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Redesign of an Existing Temporary Safe Shelter to Be Used As a Long-Term Community  
Safe Shelter

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Redesign of an Existing Temporary Safe Shelter to Be Used As a Long-Term Community  
Safe Shelter

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### Abstract

This research explores the redesign of space planning for an existing temporary safe shelter to be used as a long-term community living space that can be lived as their temporary home which loses in disaster. This research tries to find ways to maximum use of interior space for long-term living and big loads of occupants in safe shelters. It also tries to use a series of folding furniture, sliding system, and energy saving bathroom system to design a functional long-term solution.

## Definition of Terms

**CRED:** The Centre for Research on the Epidemiology of Disasters (CRED) has been active for more than 35 years in the fields of international disaster and conflict health studies, with research and training activities linking relief, rehabilitation and development. It was established in Brussels in 1973 at the School of Public Health of the Catholic University of Louvain (UCL) as a non-profit institution with international status under Belgian law. In 1980, CRED became a World Health Organization (WHO) collaborating centre as part of WHO's Global Program for Emergency Preparedness and Response. Since then, CRED has increased its international network substantially and collaborates closely with numerous UN agencies, inter-governmental and governmental institutions, non-governmental organizations, research institutes and universities (Guha, 2011).

**Disaster:** A serious disruption of the functioning of society, causing widespread human, material or environmental losses which exceed the ability of affected society to cope using only its own resources (Ibrahim, 2007).

**Earthquake:** Shaking and displacement of ground due to seismic waves. This is the earthquake itself without secondary effects. An earthquake is the result of a sudden release of stored energy in the Earth's crust that creates seismic waves. They can be of tectonic or volcanic origin. At the Earth's surface they are felt as a shaking or displacement of the ground. The energy released in the hypocenter can be measured in different frequency ranges. Therefore, there are different scales for measuring the magnitude of a quake according to a certain frequency range. These are: a) surface wave magnitude ( $M_s$ ); b) body wave magnitude ( $M_b$ ); c) local magnitude ( $M_L$ ); d) moment magnitude ( $M_w$ ) (Guha, 2011).

**FEMA:** Federal Emergency Management Agency.

**General flood:** Gradually rising inland floods (rivers, lakes, groundwater) due to high total depth of rainfall or snowmelt. A general flood is caused when a body of water (river, lake) overflows its normal confines due to rising water levels. The term general flood additionally comprises the accumulation of water on the surface due to long-lasting rainfall (water logging) and the rise of the groundwater table above surface. Furthermore, inundation by melting snow and ice, backwater effects, and special causes such as the outburst of a glacial lake or the breaching of a dam are subsumed under the term general flood. General floods can be expected at certain locations (e.g. along rivers) with a significantly higher probability than at others (Guha, 2011).

**Hydrological Disasters:** Events caused by deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up (Guha, 2011).

**Interior Design:** Is a multi-faceted profession in which Creative and technical solutions are applied within a structure to achieve a built interior environment. These solutions are functional, enhance the quality of life and culture of the occupants and are aesthetically attractive (<http://www.ncidq.org/AboutUs/AboutInteriorDesign/DefinitionofInteriorDesign.aspx#Environmental>).

**Local Windstorm (orographic storm):** Refers to strong winds caused by regional atmospheric phenomena which are typical for a certain area. These can be katabatic winds, foehn winds, Mistral, Bora etc (Guha, 2011).

**Long-term Community Safe Shelter:** A place to provide protection for a large number of people who can live for a long time approx 1 to 3 months instead of several hours. These safe shelters are typically located in public such as hospital, school, and church (FEMA 2008).



**Meteorological disasters:** Events caused by short-lived/small to meso scale atmospheric processes (Guha, 2011).

**Safe Shelter:** A safe room that provides near-absolute protection for groups of individuals sent to a building or structure expecting it to be capable of providing them life-safety protection from wind, windborne debris, and flooding (FEMA 2008).

**Sustainability:** Means the use of resources in such a way that they are not depleted; a method of practice or use of materials that is capable of being continued with minimal long-term effect on the environment (<http://www.ncidq.org/AboutUs/AboutInteriorDesign/DefinitionofInteriorDesign.aspx#Environmental>).

**Tropical Cyclone:** Is a non-frontal storm system that is characterized by a low pressure centre, spiral rain bands and strong winds.

Usually it originates over tropical or sub-tropical waters and rotates clockwise in the southern hemisphere and counter-clockwise in the northern hemisphere.

The system is fuelled by heat released when moist air rises and the water vapor it contains condenses ("warm core" storm system). Therefore the water temperature must be  $>27^{\circ}\text{C}$ . Depending on their location and strength, tropical cyclones are referred to as hurricane (western Atlantic/eastern Pacific), typhoon (western Pacific), cyclone (southern Pacific/Indian Ocean), tropical storm, and tropical depression (defined by wind speed; see Saffir-Simpson-Scale) (Guha, 2010).

**Tornado:** A violently rotating column of air, pendant from a cumuliform cloud or underneath a cumuliform cloud, and often (but not always) visible as a funnel cloud.

Tornadoes typically occur in the spring and summer months, but can occur at

any time in any part of the country (Guha, 2010).

**Types of disasters:** Natural disaster, man-made disaster and hybrid disaster (Ibrahim, 2007).

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## Introduction to Research

### **Purpose**

As natural disasters increases and worsen every year, they endanger more and more people's lives. In 2007, 414 disasters resulting from natural hazards were reported. They killed 16,847 people, affected more than 211 million others (Scheuren, 2007). Furthermore, we have witnessed a strengthening of the upward trend of natural disasters in recent years, with an average annual growth rate of 8.4% in the 2000 to 2007 period (Scheuren, 2007). The purpose of this research is to follow the rules, "In good times provision should be made for bad times." The ultimate goal of this research is to transform a short- term safe shelter into a long- term space housing people who have lost their home.

Furthermore, the temporary safe shelter can be transformed into long-term living space in a short time. This is achieved by finding examples of practical folding furniture and to create a conceptual design idea which can be used for long-term living in temporary safe shelter.

### **What is Disaster?**

The Center for Research on the Epidemiology of Disasters (CRED) defines a disaster as "a situation or event which overwhelms local capacity, necessitating a request to a national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering". Table 1 below shows the classifications of natural disaster (Guha, 2011).

**Table 1- Natural Disaster Classification**

NATURAL DISASTERS				
Biological	Geophysical	Hydrological	Meteorological	Climatologically
Epidemic	Earthquake	Flood	Storm	Extreme Temperature
Viral Infectious Disease	Volcano	General Flood	Tropical Cyclone	Heat / Cold Wave
Bacterial Infectious Disease	Mass Movement (Dry)	Flash Flood	Extra-Tropical Cyclone	Extreme Winter Condition
Parasitic Infectious Disease	Rockfall	Storm Surge / Coastal Flood	Local Storm	Drought
Fungal Infectious Disease	Landslide	Mass Movement (Wet)		Wildfire
Prion Infectious Disease	Avalanche	Rockfall		Forest Fire
Insect Infestation	Subsidence	Landslide		Land Fire
Animal Stampede		Avalanche		
		Subsidence		

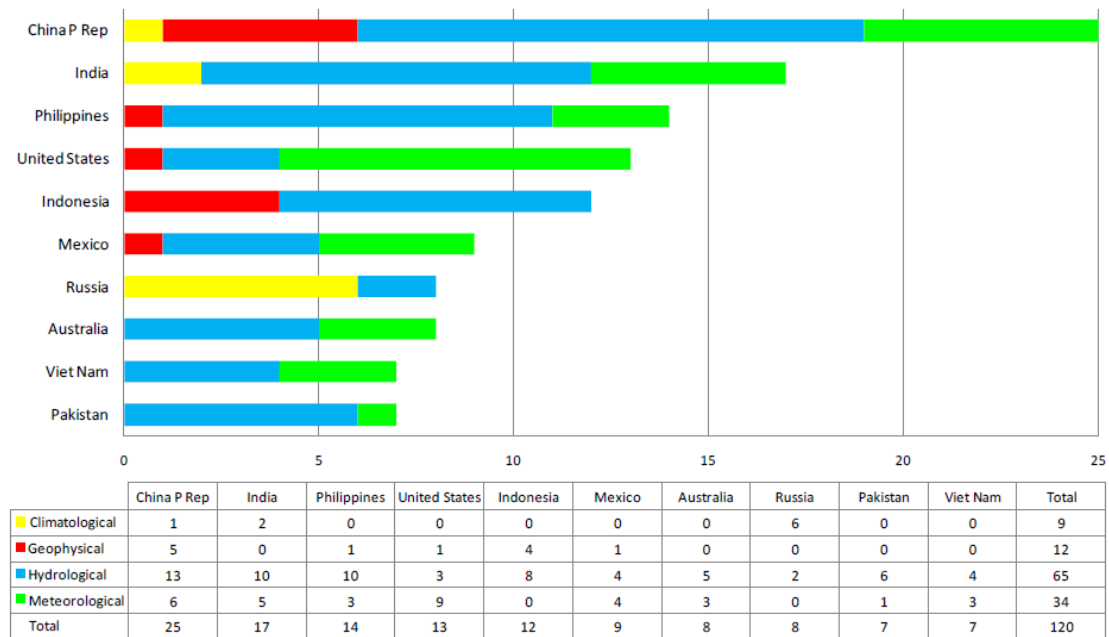
**Damage in Disaster**

According to Annual Disaster Statistical Review (2010), “After the relatively moderate year of 2009, the extent of the impact of natural disasters took a turn for the worse in 2010. A total of 385 natural disasters killed more than 297,000 people worldwide and affected over 217 million others.” ADSR(2010) also mentions that the 385 natural disasters



caused US\$ 123.9 billion of damages. A total of 131 countries were hit by these natural disasters, though only 10 countries accounted for 120 of the 385 disasters (31.2%).

**Figure 1- Countries by Number of Reported Events in 2010 (ADSR, 2010)**



Damien (2011) mentioned in his article Vulnerability and Livelihoods before and after the Haiti Earthquake:

Few months after the disaster in Haiti 2010, the human toll was extremely severe: 2.8 million people were affected by the earthquake, causing 222,570 deaths, and 300,572 injuries. Over 97,000 houses were destroyed and over 188,000 were damaged. 661,000 people moved to non-affected regions

According to the statistics in Annual Disaster Statistical Review (2010), Haiti had over 39.1% of its population – or a total of 3.9 million victims – affected by the January 12th earthquake. Besides Haiti, many deaths were reported in Russia, which was affected by extreme temperatures, floods and wildfires, causing over 55, 800 deaths. Most deaths were due to the heat wave that occurred from June to August. These two mega-disasters made 2010 the deadliest year in at least two decades.

Annual Disaster Statistical Review (2010) also provides a statistic to show how

disaster affected all over the world:

In China, a total of 7,186 deaths and 145.7 million victims from natural disasters were reported. Most victims were caused by floods and associated landslides from May to August. This country alone represents 2.4% of global reported deaths and 67% of worldwide reported victims. Pakistan also suffered greatly from the impact of natural disasters, since it was struck by floods and flash floods in July and August that caused 20.4 million victims (9.4% of global reported victims). Thailand was affected by floods (North, Center, East and South) causing 9.0 million victims, as well as droughts (North, Northeast and Center) causing 6.5 million victims, together affecting 22.8% of Thailand's population. Droughts in Somalia affected 2.4 million people, 26.5% of its population. As table 2 shows, there are total 190.3 million victims in 2010 from the top 10 most important disasters. It measures how many people affected require immediate assistance during a period of emergency (e.g. requiring basic survival assistance such as food, water, shelter, sanitation and immediate medical help).

