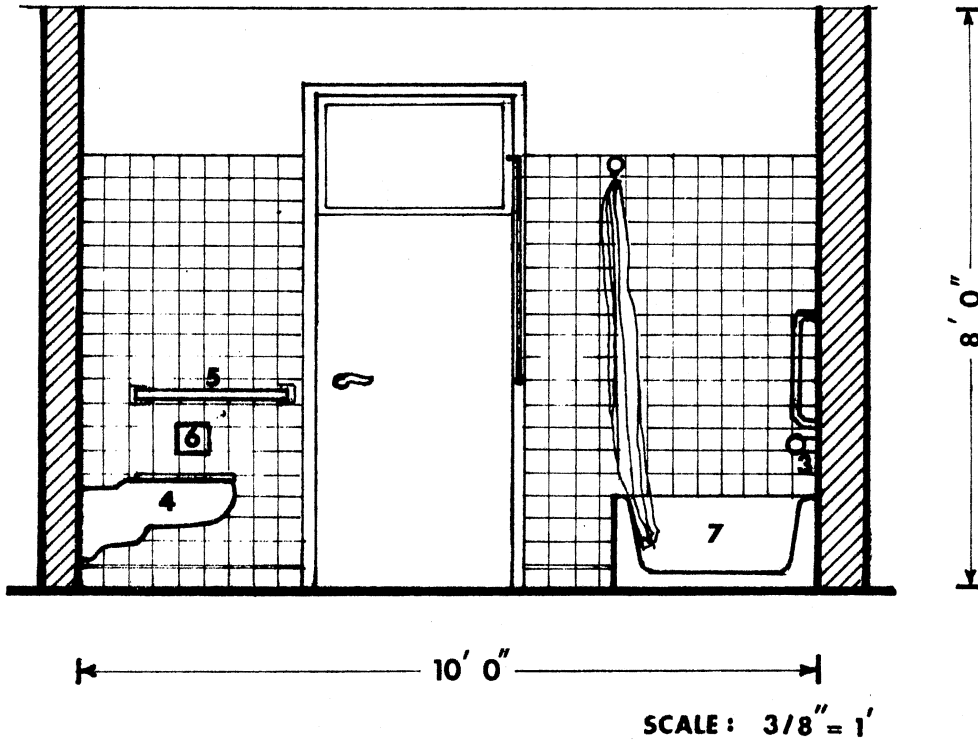


Figure 13. Bathroom Section

- | | | | |
|---|--------------|---|---------------------|
| 1 | Basin | 5 | Grab bar |
| 2 | Hanging rod | 6 | Toilet paper holder |
| 3 | Grab bar | 7 | Bathub/shower |
| 4 | Water closet | 8 | } Grab bar |
| | | 9 | |