**Table 2- Top 10 Most Important Disasters by Number of Victims**

Events	Country	Victims (in millions)
Flood, May-August	China P Rep	134.0
Flash Flood, July-August	Pakistan	20.4
Flood, October-December	Thailand, Cambodia*	9.0
Drought, March-August	Thailand	6.5
Flood, June-August	China P Rep	6.0
Earthquake, January	Haiti	3.9
Flood, September	India	3.3
Earthquake, February	Chile	2.7
Drought, February-December	Somalia	2.4
Flood, April-December	Colombia	2.2
<b>Total</b>		<b>190.3</b>

\*Thailand (8 970 911 victims), Cambodia (8 victims)

International Rescue Committee (2010) reported:

The earthquake destroyed 190,000 homes and displaced some 1.3 million people in

Haiti. The international community provided tents, tarpaulins, and other emergency shelter to many of the most affected people. However, these materials were not intended to last for more than several months and in most cases have not been replaced. The progress from temporary to transitional shelter has been very slow. Humanitarian agencies working in Haiti planned to construct 124,889 transitional shelters. However, as of November 9, 2010 only 19,197 have been built. People still live in fragile tent settlements that are not built to withstand harsh weather, hurricanes and mudslides (IRC, 2010).

This report shows how important the long-term safe shelter is. However, most of the safe shelters are temporary, not designed for long-term use. That is why it is necessary to redesign an existing safe shelter into a long-term community safe shelter for a group of people who live in high-risk areas such as Haiti, New Orleans and Japan.

## Literature Review

The purpose of this literature review provides a foundation of research for this study by researching various attributes of safe shelters including definition, location, types, location qualification, and maximum population density. This research provide people with the knowledge to know better about what is the safe shelter, where is the best location to choose for safe shelter, and what kind of things need to be prepared for disaster.

### **What is Safe Shelter?**

A safe shelter is necessary to protect people from disaster that provides near-absolute protection for groups of individuals sent to a building or structure expecting it to be capable of providing them life-safety protection from wind, windborne debris, and flooding. A community safe room is defined as a shelter that is designed and constructed to protect a large number of people from a natural hazard event (FEMA 361, 2008).

Having a safe room built for your home or small business can help provide “near-absolute protection” for you and your family or employees from injury or death caused by the dangerous forces of extreme winds. Near absolute protection means that, based on our current knowledge of tornadoes and hurricanes, the occupants of a safe room built according to this guidance will have a very high probability of being protected from injury or death (FEMA 361, 2008).

There are two types of community safe rooms described by the guidance in FEMA 361 publication which include:

1. Stand-alone safe room – a separate building (i.e., not within or attached to any other building) that is designed and constructed or retrofitted to withstand extreme winds and the impact of windborne debris (missiles) during tornadoes, hurricanes, or other extreme wind events.
2. Internal safe room – a specially designed and constructed room or area within or attached to a larger building; the safe room (room or area) that may be designed and constructed or retrofitted to be structurally independent of the larger building,

but provides the same wind and missile protection as a stand-alone safe room.

These safe rooms are intended to provide protection during a short-term extreme-wind event (i.e., an event that normally lasts no more than 24 hours) such as a tornado or hurricane. (Minimum safe room occupancy times are 2 and 24 hours for tornadoes and hurricanes, respectively.) They are not recovery shelters intended to provide services and housing for people whose homes have been damaged or destroyed by fires, disasters, or catastrophes (FEMA 361, 2008). As FEMA stated, most of the existing community safe shelters are not designed for long-term use. This is a concern to the people who have lost their homes; therefore, it is necessary to redesign the existing temporary safe shelter to be used as a long-term community safe shelter.

### **Location of Safe Shelters**

The location of a safe room on a building site is an important part of the design process for any safe room. The safe room should be located such that all persons designated to take refuge may reach the safe room with minimal travel time; this is of particular importance for tornado safe rooms. Safe rooms located at one end of a building or one end of a community, office complex, or school may be difficult for some users at a site to reach in a timely fashion. Routes to the safe room should be easily accessible and well marked (FEMA 320, 2008).

Safe rooms should be located outside areas known to be flood-prone, including areas within the 500-year floodplain and susceptible to storm surge, inundation. Safe rooms in flood-prone areas will be susceptible to damage from hydrostatic and hydrodynamic forces associated with rising floodwaters. Damage may also be caused by debris floating in the water. Furthermore, safe rooms located in Special Flood Hazard Areas (SFHAs), with flood depths of 3 feet and higher or within the 500-year floodplain may become isolated if access routes are flooded. As a result, emergency services would not be available if some safe room occupants are injured (FEMA 361, 2008).

When possible, the safe room should be located away from large objects and multi-story buildings. Multi-story buildings adjacent to a safe room could be damaged or could fail structurally during tornadoes and hurricanes which may damage the safe room by collapsing onto it or exposing it to large debris impact. Light towers, antennas, satellite dishes, and roof-mounted mechanical equipment could topple or become airborne during tornadoes or hurricanes. The impact forces associated with these objects are well outside the design parameters of any building code. Only limited debris impact testing was performed in the preparation of the FEMA publication (FEMA 361, 2008).

Examples of improper and proper locations of tornado or hurricane safe rooms on residential sites are presented in Figures 2 which is an example of a community that has several residential and community safe rooms. The figure shows which safe rooms are properly sited with respect to the mapped flood hazards (FEMA 361, 2008).

### **High Risk Wind Zone**

On the basis of 60 years of tornado history and more than 150 years of hurricane history, the United States has been divided into four zones that geographically reflect the number and strength of extreme windstorms. Figure 3 shows these four zones. Zone IV has experienced the most and the strongest tornado activity. Zone III has experienced significant tornado activity and includes coastal areas that are susceptible to hurricanes (FEMA 320, 2008).

Figure 2- Illustration of Properly and Improperly Sited Community and Residential Safe Rooms in a Coastal Environment

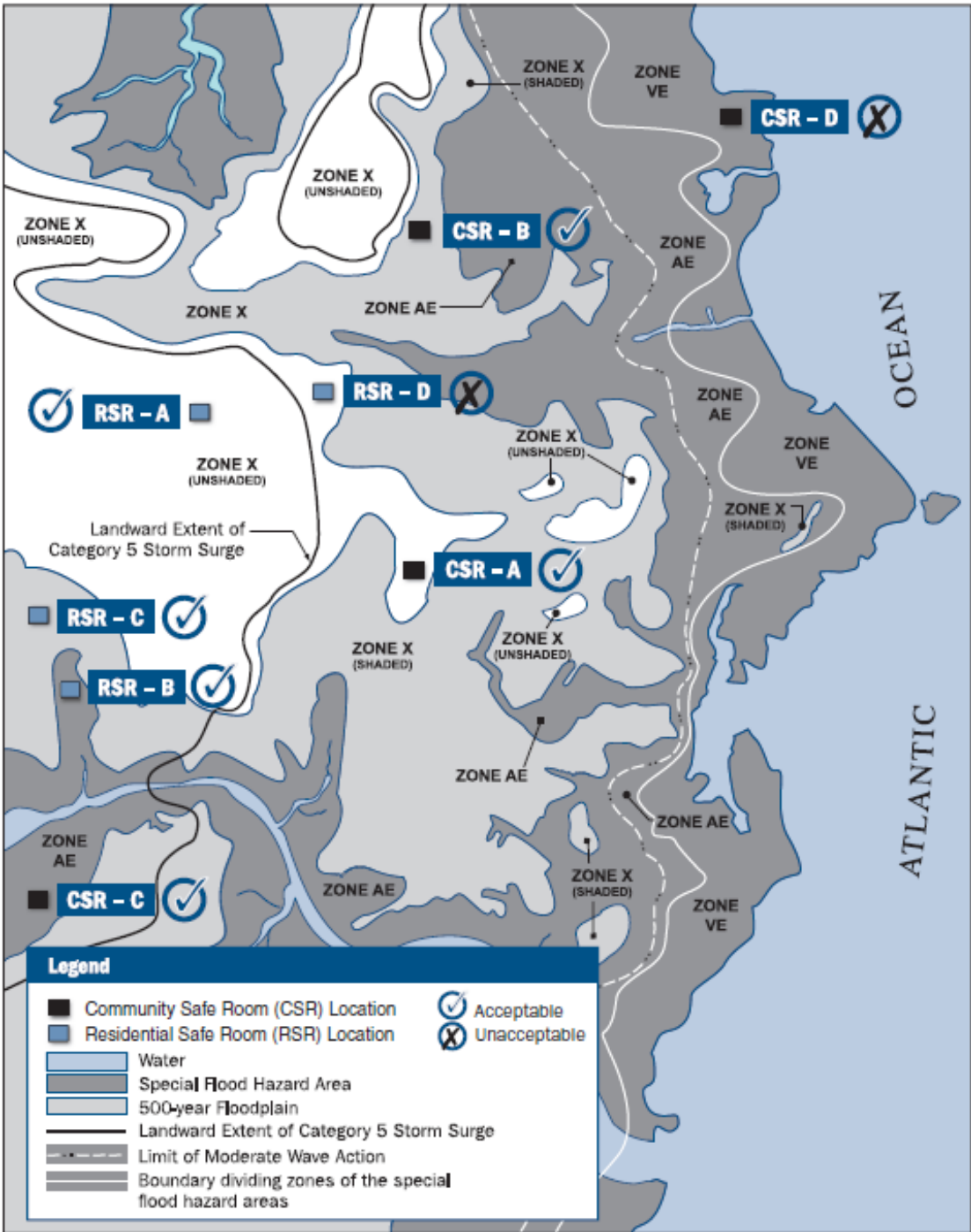


Figure 3- Wind Zones in the United States



Since the purpose of a safe room is to provide a space where occupants can survive a tornado or hurricane with little or no injury, for tornado-prone areas, people should locate the shelter so that everyone can reach it as quickly as possible from all parts of the home or business. In hurricane-prone areas, the safe room should not be built where it can be flooded during a hurricane. It is very important that the safe shelter should be away from clutter (FEMA 320, 2008).

### Types of Shelter

#### Single-used safe shelter

A stand-alone (internal or external) safe room may be used for sheltering only, or it may have multiple uses. For example, a multi-use safe room at a school could also function as a classroom, a lunchroom, a laboratory, or an assembly room; a multi-use safe room intended to serve a manufactured housing community or single-family-home subdivision could also



function as a resident's center. The decision to design and construct a single-use or a multi-use safe room will likely be made by the prospective client or the owner of the safe room. To help the designer respond to non-engineering and non-architectural needs of property owners, this section of FEMA'S report discusses how safe room use may affect the type of safe room selected (FEMA 361, 2008).

### **Multi-use Safe Shelter**

The ability to use a safe room for more than one purpose often makes a multi-use stand-alone or internal safe room appealing to a shelter owner or operator. Multi-use safe rooms also allow immediate return on investment for owners/operators; for example, the safe room space can be used for daily business when the safe room is not being used during a tornado or hurricane. Hospitals, assisted living facilities, and special needs centers are examples of building uses that may benefit from constructing multi-use, internal safe rooms. For these facilities, constructing multi-use safe rooms in building areas such as intensive care units or surgical suites, from which the occupants cannot be evacuated rapidly, is an example of a multi-use application that provides immediate return on investment for the safe room space. But, in addition to these safe room spaces, the hospitals may also need additional community safe rooms for staff, patients, and visitors who may not be allowed into these specially controlled facilities. Internal multi-use safe rooms in these types of facilities allow optimization of space while providing near-absolute protection with easy access for non-ambulatory persons (FEMA 361, 2008).

It is important to note that multi-use safe rooms frequently require permanent fixtures and furnishings that reduce the effective area for safe room usage. Auditoriums, laboratories, and libraries have such fixtures or furniture that reduces the available safe room area the maximum safe room population that can be protected in that space.

Recent FEMA-sponsored projects have evaluated the construction cost of hardening a small area or room during the design and construction of a new building. The FEMA projects indicate that, although the cost to construct this portion of a building may be 25 to 50

percent higher than the construction cost for a non-hardened version of the same area or room, the entire impact to the total project cost is often less than five to ten percent of the entire building construction project. The Mitigation Assessment Team (MAT) investigations of the May 3, 1999, tornadoes, as well as investigations conducted after numerous hurricanes in the 1990s, found many examples of multi-use areas designed or retrofitted for use as safe rooms. They include multi-use safe rooms constructed as:

- Cafeterias, classrooms, hallways, music rooms, and laboratories in school buildings
- Cafeterias/lunchrooms, hallways, and bathrooms in public and private buildings
- Lunchrooms, hallways, and surgical suites in hospitals (FEMA 361, 2008).

### **Identifying Qualified Safe Shelters**

Since not every buildings and structures can be used as a safe shelter during natural disasters, evaluating the building stock is necessary to make sure it won't damage in disasters. According to FEMA 361, there are specific documents to identify what kinds of structures are qualified or cannot be used as a safe shelter.

### **Vulnerability of Buildings**

An inventory of vulnerable buildings based on architectural/engineering (A/E) review of building-specific factors such as structural integrity, age, condition, building materials, design, quality of construction, etc., should be conducted. It is recommended that a building vulnerability assessment be performed in two stages. The first stage should comprise a general survey of the building stock in the community to identify the buildings that could potentially pose the greatest risk of serious damage or collapse in an extreme wind event. It is recommended that the second stage should identify all high-occupancy buildings that are prone to wind damage and rank them according to the level of potentially harmful wind effects. This stage is an especially important component of the risk analysis that will assist communities in prioritizing their safe room needs. It is also recommended that the second stage of the vulnerability assessment identify the interior areas of high-occupancy buildings

that may serve as the safest refuge areas during an extreme-wind event. These areas should not be confused with safe rooms or other types of wind shelters because they would not be able to offer the near-absolute level of life-safety protection. The occupants of buildings, however, should be aware of the best places in the building in which to seek refuge in an emergency (FEMA 361, 2008).

The above-mentioned first stage of the vulnerability assessment of the community's building inventory serves another important purpose. By identifying the areas of high concentrations of vulnerable structures and occupancies based on area-specific factors such as the presence of manufactured housing parks, old residential neighborhoods, blighted areas, topography, and others, local communities can easily map and plan their safe room needs. This can be an invaluable tool in selecting the most appropriate and most effective sites for new and retrofitted safe rooms (FEMA 361, 2008).

### **Safe Shelter Maximum Population Density**

FEMA 361 (2008) provides, the minimum recommended safe room floor area per occupant is provided in Table 3.1 and Table 3.2. The amount of number needed for standing, seated (wheelchair-bound), or bedridden spaces should be determined based upon the needs of the safe room calculated by the designer and the applicable authority having jurisdiction. However, each community safe room should be sized to accommodate a minimum of one wheelchair space for every 200 occupants. It is also important to note that floor areas within community safe rooms should provide an access route in accordance with International Code Council (ICC)/American National Standards Institute (ANSI).

**Table 3.1- Occupant Density for Tornado Community Safe Rooms**

Tornado Safe Room Occupant Minimum	Minimum Recommended Usable Floor Area in Square Feet per Safe Room Occupant
Standing or Seated	5
Wheelchair-bound	10
Bedridden	30

**Table 3.2- Occupant Density for Hurricane Community Safe Rooms**

Hurricane Safe Room Occupant Minimum	Minimum Recommended Usable Floor Area in Square Feet per Safe Room Occupant
Standing or Seated	20
Wheelchair-bound	20
Bedridden	40

**Usable Floor Area Calculation**

The usable safe room floor area should be determined by subtracting the floor area of excluded spaces, partitions and walls, columns, fixed or movable objects, furniture, equipment, or other features that, under probable conditions, cannot be removed, or stored, during use as a safe room from the gross floor area (FEMA 361, 2008).

An alternative method for determining the usable safe room floor area is to use the following percentages:

1. Reducing the gross floor area of safe rooms with concentrated furnishings or fixed seating by a minimum of 50 percent.
2. Reducing the gross floor area of safe rooms with un-concentrated furnishings and without fixed seating by a minimum of 35 percent.
3. Reducing the gross floor area of safe rooms with open plan furnishings and without fixed seating by a minimum of 15 percent.

**Ventilation, Sanitation, Power, and Other Non-structural Design Criteria**

Ventilation, sanitation, and other recommendations for hurricane community safe rooms should be incorporated into the design of the safe room. In addition, the safe room should be equipped with an electrical system with an emergency power system for lighting and other needs. Emergency lighting recommendations may be met through means other than generators (i.e., flashlights may be used to meet this recommendation). Additional information is also provided in Chapters 4 and 8 of FEMA 361.

**Emergency Supply Kit:**

An amount of the emergency supply kits are necessary not only when disaster comes but also after disaster. FEMA 320 has provided a list of the emergency supplies should be prepared for safe shelters.

- An adequate supply of water for each person in your home or small business  
(1 gallon per person per day)
- Non-perishable foods that do not have to be prepared or cooked (if these include canned goods, remember to bring a manual can opener)
- Disposable eating utensils, plates, cups, paper towels, etc.
- A first-aid kit, including necessary prescription medicines, bandages, and antibiotic ointment
- Tools and supplies:
  - Flashlight (one per person; do not bring candles or anything that lights with a flame)
  - Battery-operated radio or television and NOAA1 weather radio
  - Cellular phone or Citizen's Band (CB) radio
  - Extra batteries for the above tools
  - Wrench (to turn off gas and water)
  - Insect repellent and sunscreen
- Personal hygiene items such as hand wipes and toilet paper
  - Extra change of clothing per person (store in plastic trash bags to keep clean and dry)
  - Appropriate outer wear (e.g., sunglasses, ponchos, jackets, gloves, headwear, boots,

etc.)

Bedding materials such as pillows and blankets or sleeping bags

■ Special items for:

Babies – formula, diapers, bottles, powdered milk

Children – entertainment items such as books, games, or toys

Adults – contact lenses and supplies, extra glasses, and a sufficient supply of prescription medications

Pets – appropriate supplies such as water (1/2 gallon per day), food, leash, ID tag, carrying container, etc.

■ Additional items:

Important documents such as insurance documents, a list of all your important contacts (e.g., family, doctors, insurance agents), banking information, leases/ mortgage, proof of occupancy (such as a utility bill), and a waterproof container in which to keep these documents.

ABC2 rated fire extinguisher

Roofing tarps or plastic sheeting

Roll of large heavy-duty trash bags and duct tape

Money (cash)

**Americans with Disabilities Act (ADA)**

The needs of persons with disabilities requiring safe room space should be considered. The appropriate access for persons with disabilities should be provided in accordance with all federal, state, and local ADA requirements and ordinances. If the minimum requirements dictate only one ADA-compliant access point for the safe room, the design professional should consider providing a second ADA-compliant access point for use in the event that the primary access point is blocked or inoperable. Additional guidance for compliance with the ADA can be found in many privately produced publications (FEMA 361, 2008).

Developing a sound operations plan is extremely important if compliance with ADA

at the safe room site requires the use of lifts, elevators, ramps, or other considerations for safe rooms that are not directly accessible to non-ambulatory persons.

See appendix A for “ADA Checklist for Emergency Shelters”.

## **Interior Design**

This section mentions eight elements of interior design and how these elements affect psychology to help design the safe shelter.

National Council for Interior Design Qualification (NCIDQ) provided a definition of interior design: Interior design is a multi-faceted profession in which Creative and technical solutions are applied within a structure to achieve a built interior environment. These solutions are functional, enhance the quality of life and culture of the occupants and are aesthetically attractive.

What is interior design about? As the book *Interiors* mentions: Interior design has a vocabulary of materials, styles, forms, details, light, colors, patterns, textures, lines, and mass. The grammar can be compared to design principles of balance, rhythm, emphasis, scale, proportion, unity, variety, and harmony.

## **The Elements of Design**

As *Interiors* (2010) states that there are 9 elements of interior design: space, shape or form, mass, line, texture pattern, light, and color are used by every designer in every discipline. These elements were not invented but discovered and skillfully incorporated and balanced by artisans and designers over the course of history.

## **Space**

Space exists as a diffuse, endless entity until it is defined. The definition of space occurs with building construction, resulting in exterior and interior spatial allotments. Space-restriction devices within the building- walls, floors, ceilings, and furnishings- create a series of spaces with individual dimensions and qualities. These qualities can be discovered

only as a person moves through spaces and perceives them one at a time: one space flowing into another or one abruptly ending and another beginning. When the space/time movement is complete, the perceptions are mentally assembled to give a true picture and judgment of the space (P.62).

### **Shape or Form**

Often an interior is successful because the forms that fill it are pleasing shapes and well proportioned one to another. There are several kinds of shapes: two-dimensional outline shapes or planes- such as rectangles, squares, triangles, circles and other geometric shapes- or meandering, curved, or angular shapes that do not fit neatly into geometry. When these 2-D planes are given a third dimension (3-D), they become forms such as cubes, cones, and spheres or forms that are sinuous or curving.

For example, a rectangular table can be an appreciated form and shape that is simple and pleasing, yet if the entire room were filled with similar shapes and forms, the room would become boring and repetitious (P.63).

### **Mass**

Mass is the solidity, matter, or density that is defined by shape or form. In furniture, mass is actual density when the material is filled in, such as a solid block of wood. Mass can also be optical density where the material may not be solid. Heavier or more solid mass will make furniture pieces look larger than furniture with the same overall solid areas. Examples of furniture with solid or heavy mass include sofas, chairs, and ottomans with skirts to the floor and with oversized cushions; end tables and nightstands supported with bracket feet or no feet or with doors or solid legs or pedestals; and bookcases filled with books. Heavy mass is desirable where the room is large and furnishings need to visually take up as much space as possible or where furniture needs to appear dignified or commanding (P.64).

### **Line**

Line is the connection of two or more points. The eye also perceives line when two planes meet and when shape is seen in silhouette as an outline. Line may be straight angular,



and curved. Lines are used by interior designers to create effects such as increase height, width, or the impression of movement. The psychology of line is important to creating ambience or a particular mood in interior design. The types of line are listed in Table 4, along with the psychological effect of each (P.65).

**Table 4- Psychological Effects of Line**

Straight Lines	Horizontal Lines: Weighty, Secure, Restful, Repose
	Vertical Lines: Imposing, Lofty, Solid, Formal, Restrained
Angular Lines	Diagonal lines: Action, Movement, Interest, Angular Stability
	Zigzag Lines: Exciting, Lively, Rhythmic Movement
Curved Lines	Curved/ Circular Lines: Soft, Humanizing, Repetitive Tempo, Gracefulness
	Flowing Lines: Gentle Movement, Growth, Linear Development
	Tightly Curved/ Busy Lines: Playful Activity, Zest, Lively Visual Stimulation

### **Texture**

Texture is the surface characteristics and appearance inherent in every element and component of interior design. As the relative smoothness or roughness of a surface, texture is determined in two ways: by touching the physical texture and by visually reading the surface, which may appear quite different to the eye than it actually is to the touch. A balance or a variety of texture is necessary within the unified theme or ambience in order to achieve harmony (P.66).