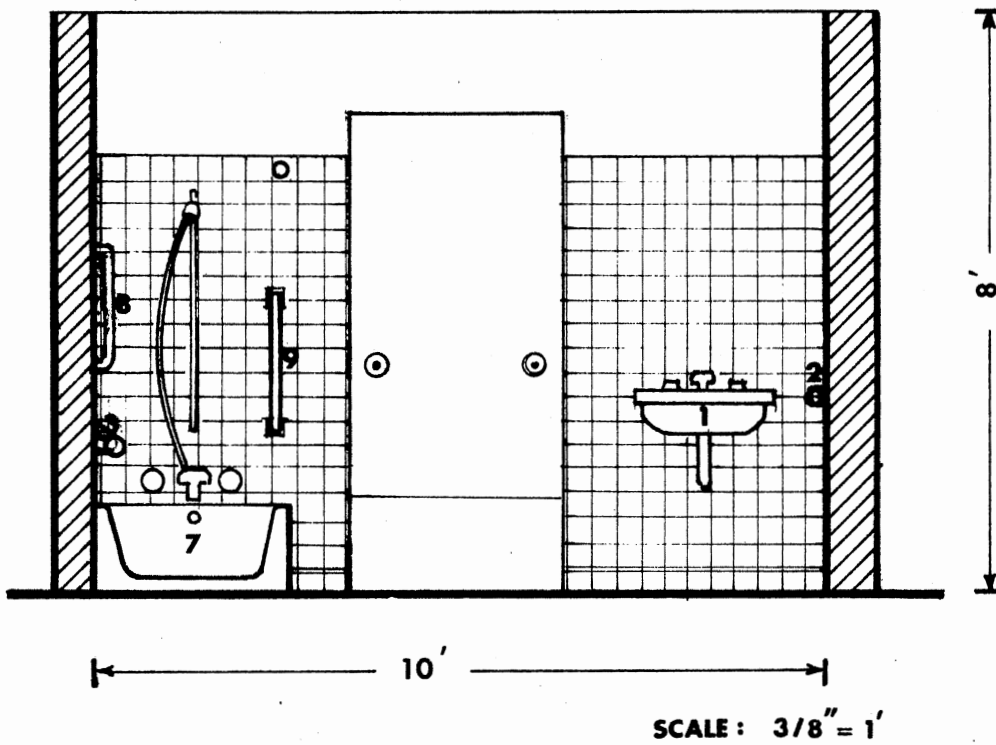


Figure 14. Bathroom Section

- 1 Basin
- 2 Hanging rod
- 3 Grab bar
- 4 Water closet

- 5 Grab bar
- 6 Toilet paper holder
- 7 Bathub/shower
- 8 } Grab bar
- 9 }

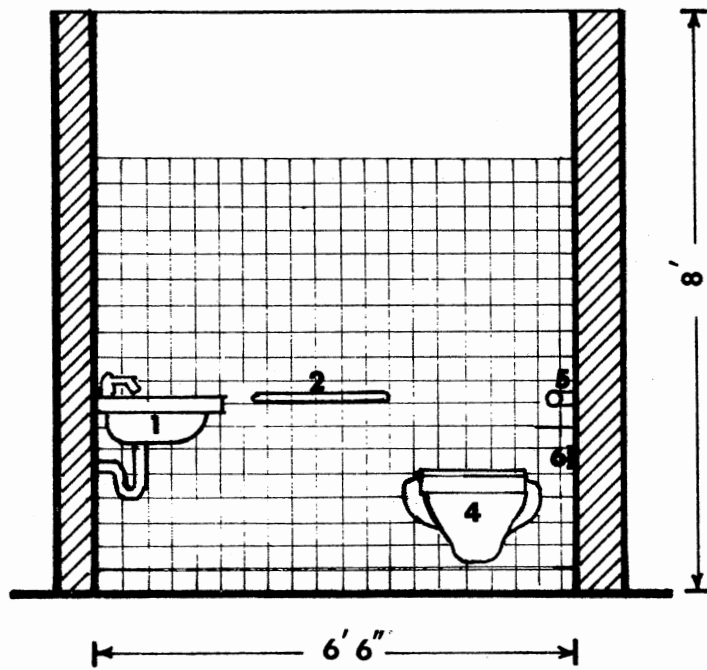


Figure 15. Bathroom Section

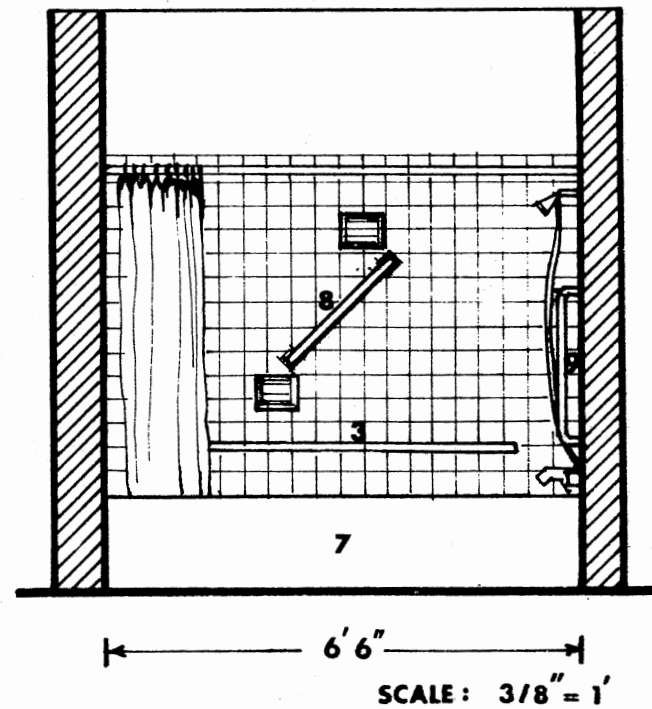


Figure 16. Bathroom Section

equipped with a detachable seat which allows the bather to sit down. The minimum height from the floor to the bathtub rim is eighteen inches (Olson and Meredith, 1973, p. 32). The platform at the head of the bathtub is also helpful for transferring from chair to tub (Figure 12, No. 7). A diagonal grab bar and soap dish, placed at a high level about 51 inches from the bottom of the tub, will avoid the necessity to bend down for soap (Green, Fedewa, Johnstons, Jackson and Deardoff, 1974, p. 152) (Figures 10 and 14, No. 8; Figure 16, No. 10). The vertical grab bar at the wall beside the shower head is for pulling up if the bather wants to transfer from the wheelchair to the bathtub at this side (Figures 12 and 14, No. 9).

Circulation in the Bathroom. In Figure 8 the bathroom is planned to have direct accessibility from the bedroom. The sliding door of the bathroom is very practical when the space is limited; an outward opening door would not be practical. Also, it is safer than using an inward opening door which is not suitable because of the hazard of falls and because of the inconvenience of opening and closing the door when the wheelchair is in the bathroom. The door should be unlockable from either side or should have privacy locks which can be easily unlocked from the outside in case of emergency. Non-slip, easily maintained floor surfaces which are free from changes in level should be provided. To allow for wheelchair turning, the clear

space in the bathroom should be not less than four feet, eight inches wide (Goldsmith, 1976, p. 291).

Bedroom

As a guide to space formation, it is noted that bedrooms with the smallest dimensions of less than nine feet, six inches tend to be difficult to furnish, and circulation in the bedroom may also become difficult (Green, et al., 1974, p. 152).

This bedroom is 13 feet by 12 feet, 6 inches, which is big enough to permit a wheelchair to move about freely, without difficult maneuvering (Figure 17). The numbers of articles of furniture are only the number actually needed. Also, the dimensions of these furnishings are suitable for use by handicapped persons (Table III).

The indispensable piece of furniture which deserves great consideration in its selection is the bed. It should be made of strong materials and of a size which assures maximum comfort for the disabled.

For most individuals who have difficulty turning in bed, the twin size is most practical. It provides ample sleeping area and is narrow enough so that an occupant may reach and grip the mattress edges for added leverage when desiring a change of position (Gutman, 1968, p. 66).

The bed (Figure 17, No. 1) with mattress, is approximately the same height as the wheelchair seat. The clearance space under this bed is ten inches, to allow room for

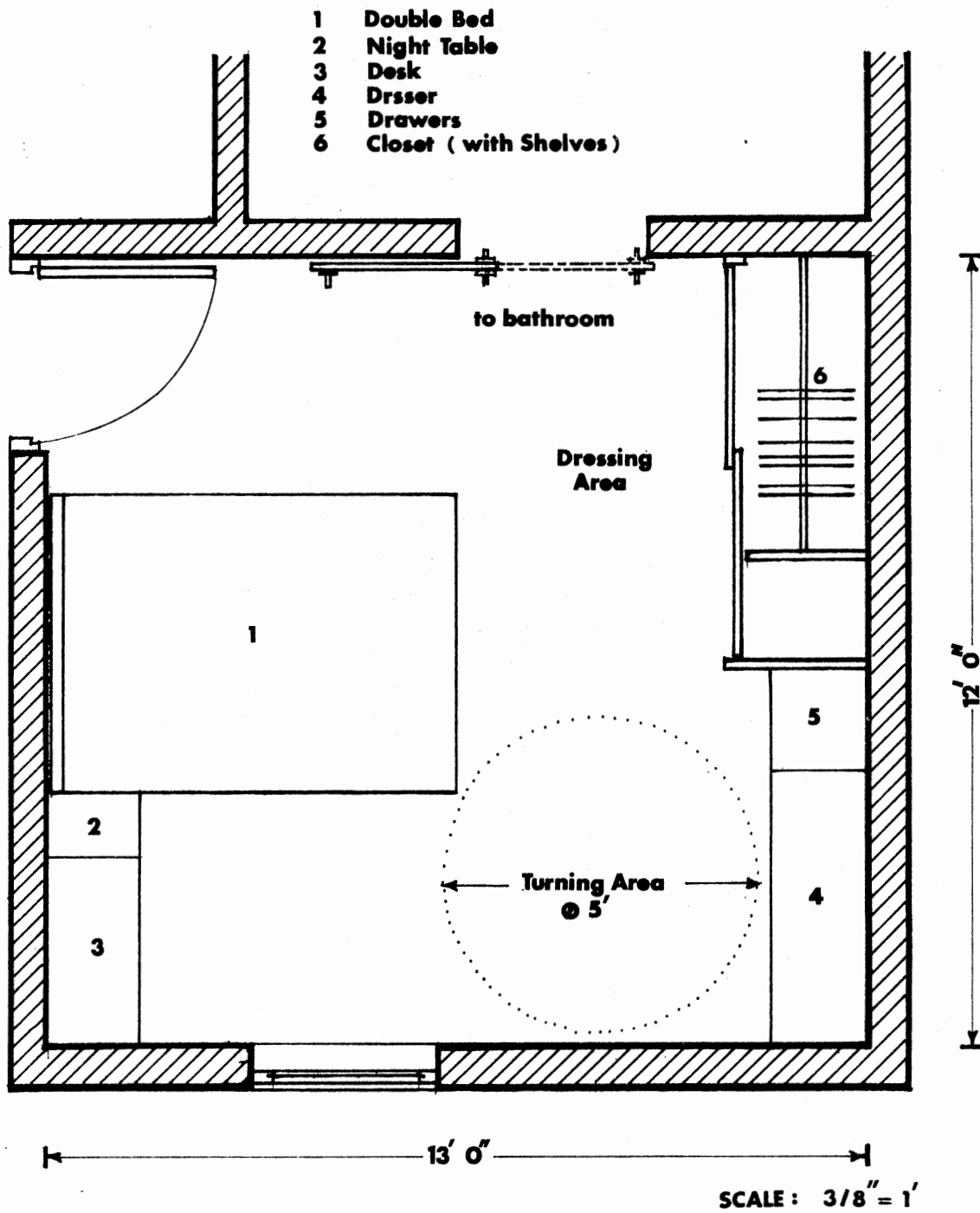


Figure 17. Bedroom Plan

footrests when approaching in a wheelchair. The headboard has a grab bar or spindle attached to it to assist the occupant in moving and turning over. A night table with roomy drawers is also important for holding a telephone, books, a signal device, and anything else for convenience of use in bed (Figure 17, No. 2).