### **Pattern**

Pattern is the arrangement of forms or designs to create an orderly whole. Pattern often consists of a number of motifs, or single-design units, arranged into a larger design composition.

Angled and straight patterns are difficult to combine unless there is enough of each to

have unity in the space. Curvilinear patterns combine more successfully with straight or angled patterns. In small spaces, too many pattern directions are confusing (P.67).

### **Light**

Light in interior design has two sources: natural light and artificial light. Light as an element of design affects all other elements. Light can make space appear large or small, friendly or cold. Areas well lit with clear, bright light will make spaces appear larger, whereas dim light and shadows cast upon walls will seem to close in space (P.68).

### **Color**

Color, the last element of design, is the most emotional and personal of all the elements. The psychology of color is a valuable tool that the interior designer can use to fulfill the needs of the users. In homes as well as public buildings, a knowledge of how people typically view and understand colors can help the designer create effective and efficient interiors. Color psychology is both physiological and cultural. Some common associations or color symbolisms in western societies are listed in Table 5. This is a general idea of which colors are better to be used in the long- term safe shelter design.

**Table 5- Common Color Associations**

<p><b>Red</b></p> <p>Pure, intense: Danger, passion, love, excitement, stimulus, conspicuousness.</p> <p>Dark, neutralized: Wealth, power, sometimes evil.</p> <p>Pure chroma pink: cheerfulness, youth, festivity.</p> <p>Light or pastel pink: femininity, innocence, relaxation, delicacy.</p>
<p><b>Orange</b></p> <p>Pure intense: friendliness, warmth, celebration, clarity.</p> <p>Dark, neutralized: wealth, success, fame, rich depth.</p> <p>Light or pastel: stimulation (to the appetites), security, relaxed euphoria (sense of well-being).</p>
<p><b>Yellow</b></p> <p>Pure, bright: cheerful optimism, sunshine, springtime, renewal, intensity, demanding, revealing, warmth (too much is hot), intellect, stimulation.</p> <p>Dark, neutralized golden yellow: wealth, affluence, status, distinction, high esteem. Too much is brash, garish, or ostentatious.</p> <p>Middle to light value: intelligence, wisdom, compassion, freshness, cheerfulness, optimism, goodness, clarity, cleanliness.</p>
<p><b>Green</b></p> <p>Pure, bright: nature, calmness, friendliness, integrity, practicality, frankness.</p> <p>Dark, neutralized: solidity, wealth, anchored tenacity, security.</p> <p>Blue-green: sea and sky, cleanliness, nostalgia, calmness.</p> <p>Yellow- green: youthfulness, freshness, happiness.</p>
<p><b>Blue</b></p> <p>Pure, intense: loyalty, honesty, integrity, royalty, stimulation, restlessness. These also apply to deep or neutralized blues.</p> <p>Deep, neutralized: sincerity, conservatism, safety, peacefulness, kindness, compassion. These also apply to pure or intense blues.</p> <p>Light or pastel: tentativeness, cleanliness, calm, expanded time and space, lack of security.</p>
<p><b>Purple or violet</b></p> <p>Pure, intense: optimism, imagination, royalty, dignity, poise, renewal, commitment, drama.</p> <p>Dark, neutralized: depth, richness, security, sternness, soberness, sobriety, dullness.</p> <p>Light or pastel: freshness, springtime, flowers, imaginativeness, femininity, kindness, sensitivity.</p>

Color-group moods can also be determined through research. Philip Thiel, in his book *Visual Awareness and Design* (1980), reports his finding that groups of colors produce specific emotional responses:

- Light-value and bright color groups produce feelings of spontaneity and happiness.
- Light and dull or neutralized colors produce feelings of calm and relaxation.
- Dark and dull or neutralized colors are serious and profound.
- Dark values and bright chroma (jewel tones) suggest richness and strength.

The psychology of color can be seen in the effects produced by warm and cool colors.

Warm colors visually and psychologically warm the temperature of an interior. They are inviting, homey, optimistic, encouraging, and stimulating to the appetite, and they facilitate the blending of objects, patterns, and textures. Warm colors also tend to reduce space and create more intimate interiors. Keep in mind that these are generalities. Depending on the value and the intensity of the chroma, colors can be very warm (high chroma, which intensifies these attributes), warm, or only slightly warm (middle to low chroma, which deemphasizes the qualities listed).

Cool colors generally calm and relax the mind and body, giving the impression of lack of pressure and plenty of time to wait or to accomplish tasks. Cool colors often suggest more formality and precision of detail, pattern, and color. They visually expand space, and thus are erective tools in small, cramped quarters. Cool colors subdue the appetite and emotions. Very cool colors are intense, cool colors are middle chroma, and slightly cool colors are low in chroma (neutralized).

## Methodology

The purpose of this research follows the rule “In good times provision should be made for bad times”. The ultimate goal of this research is to transform a short- term shelter into a long- term livable for people to stay if affected by a natural disaster. This is done by providing and discussing examples of practical folding furniture and to create a conceptual design idea of folding furniture, which can be used for long-term living in temporary safe shelter. The benefit of the folding furniture is the space saving feature, and it is movable and easy to transport. The pictures, which are included into this report, illustrate the inspiration for the overall design of the created pieces furniture that allow for the transformation of the shelter from a temporary space to a long-term shelter. In addition some of the pieces featured in the pictures are included as part of the design that transforms the shelter into a long-term shelter.

### **Need of Furniture**

As seen in these pictures below, there are multitude of people, who are homeless, living in a temporary safe shelter with no furniture and privacy. Therefore, it is necessary to create a system that can be used to make them happier and more comfortable. Warm colors will be the main color theme because of the inviting, homey, optimistic, and encouraging feature. Pure, bright green will remind them about nature, as well as yellow-green will make them happy and light or pastel orange is cheerful and relaxing they provide. Massive use of white, black, blue, and violet will not be used in this space because they are the colors that make people calm but sad.

**Figure 4- Survivors in Miyako Shogako School sports hall in Japan**



The picture above shows survivors, of the March 11, 2011 earthquake and tsunami that devastated the eastern coast of Japan, in the Miyako Shogako School sports hall, which was used as a shelter for evacuees, in Miyako town (Lane, 2011).

**Figure 5- People Huddling Close to the Heater at a Shelter at Yamada Town in Japan**



The picture above shows people huddling close to the heater at a shelter at Yamada town in Iwate County on March 16, 2011 (Lane, 2011).

**Figure 6- Survivors in a Cold Refugee Center in Japan**



The picture above shows Yukie Ito (left), trying to comfort her daughter Hana, 8, with grandmother Tamiyo at a cold refugee center for the homeless March 16, 2011 in Kesenuma, Miyagi province (Lane, 2011).

### **Folding Furniture (Kitchen, Bedroom, and Office)**

This series of folding furniture called Kenchikukagu are designed by Toshihiko Suzuki and produced by Horiguchi glass and comma. Kenchikukagu furniture complements interiors by functioning as both architecture and furniture. To create an office, simply open it, and then when finished, fold it back up. The dual-function of Kenchikukagu meshes with the Skelton-infill construction concept, in which the structure of a building is separate from the interior and room layout (Sugihara, 2010).

The form of the Kenchikukagu box is a clever idea to hide bed, desk, or storage inside which is easy to move when folding as a box. The principles for this series are incorporated into the design of the piece integrated into this report. The specific information will be discussed later in this report.



**Figure 7- Kenchikukagu Folding Furniture 1**



**Figure 8- Kenchikukagu Folding Furniture 2**



**Figure 9- Kenchikukagu Folding Furniture 3**





### **Folding Furniture (Dining Table and Chair)**

The Pick Chair is designed by Dror Benshetrit and can be hung and folded by the design of the polished aluminum structure and open-pore dyed wood panels. The chair can be hung on the wall as aesthetic art piece or be folded into a functioning chair. The included tree motifs created with laser graphic engraving make life happy and fun. The reason this piece was chosen for the safe shelter is because it does not need space to store, but it also has the beautiful graphic element and fun formation to evoke positive emotions.

**Figure 10- Pick Chair Designed by Dror Benshetrit**



The Folding Stool, which is made from cardboard, is designed by Sorja Vrbovszky Product Design (SVPD) Company. Designed as a temporary seat for indoor parties, the stool can be unfolded to standard stool measurements in less than one second. When not in use, it can be fold and stored. The folded thickness is three cm, allowing for a space saving design with just 450 grammes. It was selected to be used in the shelter because the stool is truly flyweight furniture and is very easy to transport.

**Figure 11- Folding Stool Designed by Sorja Vrbovszky**



Goliath is a console and dining table designed by Resource Furniture. The Goliath Table effortlessly extends from 17 inches to an unbelievable 115 inches allowing for a full-time console and part-time dinner table. The table includes sleek frame with angled legs, aluminum telescoping mechanism and five extensions. When not used as a dining room table, it can be put in the corner of the room. Easy transformation is the advantage of the table to be used in long-term safe shelter.

**Figure 12- Goliath Dining Table Designed by Resource Furniture**



F2 is designed by Nils Frederking. This distinct round table is both functional and requires minimal space to store. The top is comprised of three articulated panels available in walnut or gloss white lacquer, with a steel chrome frame. The use of this piece is imperative in a long- term shelter because this table is very easy to store and transport.

**Figure 13- F2 Folding Table designed by Nils Frederking 1**



**Figure 14- F2 Folding Table designed by Nils Frederking 2**



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### Space divider--Tapered Kraft Softwall

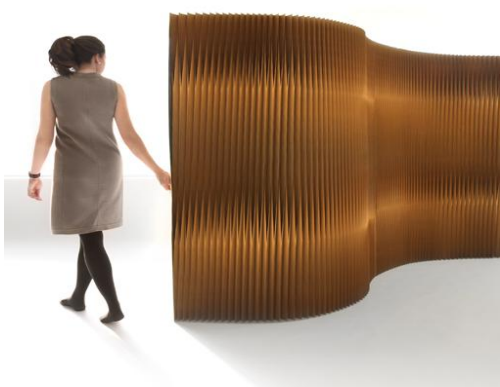
This product is designed by MOLO Design Studio, Canada. When opened, the profile exposes patterns from the internal honeycomb geometry giving the tapered softwalls a unique visual expression. The tapered softwall is lighter and uses less material than the already resource efficient modular softwall. Each softwall is flexible in length by opening to a maximum of 4.5 meters (15') long. Each unit can be joined to other tapered softwalls by the magnetic end panels to create various, continuous lengths. A stainless steel wall hook is provided for simple compact storage.

People living in the long-term safe shelter need privacy. The way to provide private space is by using partitions or other elements to section off spaces. The Tapered Kraft Softwall is the perfect way to be used in the safe shelter because it is light for moving while providing personal spaces. It also allows people to play with the softwall so that they will have fun while keeping privacy.

**Figure 15- Tapered Kraft Softwall Designed by MOLO Design Studio 1**



**Figure 16- Tapered Kraft Softwall Designed by MOLO Design Studio 2**



## Lounge Seating-- Softseating

This piece was chosen for the transformation of the shelter due to the flexible design of this product. The inspiration for “Softseating” comes from a desire for flexible and spontaneous space making furniture. Softseating’s magnetic ends allow it to connect to itself forming a cylindrical stool or low table. Elements of the same size can also connect to one another to form long winding benches, providing endless seating topographies. Made from a single material, the beauty of these pieces sits between the representative and the abstract while creatively interchanging with one another. Designed for long term use, the surface texture of softseating’s paper edges soften into a pleasing natural patina over time. This product is designed by MOLO Design Studio, Canada.

**Figure 17- Softseating Designed by MOLO Design Studio 1**



**Figure 18- Softseating Designed by MOLO Design Studio 2**





**Figure 19- Softseating Designed by MOLO Design Studio 3**



**Figure 20- Softseating Designed by MOLO Design Studio 4**



**Figure 21- Softseating Designed by MOLO Design Studio 5**



## Kids Furniture

The furniture selected for children should be cheerful and fun. The Playzzle is furniture and a playground-type toy for kids. It is designed by Katy Tromsdorf from Projekter Industrial Design, Duisburg. Pattern, color, and form allow the playzzle furniture to play an important role for kids to forget the pain from the disaster.

**Figure 22- Playzzle for Children Designed by Katy Tromsdorf 1**



**Figure 23- Playzzle for Children Designed by Katy Tromsdorf 2**





Livingstone, designed by Smarin, is high quality, surrealistic set practical as a floor cushion. This furniture line consists of oversized pebbles. Its main purpose is to create a resting area with varying sizes and shapes that can be arranged for various compositions while bringing the feeling of being outdoors inside. The pebbles are fanciful landscape for any living space. The act of rearranging can be transformed into an enjoyable domestic game, which makes people happy and relaxing.

**Figure 24- Livingstone Designed by Smarin 1**



**Figure 25- Livingstone Designed by Smarin 2**



## Bathroom System

The Vertebrae Bathroom stacks a toilet, sink, storage system, water cistern, and showerhead into one 8 ft. aluminum column. Since bathroom is one of the most important spaces for residents to use, toilet, sink, and shower will be in enormous demands. This product combines all needs in a column that save a lot of space. It is designed by Paul Heron. See Appendix B for Brochure of this product.

**Figure 26- Vertebrae Bathroom designed by Paul Heron**



As seen in the previous pictures, these are some furniture ideas to redesign an existing temporary safe shelter to be used as a long-term community living space because the flexible, multifunctional features designed into each piece.

## Design Process

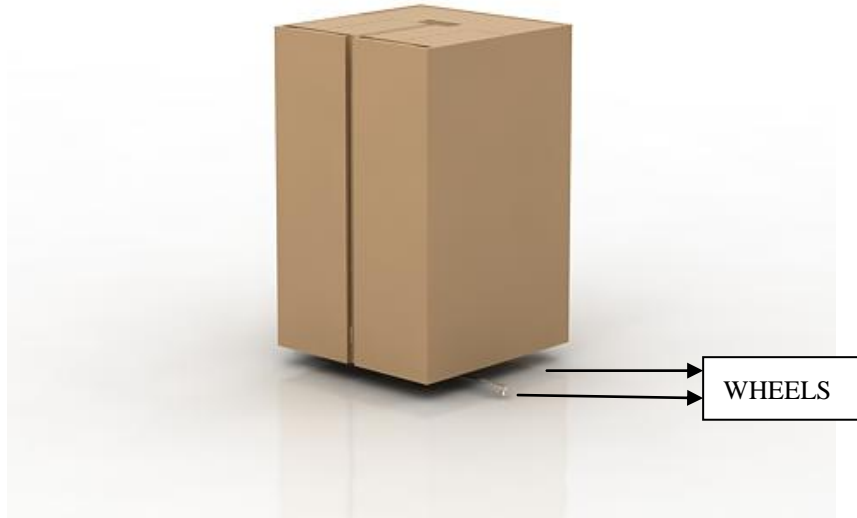
The book, *Design for Small Spaces* (2010), mentions that there are five structural, compact, flexible, multifunctional, and organizational ways to design space saving furniture or to make furniture more efficacious. By using the five methods, described in the book and the provided pictures as an inspirational foundation, the primary researcher of this report created a folding furniture, which can be unfolded into four beds and eight small separate closets that can be used for long-term purpose in safe shelter. Before designing the furniture, the first question that was asked was, “what is the piece of furniture that people spend most of time on it?” The answer is “Bed”. Because one of the most important parts of one’s life is sleeping, people can live without tables, chairs, and closets. That is the reason why bed is chosen as the design target.

The inspiration of the self-design folding bed-box is from Kenchikukagu furniture. The advantage of this furniture is that it is easy to store and transport, which is the goal of the design for the self-design furniture. The design philosophy for this piece is to maximum use of the space in the box, while accounting for easy transportation storage. This design began with four folding beds which can be hidden in the box. Then, privacy is provided by adding sliding walls, which is accomplished through the arrangement of necessary elements. Last, to perfect the design, personal storage is added. This is accomplished by adding closets. This self-design folding bed box is not only unique but also humanized allowing the privacy and storages. See appendix C for renderings of self-designed folding furniture.

The following pictures illustrate the steps with preparing the furniture for use.

The picture below shows the original box form of the self-design folding bed-box.

**Figure 27- Original Box Form of the Self-design Folding Bed-box**



**Figure 28- Step1: Open the Box**



**Figure 29- Step 2: Pull down the Beds**

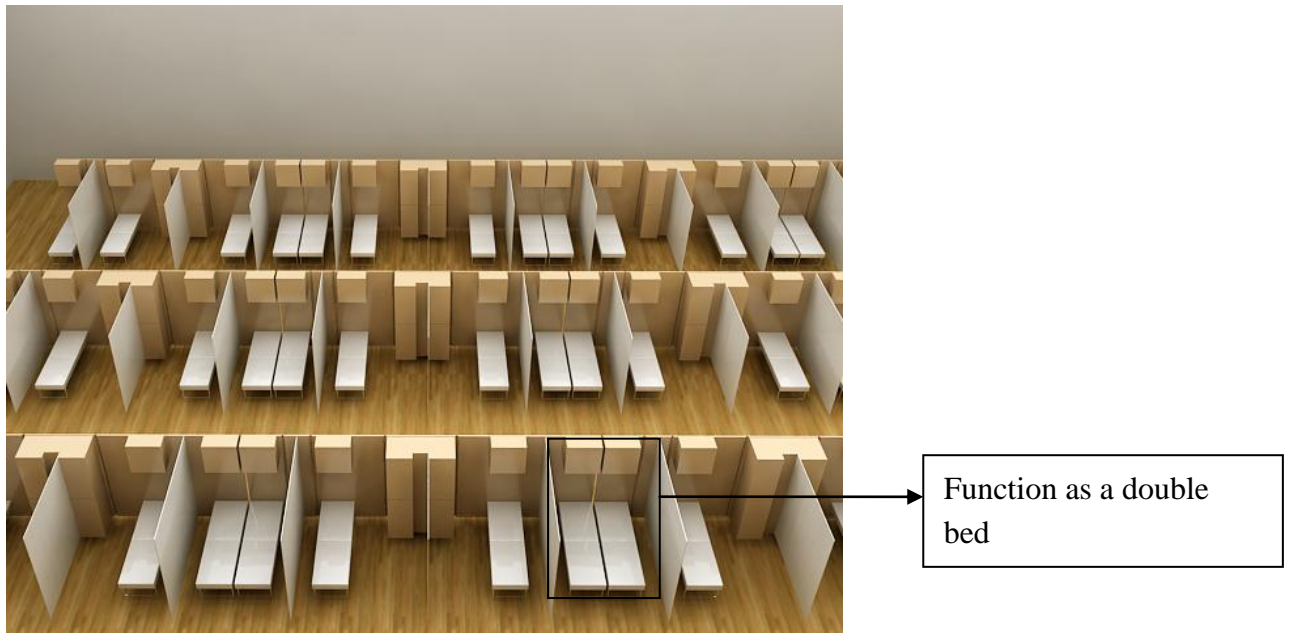


**Figure 30- Step 3: Pull out the Folding Walls. At this Point, the Folding Furniture Is Ready to Use**



It is important to note that the reason why there are not folding walls in both ends is because considering the particular requirements of couples or families, they may need a double bed to sleep together. The picture below shows how double size beds utilized in conjunction together.

**Figure 31- How Double Size Beds Utilized in Conjunction Together**





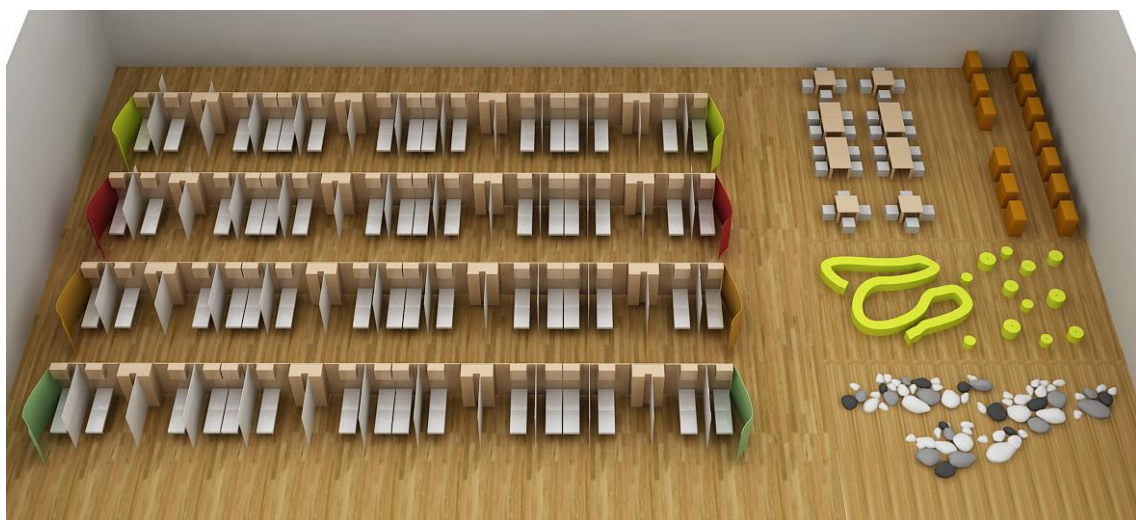
The two pictures show the comparison of shelters. The first picture illustrates a short-term, temporary shelter without the use of folding furniture. The second picture simulates how the shelter could be transformed into a long-term shelter utilizing the piece created for this study and the other furniture reviewed in this report.