TABLE III
DIMENSIONS OF FURNISHINGS SUITABLE
FOR THE DISABLED

No. in Figure	Furniture	Width	Length	Height from Floor
1	Twin Bed or Double Bed	3'-3"	6'-6"	1'-6"
2	Night Table	1'	1'-6"	1'-4"
3	Desk	1'-6"	3'	31"
4	Dresser	1'-6"	4'-4"	31"
5	Drawers	1'-6"	1'-8"	31"
6	Closet (with Shelves)	2'-2"	6'-6"	10'

A desk for studying is necessary for an occupant who is a student (Figures 17 and 20, No. 3). A dresser with a wall mirror is in the right-hand corner of the room (Figure 17, No. 3). The clearance space under the desk is 30

- 1 Double Bed
- 2 Night Table
- 3 Desk
- 4 Drsser
- 5 Drawers
- 6 Closet (with Shelves)

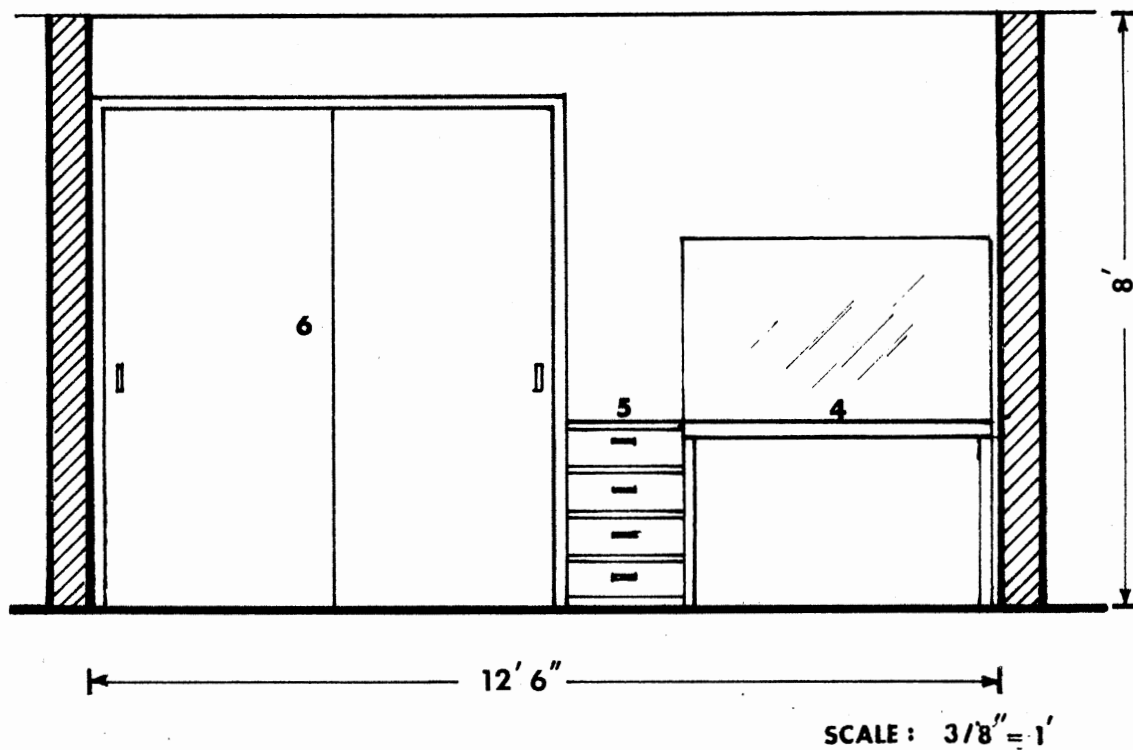


Figure 18. Bedroom Section

- 1 Double Bed
- 2 Night Table
- 3 Desk
- 4 Drsser
- 5 Drawers
- 6 Closet (with Shelves)