**Figure 32- A Short-term, Temporary Shelter without the Use of Folding Furniture**



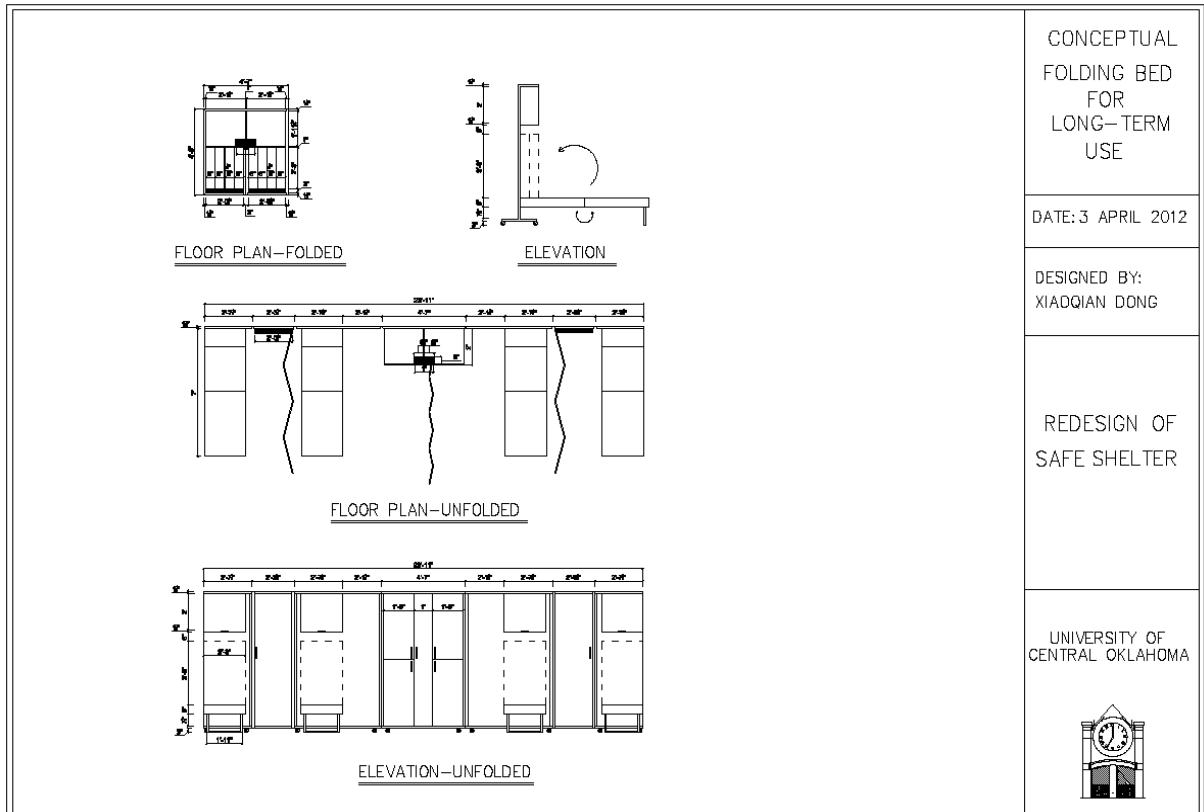
As seen, the space is the same, but a different feeling is created.

**Figure 33- How the Shelter Could be Transformed into a Long-term Shelter**



The drawings below are part of the design process utilized in the development of the furniture created for this study. The drawing below is the dimension plan providing important information regarding size. See Appendix D for high resolution drawings.

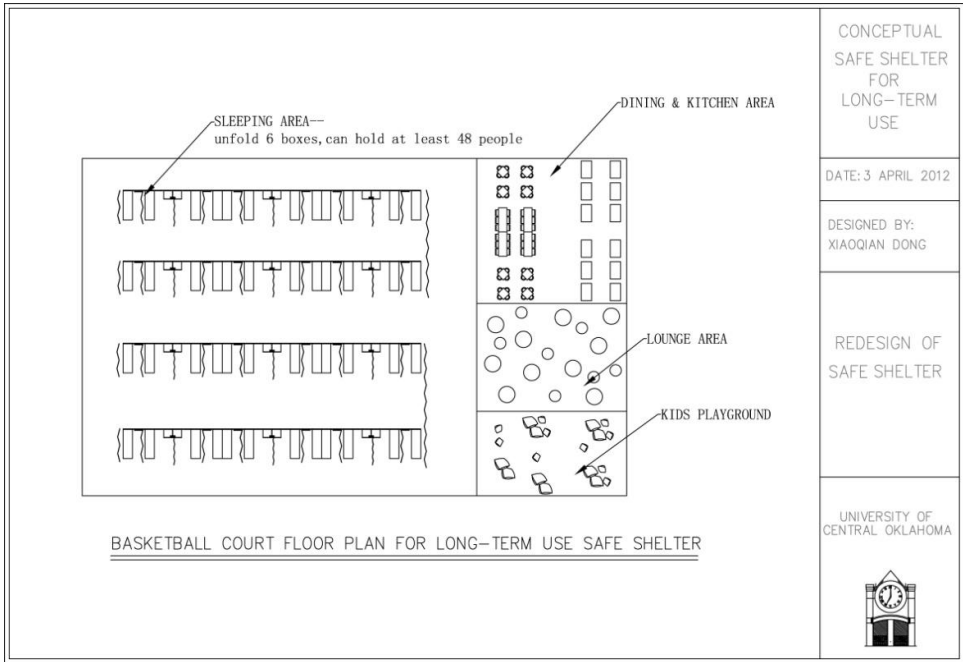
**Figure 34- Design Process Utilized in the Development of the Furniture Created for this Study: Dimension Plan Providing Important Information Regarding Size**



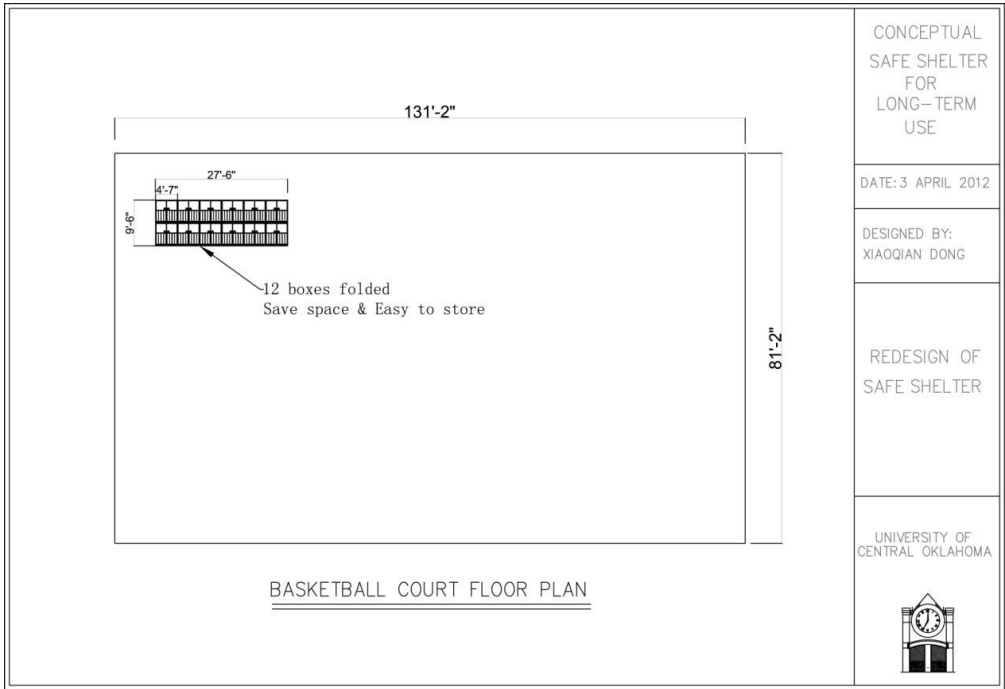


The first drawing shows how the design has been applied into the safe shelter. The final drawing illustrates how compact the designed piece is when folded for storage. As seen, the furniture is relatively small and takes up little space when compared to the basketball court.

**Figure 35- How the Design Has Been Applied into the Safe Shelter 1**



**Figure 36- How the Design Has Been Applied into the Safe Shelter 2**



### **Recommendations for Future Study**

This report stated what kind of furniture should be chosen and why, to be included into the long-term use in safe shelter. It is also trying to identify ways to help future researchers have a better understanding of how to create folding furniture for the safe shelter. The future researchers can get the inspirational ideas not only from the existing examples but also from the self-designed folding bed. These examples will help them think about details such as keeping privacy and providing storage space, and also comprehend how interior design elements will be involved into long-term safe shelter. Furthermore, additional future studies include calculating the pricing of the self-design folding bed-box and other folding furniture developed as a result of this study, and selecting finishes to match the color psychology described in this document.

## Conclusion

As more and more people lose their home from natural disasters, there is a huge need for them to have a place not only to live, but also to heal the mental wound and emotional distress. Temporary safe shelters such as basketball stadiums, cafeterias or libraries are the place to live when thousands of people lose their home. They will live in these places for awhile, sometimes longer than one year, till they can find another place to live. So it is necessary to give the refugees a place where they can feel happy and comfortable.

As seen in this report, natural disasters are increasing in frequency and intensity, and as a result, long-term safe shelters are needed for the people who lose their home in the disaster. Then, a conclusion about where should the safe shelter be located, what is the maximum population density of a community safe room, and what emergency supplies need to be prepared. The second part of the literature review introduced interior design and mentions eight elements of interior design and how these elements affect psychology to help design the safe shelter.

The methodology part is to find examples of functional, space saving furniture. The reason of selecting the folding furniture is because temporary safe shelter needs to be transferred easily, and furniture needs to be flexible to move and transform that the temporary safe shelter can ensure the daily use, yet allow the function to be used as long-term use safe shelter. At last, this design project created a 4'7" x 4'9" box which can be unfolded into four single size beds and personal storage, which is easy to store and transport for the long-term safe shelter.

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Taking Shelter from the Storm: Building a Safe Room for Your Home or Small Business

Includes Construction Plans and Cost Estimates (3rd ed.). (August, 2008). Federal

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Appendix A

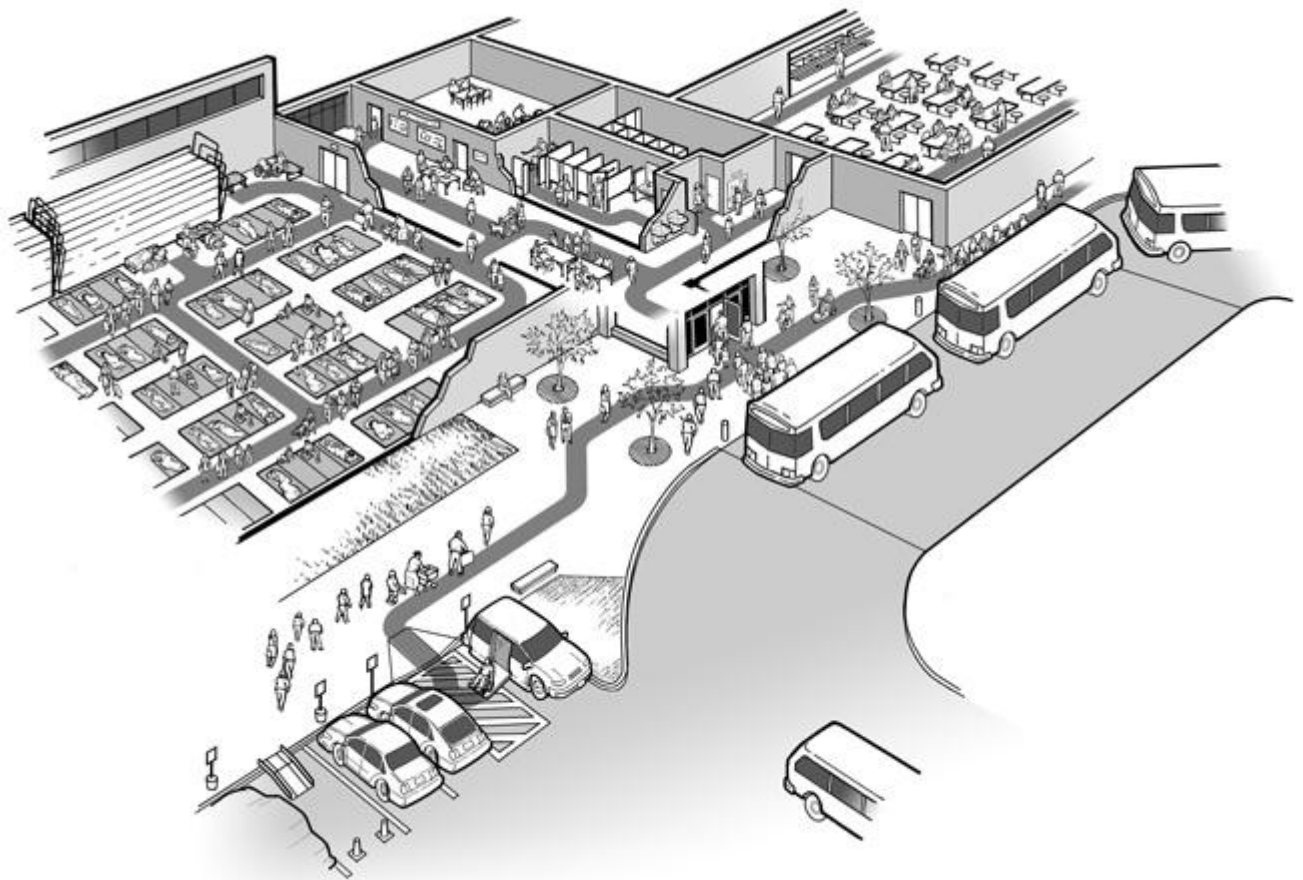
ADA (Americans with Disabilities Act) Checklist for Emergency Shelters

**U.S. Department of Justice**  
Civil Rights Division  
*Disability Rights Section*



**Americans with Disabilities Act**

**ADA Checklist for Emergency Shelters**



July 26, 2007

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### **Disclaimer**

The ADA authorizes the Department of Justice to provide technical assistance to individuals and entities that have rights or responsibilities under the Act. This document provides informal guidance to assist you in understanding the ADA and the Department's regulation. However, this technical assistance does not constitute a legal interpretation of the statute.

### **ADA Checklist for Emergency Shelters**

- A. Evaluating the Physical Accessibility of Emergency Shelters
- B. Conducting Accessibility Survey
- C. Getting Started
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- C. Accessibility within Toilet Rooms

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1. Typical Issues for Individuals Who Use Wheelchairs, Scooters, or Other Mobility Devices

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O. Accessible Portable Toilets

**Accessible Emergency Shelters**

One of the most important roles of State and local government is to protect people from harm, including helping people obtain



food and shelter in major emergencies. When disasters occur, people are often provided safe refuge in temporary shelters located in schools, office buildings, tents, or other facilities. Advance planning for an emergency shelter typically involves ensuring that the shelter will be well stocked with basic necessities, such as food, water, and blankets. Planning should also involve ensuring that these shelters are accessible to people with disabilities. Making emergency sheltering programs accessible is generally required by the Americans with Disabilities Act of 1990 (ADA).

### **A. Evaluating the Physical Accessibility of Emergency Shelters**

In order to be prepared for an emergency that requires sheltering, accessible features should be part of an emergency shelter. A first step to providing an accessible shelter is to identify any physical barriers that exist that will prevent access to people with disabilities. One good way to do this is to inspect each shelter facility that your community plans to use in an emergency and identify barriers to people with disabilities, including people who use wheelchairs or scooters or who have difficulty walking, people who are deaf or hard-of-hearing, and people who are blind or who have low vision. Facilities built or extensively altered since the ADA went into effect in 1992 may have few barriers to accessibility and could be good choices for emergency shelters. Facilities built before 1992 and not altered to provide accessibility may have barriers that prevent access to people with disabilities.

When evaluating physical accessibility in older facilities, it may be a good idea to do the analysis in two parts. If you suspect that an older facility is not accessible, you can do a preliminary analysis before completing a detailed accessibility survey. This preliminary analysis, or quick-check, can eliminate facilities with extensive barriers so that the focus can be on those facilities that are most appropriate to become accessible shelters. To help identify older buildings that may be good candidates to become accessible shelters, a copy of the Accessible Shelter Quick-Check Survey is provided on page 7. After completing the Quick-Check Survey, if you have checked “Yes” for most of the questions on the forms, you should conduct a full accessibility survey using the ADA Checklist for Emergency Shelters.

If you find barriers to accessibility after completing the checklist, the next step is to either remove the barriers or identify other nearby accessible facilities that can serve as a shelter. In communities with more than one emergency shelter, until all shelters are accessible, the locations of accessible shelters should be widely publicized, particularly to people with disabilities and organizations that serve the disability community.

### **B. Conducting Accessibility Surveys**

The following Quick-Check Survey (beginning on page 7) and the ADA Checklist for Emergency Shelters (beginning on page 11) are designed to assist State and local officials and operators of emergency shelters to determine whether a facility being considered for use as an

emergency shelter is accessible and if not, whether modifications are needed to remove barriers or whether relocation to another accessible facility is necessary. Filling out the Quick-Check Survey will provide guidance on whether a facility has certain basic accessible features, and filling out the detailed ADA Checklist for Emergency Shelters will provide specific information on any barriers to accessibility.

### **C. Getting Started**

Individuals conducting the surveys need not be experienced in evaluating facilities for accessibility. The checklist provides guidance on how to complete the survey and will prompt the user to check key elements. The checklist pages also provide space for notes and other key information. The checklist is designed to prompt the user to check key features by asking questions about sizes, sloped surfaces, and availability of accessible features; and in some areas, it suggests alternatives if a physical barrier is identified. By following the directions provided for filling out the checklist, staff can identify accessible shelters and develop information needed to implement temporary and permanent accessibility modifications.

An evaluation of shelter accessibility should focus on those areas of the facility that may be used for providing shelter in an emergency. These include areas where people are dropped off by a bus, van, or car; the parking area; the entrance to the shelter; pedestrian routes (both exterior and interior); sleeping, eating, information, and recreational areas; and toilet rooms.

Before shelter accessibility is evaluated, it is useful for staff to review the instructions for filling out the checklist and become familiar with the questions. It is also helpful to practice taking measurements, photographs, and recording information. On the day of the survey, it is helpful to first become familiar with certain areas before starting to record information. Upon arrival at the proposed shelter, first find the areas where people will disembark from vehicles, both passenger drop-off and loading zones as well as parking areas. Next find the entrances to the shelter areas that will be used during an evacuation. If possible, take an identifying “location” photograph that shows the name of the facility and the address so that other photographs can be identified correctly. When inside the building, locate the areas where people are likely to register, sleep, and eat. Locate the toilet rooms that serve the shelter area. It is also a good idea to locate any areas used for telephones, food distribution, and medical services.

### **D. Tools Needed**

The following items are needed for the survey:

- A metal tape measure that is at least 20 feet long;
- A digital level or bubble level that is 24 inches long;
- A door pressure gauge;
- A digital (preferred) or film camera with a flash;

- One copy of the checklist for each shelter (and Quick-Check Survey if used); and
- A clipboard and pens.

If you are not familiar with taking the types of measurements needed to complete the checklist, review the following section and practice using the tools before going to conduct a survey.

## **E. Taking Measurements**

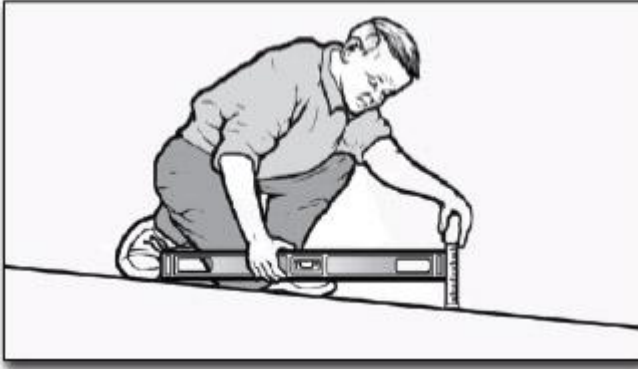
### **1. Sloped Surfaces**

Measuring the slope of a ramp, parking space, walkway, or other ground or floor surface is important to identify whether the surface is accessible. The amount of slope or grade is described as the proportion of a vertical rise to a horizontal length. It is usually described as:

- a ratio (e.g., 1:20, which means one unit of vertical rise for each 20 units of horizontal length); or
- a percentage (e.g., 8.33% which equates to a ratio of 1:12 or 4.76 degrees).

The easiest way to measure slope is to use a digital level. The digital display gives a reading that may be shown as a percent, degrees, or as a digital bubble. Before using a digital level, make sure to understand the directions for its use. It will need to be calibrated before each use. The maximum running slope generally allowed for ramps is 1:12 (8.33% or 4.76 degrees). Cross slope is the slope or grade of a surface perpendicular to the running slope. The most cross slope allowed on an accessible route is 1:50 (2% or 1.15 degrees).

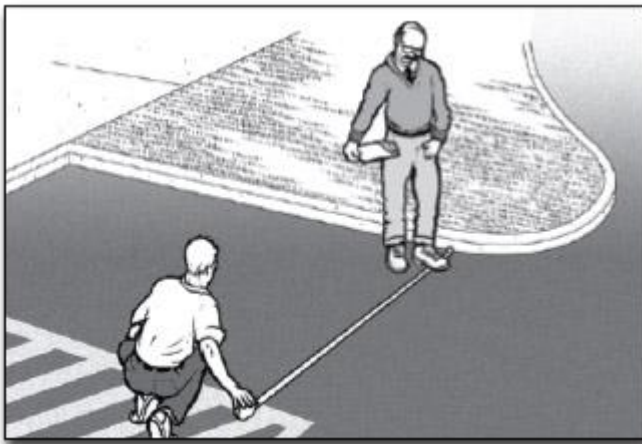
Another way to measure slope that requires more effort is to use a 24-inch level with leveling bubble and a metal tape measure. Place the level on the sloped surface in the direction you wish to measure. Rest one end of the level at the highest point of the sloped surface and lift the other end (see below) until the bubble is in the middle of the tube. This is the “level” position. While the level is in this position, measure the distance between the end of the level and the sloped surface below. If the distance is two inches or less, then the slope is 1:12 or less. When the distance is more than two inches, record the distance on the checklist so the exact slope can be calculated later. For measuring cross slope, if the distance, measured from the level position, is ½ inch or less then the slope is 1:48 or less.



**Measuring slope using a 24-inch bubble level and tape measure**

## **2. Using the Tape Measure**

A metal tape measure is needed to measure the length, width, height, and depth of various elements. When measuring long distances, pull the tape tight to get an accurate measurement. The checklist will offer guidance for the specific measurement that is required.



**Using a tape measure to measure the width of a parking space**

## **3. Measuring Door Openings**

Special care is needed when measuring the clear opening of a doorway. To measure the clear opening of a standard hinged door, open the door to 90 degrees. Place the end of the tape measure on the side of the door frame next to the clear opening (see below). Stretch the tape across the door opening to the face of the door. This measures the clear width of the door opening through which people pass, which is less than the width of the door itself.



**Measuring the clear opening from the face of the doorstop on the frame to the face of the open door**

#### **F. Taking Photographs**

A comprehensive set of photographs makes it easier to understand existing conditions after the survey is completed. It is a good idea to take many photos of the exterior and interior of the potential shelter. It is likely that many other people in your decision-making process will need to review information about the facility you are surveying, so try to record each element that you survey with several photos. It is always useful to first take a photo that will clearly identify the location of the element so that others will easily be able to find the element. Then, take several close-up shots of that element to document the conditions you found during your survey. If you are not familiar with the camera that you plan to use, practice using it both indoors and outdoors before starting to survey the various facilities being considered for use as shelters. If you are using a digital camera, it is a good idea to review the images as you take them to ensure that you have good quality photographs.