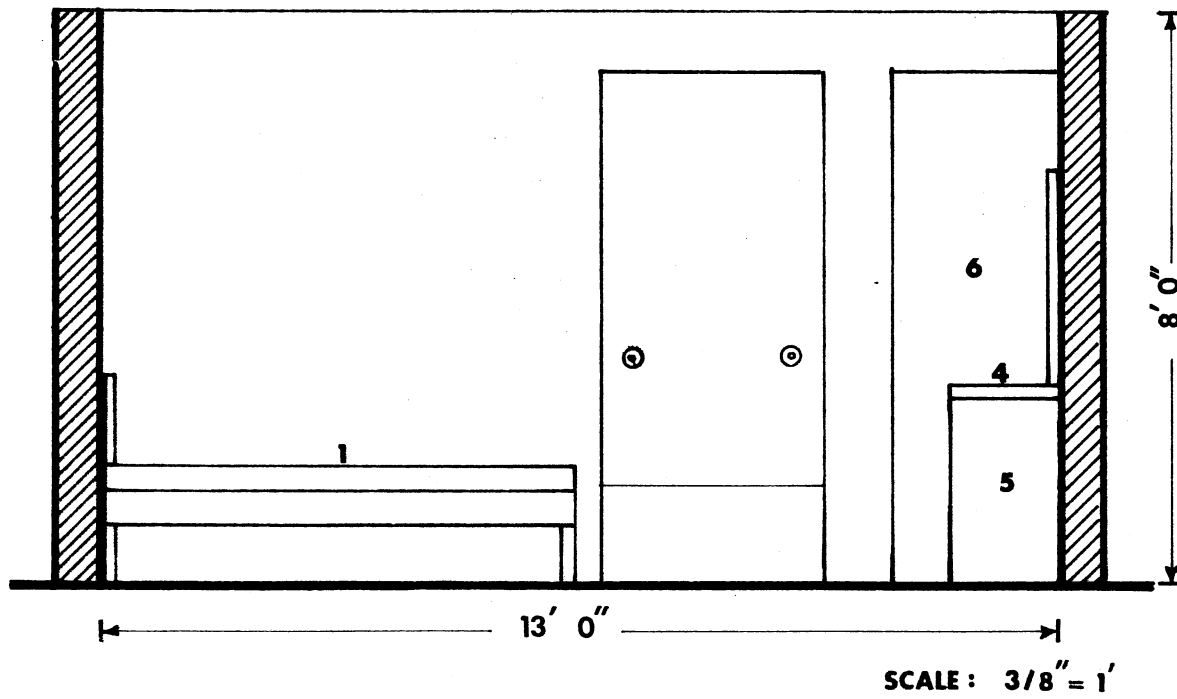


Figure 19. Bedroom Section

- 1 Double Bed
- 2 Night Table
- 3 Desk
- 4 Drsser
- 5 Drawers
- 6 Closet (with Shelves)

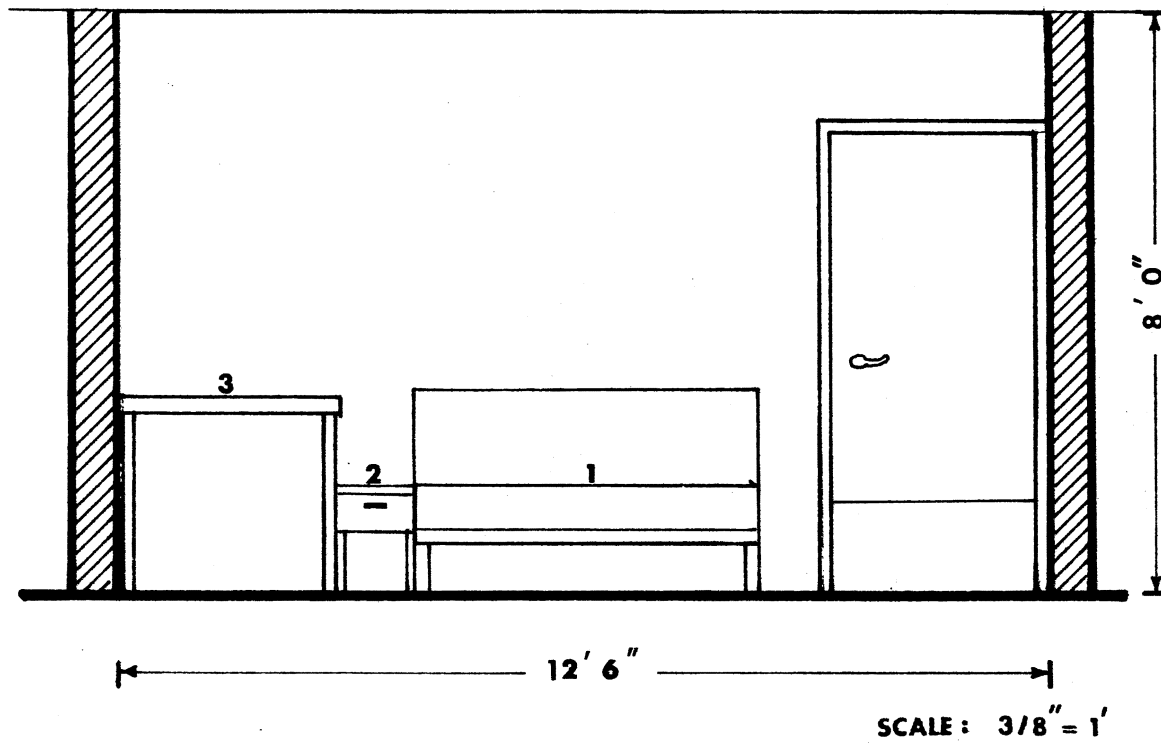


Figure 20. Bedroom Section

- 1 Double Bed
- 2 Night Table
- 3 Desk
- 4 Drsser
- 5 Drawers
- 6 Closet (with Shelves)

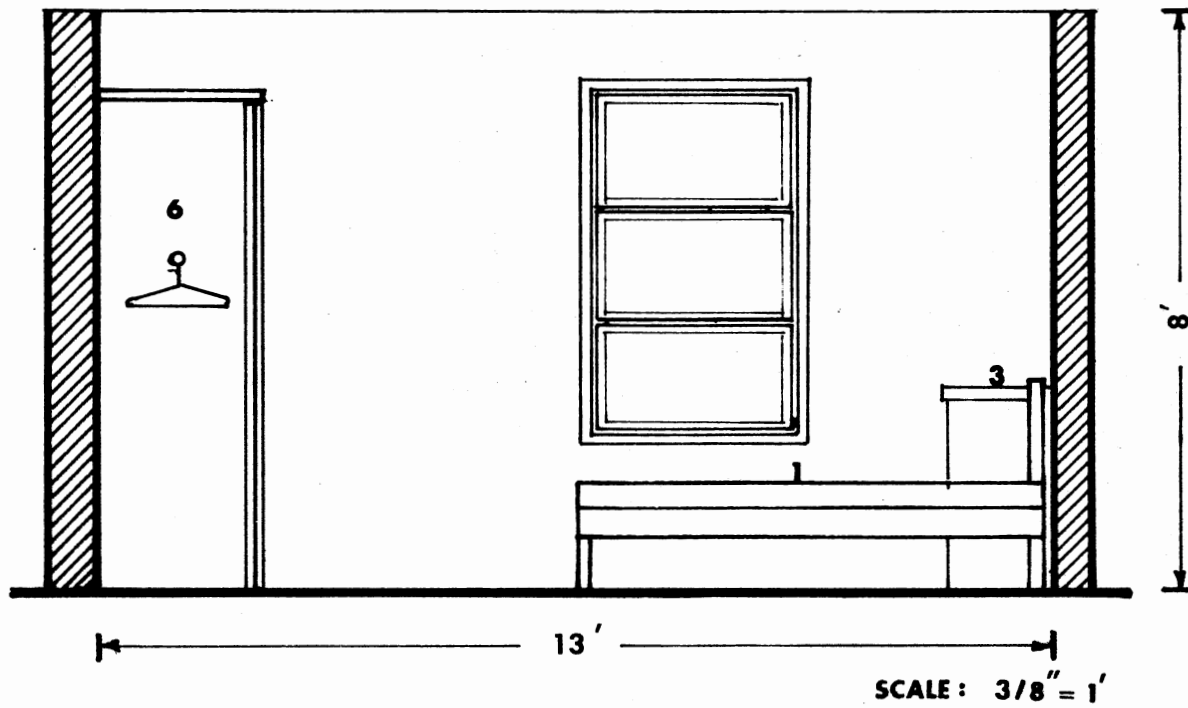


Figure 21. Bedroom Section

inches for the wheelchair's footrests, since the arms of the standard wheelchair are 29 inches high. The closet with bar and shelves are within reach of a person in a wheelchair. The height varies from 48 inches to 54 inches (Figures 17 and 21, No. 6). The closet sliding door is convenient for wheelchair users; it is easy to manipulate and negotiate (Figures 18 and 19).

Circulation and Furniture Arrangement in the Bedroom.

In a wheelchair house bedrooms should allow for wheelchair turning and for access to dressing table, wardrobe, etc. (Goldsmith, 1976, p. 259). The bedroom door is 32 inches wide in the corner position and the side is hinged at the wall side. Thus, it is easy to approach. On the opening sides of each door, some clearance must be allowed. In Figure 8 there are shown ample spaces at the door sides, both inside and outside the bedroom. The lever door handle is used because it has been proved most suitable. It is 36 inches above the floor, which is convenient for a person in a wheelchair to hold. A double bed is placed parallel with a window to avoid uncomfortable glare. Also, the outside view is allowed from the bed. The suitable height of the window sill is 24 inches to 36 inches.

Goldsmith (1976) states that:

Horizontally pivoted windows with a friction pivot and single lever stay at sill level may be suitable for disabled people. Controls to these windows can usually be located so that they are reachable by chairbound people (p. 180).

At both sides of the bed there is enough space for a handicapped person to transfer to or from the bed. And it also allows for bedmaking from a wheelchair. Where bedrooms are planned for wheelchair use the clear dimension to the side of the bed should not be less than four feet. A severely handicapped person may require a single bed, in which case the living room would accommodate a sofa bed. In front of the dresser is a clear space about five feet wide to allow for comfortable wheelchair turning. The dressing space is provided by using the sliding doors for the bathroom and the closet. It is in front of the closet and in a direct route from the bedroom to the bathroom.

Living Area

For wheelchair users attention should be given to the probable placing of furniture to ensure that adequate space is provided for maneuvering and circulation (Goldsmith, 1976, p. 257). Sufficient space should be available for wheelchair turning. In Figure 22 the furniture is arranged in an L-shaped plan. The moveable coffee table is used to avoid being an obstacle to wheelchair mobility. The main furniture in this living area is listed in Table IV (Figures 22, 23, and 24).

The armrests of the chair and the sofa are approximately 7 inches above the chair seat, extending forward to allow for pushing to a standing position (Goldsmith, 1976, p. 257). No crossbars are beneath the front edge

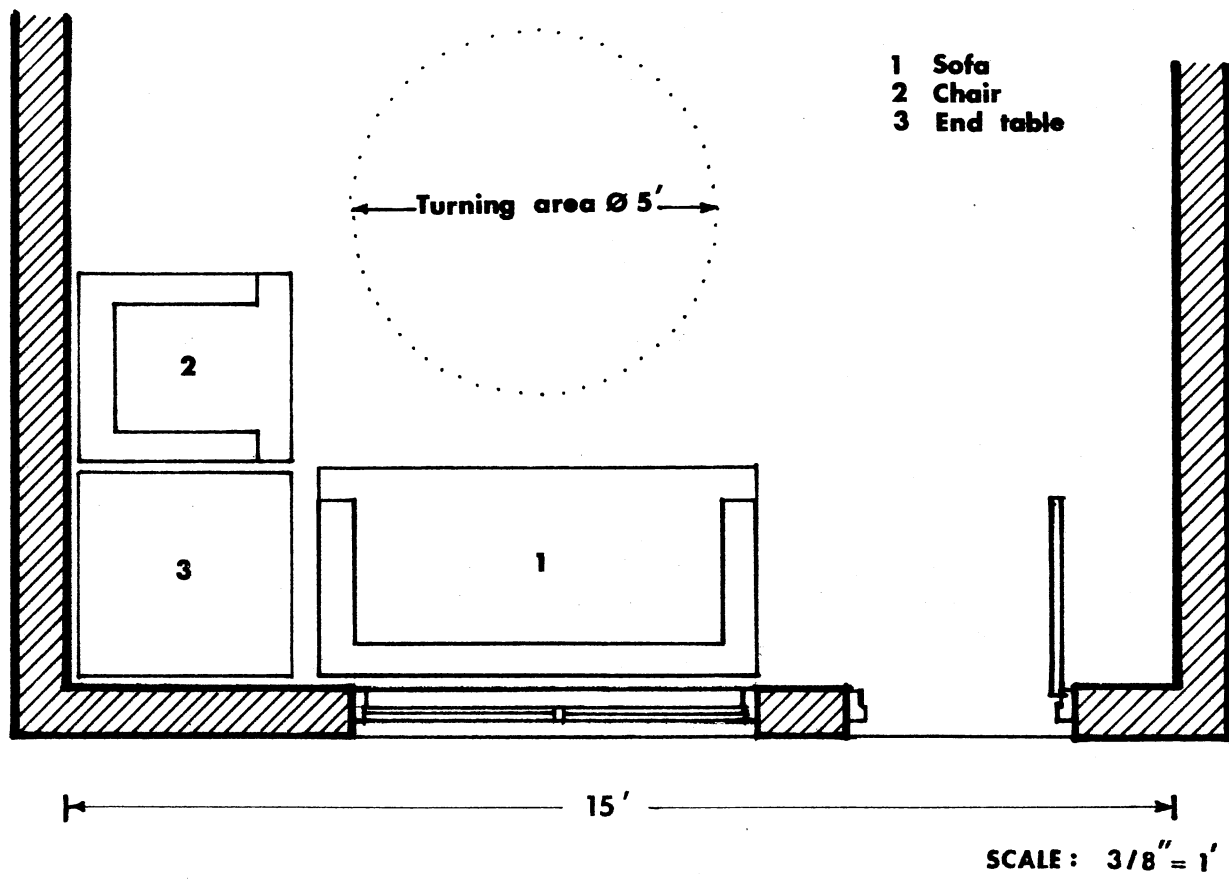


Figure 22. Living Area Plan

- 1 Sofa
- 2 Chair
- 3 End Table

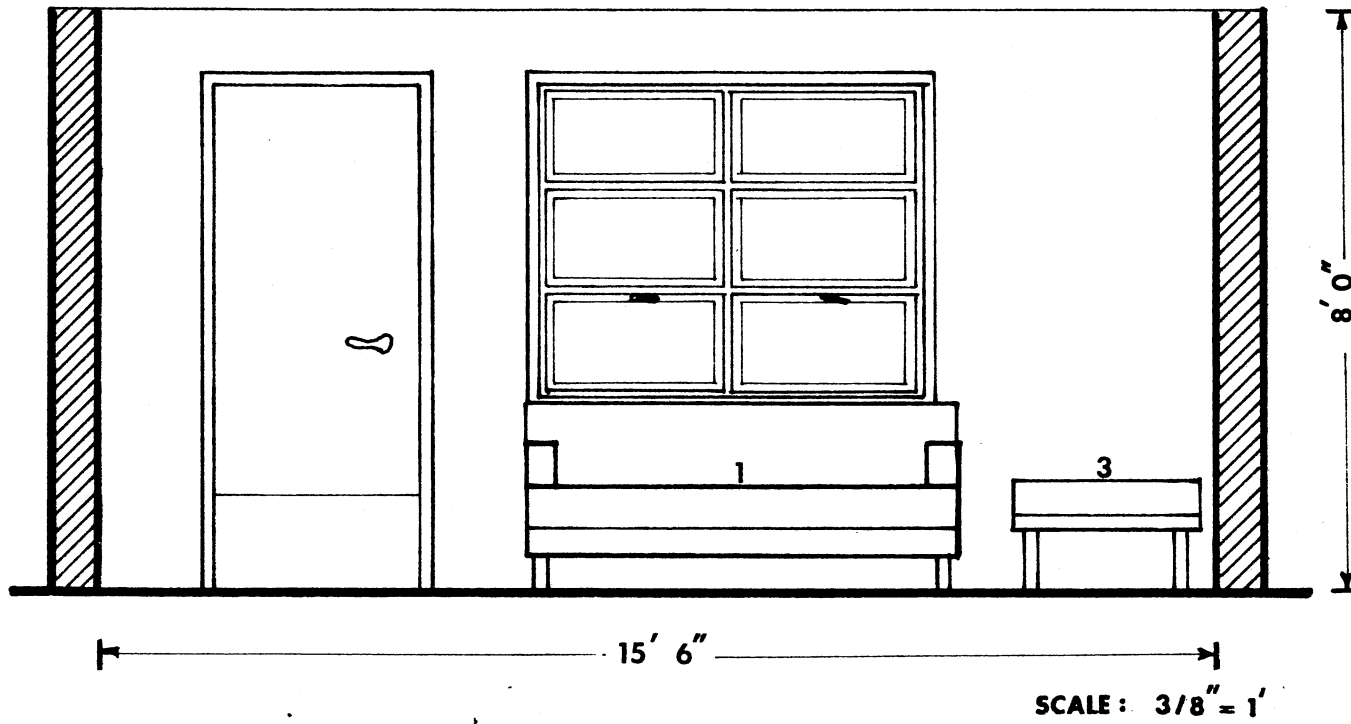
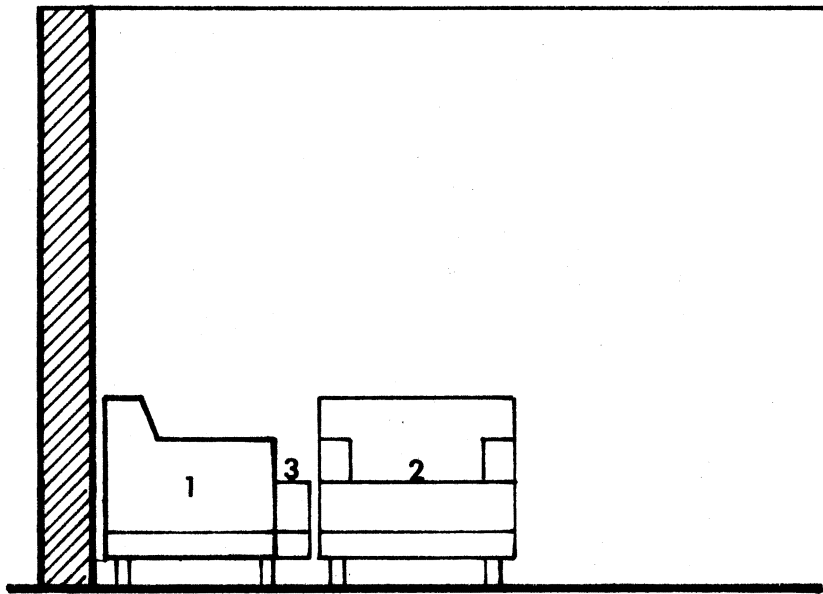


Figure 23. Living Area Elevation

- 1 Sofa
- 2 Chair
- 3 End Table



SCALE: 3/8" = 1'

Figure 24. Living Area Elevation

of the seat. The seated person would be able to see out of the windows.

TABLE IV
LIVING AREA FURNITURE

No. in Figure	Furniture	Width	Depth	Height from Floor
1	Sofa	6'	3'	1'6"
2	Chair	2'8"	3'	1'6"
3	End Table	3'	3'	1'6"

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This study indicated that certain modifications in housing would be required to accommodate wheelchair students in married student housing at Oklahoma State University in Stillwater, Oklahoma. The need and special design considerations for wheelchair students on campus has been established by previous studies. It was the purpose of this study to compile standards from the literature and to apply them to the conversion of married student housing into housing suitable for and applicable to disabled students.

Exterior of Housing

Modifications recommended for the exterior of the housing primarily pertains to (1) the extension of entrance platforms, (2) the construction of ramps, (3) the provision of suitable doors, (4) the construction of curb inclines at the parking area and street (these inclines should not protrude into the street nor have a gradation over ten percent), and (5) the walks should be kept clear of sleet and snow.

Interior of Housing

Architectural barriers were found in the married student housing surveyed. The recommendations for their elimination can be made as follows:

1. Doors and hardware properly chosen and installed can eliminate many interior barriers.

2. Rearrangement of the kitchen to provide accessibility of wheelchair students, needed circulation space, and clearance under the counter.

3. Provision for utilization of bathroom for wheelchair students. Bathtubs with showers are recommended. Grab bars should be provided for bathtubs, showers, and water closets.

4. Provide bedrooms with desks having the required chair clearance, closet rods that can be lowered when necessary, and mirrors no higher than 40 inches.

5. Provide living area with chairs and sofas suitable for disabled students.

The findings of the study indicate that there is a lack of accessibility and utilization of housing for wheelchair students. It is concluded that the presence of architectural barriers in the married student housing make it extremely difficult, if not impossible, for many potential students confined to wheelchairs to live in these units. It has been shown by this study that the conversion of married student housing into housing for disabled

students is possible. It depends upon the encouragement of educators, organizations, and personnel involved.

Recommendations

To achieve barrier free housing for married students on the Oklahoma State University campus, the following recommendations are made with the hope of encouragement and support:

1. Obtain cost estimates for these alterations to the recommended units.
2. Begin the next steps of the actual construction process.
3. Evaluate the spaces as living units for disabled students.
4. For further studies, it is recommended that this study be applied for the elimination of barriers in other related areas on campus.

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