#### **G. Completing the Survey and Checklist**

The survey and checklist forms will prompt you for what to look at and where to measure. You should write down all answers and notes for use later in the planning process. If a photo is taken of a particular element or condition, then you should note this on the checklist. It is usually more efficient for two or three people to work together doing these surveys. One person can measure while the other records the information and takes photos.

For each item, check either “Yes” or “No.” If the measurement or number falls short of that required for accessibility, write the measurement or number to the right of the question. Add notes or comments as needed. For some questions when “No” is the answer, the checklist will

include a prompt to check for an alternate solution. Information on possible alternative solutions can be used later to decide how to better provide accessibility. Taking several photos is also helpful when the answer is “No” and an alternative way to provide accessibility is not readily apparent.

When completing the survey or checklist, try to answer every question in each section unless the element is not present at that facility. For example, if no parking lot is provided at the facility, (such as where only on-street parking is provided), do not measure the size of the on-street parking spaces.

Some sections of the checklist are divided into two parts, one for individuals with a mobility disability and the other for individuals who are blind or who have low vision. While evaluating a facility you will be checking to ensure that an accessible route is provided. The accessible route is a continuous unobstructed pedestrian path without steps or steep slopes that connects all accessible site and building features and spaces together. A continuous accessible route must be available at the shelter for people who use a wheelchair, scooter, or other mobility device. Other sections of the checklist ask questions related to individuals who are blind or have low vision. These questions cover all circulation paths, not just pedestrian paths that are also an accessible route.

The survey and the checklist are based on some of the requirements from the ADA Standards for Accessible Design (the Standards). Questions have been selected to reflect features that may be most important for the short-term stays common for emergency shelters. To learn more about the Standards, see the Department of Justice regulations, 28 C.F.R. Part 36, Appendix A. The regulations and the Standards are available at [www.ada.gov](http://www.ada.gov). Copies are also available by calling the ADA Information Line at 800-514-0301 (voice) or 800-514-0383 (TTY).

## **H. After Completing the Survey and Checklist**

Once you have completed the survey and filled out the checklist, you can determine which elements or spaces in a potential shelter facility are accessible and which may need modifications. If most answers are “yes,” the facility may need little or no modification. If some answers are “no,” modifications may be needed to remove barriers found in that space or element. Emergency shelters in older buildings with inaccessible features might be made accessible with temporary modifications, (such as portable ramps at the entrance and accessible parking spaces marked off by traffic cones) until permanent modifications can be made. However, where facilities are not capable of being made accessible, another facility will need to be selected for use as a shelter.

### **Step One: Accessible Shelter Quick-Check Survey**



## Selecting Sites to Survey for Accessibility

Providing an emergency shelter that is accessible to people with disabilities involves making sure that a number of accessible features and spaces are available. To verify accessibility before deciding on a site for an emergency shelter can involve asking many questions such as those in the ADA Checklist for Emergency Shelters. For some older buildings, especially those on hilly sites and those that have not been renovated, remodeled, or altered since 1992, before completing the detailed checklist, it may be better to do a pre-test that can rule out a facility with major accessibility problems so available resources can be focused on other locations. The following questions will help evaluate whether a facility has such major accessibility barriers. After this first step, buildings that do not have major accessibility problems should be surveyed more thoroughly, using the ADA Checklist for Emergency Shelters, to find out which, if any, barriers need to be removed to provide an accessible shelter.

### A. Accessible Entrance

Having a way to get into the emergency shelter on a surface that is firm, stable, slip resistant, without steps or steep slopes, and wide enough for a person using a wheelchair or other mobility aid is essential.

A1. Is there a sidewalk connecting the parking area and any drop off area to the walkway leading to the building? [ADA Standards §4.1.3(1)]

Yes

No

A2. Is there a route without steps from this sidewalk to the main entrance?

Yes

No

If No, are there two or fewer steps? Yes \_\_\_\_\_ No \_\_\_\_\_ Number of Steps: \_\_\_\_\_

If No, is there another entrance without steps that is connected by a sidewalk to the parking or drop off area? Yes \_\_\_\_\_ No \_\_\_\_\_ Location: \_\_\_\_\_

### B. Accessible Routes To All Service/Activity Areas

Everyone must be able to get to each of the various areas where activities and services take place. This includes people who use mobility devices, such as wheelchairs and scooters, being able to get to locations where supplies are distributed, to eating areas, to sleeping areas, to toilet rooms, and to other activity areas without encountering stairs or steep slopes.

Check all of the various ways to get to each of the areas where sheltering activities are likely to take place (sleeping, eating,

B1. Sleeping Area (Location: \_\_\_\_\_)

B1-a. Is there a route without steps from the accessible entrance to this location?

Yes

No

If No, are there two or fewer steps? Yes \_\_\_ No \_\_\_ Number of Steps: \_\_\_\_\_

If No, is there a ramp, lift, or elevator? Yes \_\_\_ No \_\_\_ Type of device: \_\_\_\_\_

B1-b. If an elevator or lift provides the only accessible route, is there a source of backup power to operate the device for an extended period?

Yes

No

B2. Eating Area (Location: \_\_\_\_\_)

B2-a. Is there a route without steps from the accessible entrance to this location?

Yes

No

If No, are there two or less steps? Yes \_\_\_ No \_\_\_ Number of Steps: \_\_\_\_\_

If No, is there a ramp, lift, or elevator? Yes \_\_\_ No \_\_\_ Type of device: \_\_\_\_\_

B2-b. If an elevator or lift provides the only accessible route, is there a source of back up power to operate the device for an extended period?

Yes

No

B3. Supply Distribution Area (Location: \_\_\_\_\_)

B3-a. Is there a route without steps from the accessible entrance to this location?

Yes

No

If No, are there two or fewer steps? Yes \_\_\_ No \_\_\_ Number of Steps: \_\_\_\_\_

If No, is there a ramp, lift, or elevator? Yes \_\_\_ No \_\_\_ Type of device: \_\_\_\_\_

B3-b. If an elevator or lift provides the only accessible route, is there a source of backup power to operate the device for an extended period?

Yes

No

B4. Toilet Rooms (Location: \_\_\_\_\_)

B4-a. Is there a route without steps from the accessible entrance to this location?

Yes

No

If No, are there two or fewer steps? Yes \_\_\_ No \_\_\_ Number of Steps: \_\_\_\_\_

If No, is there a ramp, lift, or elevator? Yes \_\_\_ No \_\_\_ Type of device: \_\_\_\_\_

B4-b. If an elevator or lift provides the only accessible route, is there a source of backup power to operate the device for an extended period?

Yes

No

### **C. Accessibility Within Toilet Rooms**

C1-a. Is there an area within the toilet room where a person who uses a wheelchair or mobility device can turn around - either a minimum 60-inch diameter circle or a "T"-shaped turn area? [ADA Standards §§ 4.22.3; 4.2.3, Fig. 3]

Yes

No

C1-b. Is at least one stall at least 60 inches wide and 56 inches deep (wall mounted toilet) or 59 inches deep (floor mounted toilet)? [ADA Standards § 4.17.3]

Yes

No

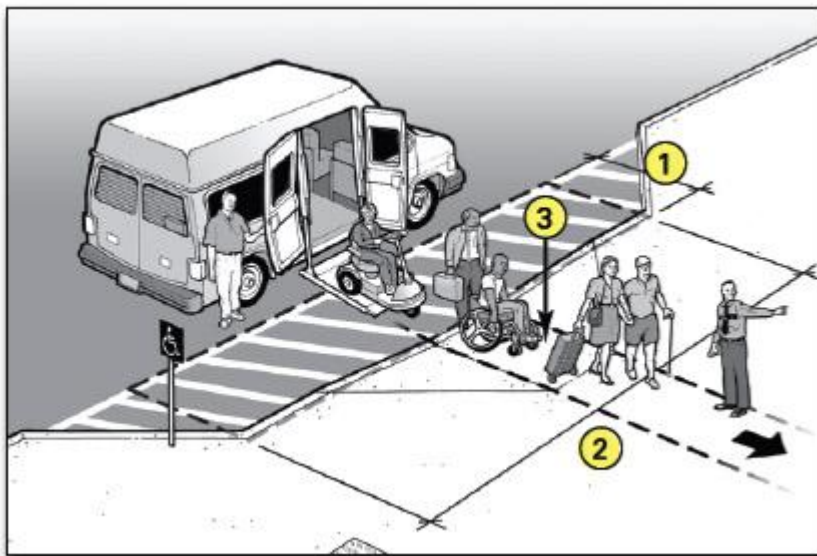
**Using The Information:**

If most of your answers to the previous questions are Yes, then the facility has some basic accessibility features and should be surveyed using the ADA Checklist for Emergency Shelters. Whenever most of your answers are No, then these problems should be evaluated before conducting a more detailed survey, or perhaps you should consider another location to serve as an emergency shelter.

**Step Two - ADA Checklist For Emergency Shelters****Getting to the Emergency Shelter****A. Passenger Drop-Off Areas**

During an evacuation the most efficient method of transporting people to shelters likely will include using vans and buses. Accessible buses and vans with wheelchair lifts will be needed to transport people who use wheelchairs, scooters, or other mobility aids. When they arrive at the shelter, an accessible drop-off area (also known as a passenger loading zone) is needed for people using mobility aids to get off of the bus or van and proceed to the shelter's accessible entrance.

An accessible drop-off area must have a level access aisle that is adjacent and parallel to the vehicle space. Where a curb separates the vehicle space from the access aisle or the access aisle from an accessible route, a curb ramp must be provided so people with mobility disabilities can get to the accessible route leading to the accessible entrance of the shelter.



**Accessible drop-off area with an access aisle provided at the same level as the vehicle.**

**Notes**

1. Access aisle depth is at least 5 feet.
2. Access aisle length is at least 20 feet.
3. Curb ramp connects the access aisle for the accessible drop-off area (which is at the level of the parking lot) to the accessible route to the accessible entrance of the shelter.

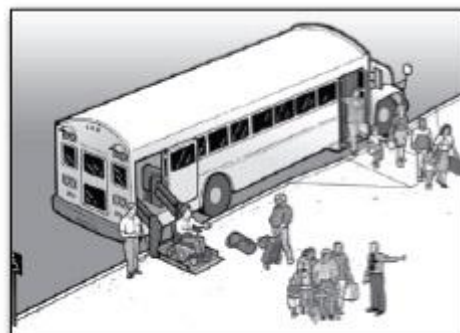
The access aisle may be at the parking-lot level or at sidewalk level. If the access aisle is at the parking-lot level, the curb ramp is provided between the access aisle and the sidewalk. If it is at the sidewalk level, an adjacent curb ramp is provided between the street and the sidewalk.

A1. Is a relatively level (1:50 or 2% maximum slope in all directions) access aisle provided adjacent and parallel to the side of the vehicle pull-up area? [ADA Standards § 4.6.6]

Yes

No

If No, look for another relatively level location that is on an accessible route to the accessible shelter entrance that could be used.



**Accessible drop-off area with an access aisle provided as part of the sidewalk.**

A2. Is the vehicle pull-up area relatively level (1:50 or 2% maximum slope in all directions)?

Yes

No

A3. Is the area for the access aisle at least 5-feet wide and 20-feet long? [ADA Standards § 4.6.6].

Yes

No

*Note: Unlike at an accessible parking space, the surface for the access aisle of an accessible passenger drop-off area does not have to be marked or striped.*

A4. Is there vertical clearance of at least 114 inches (9 feet 6 inches) from the site entrance to the vehicle pull-up area, the access aisle, and along the vehicle route to the exit? [ADA Standards §4.6.5]

Yes

No

A5. Is a curb ramp provided between the vehicle pull up area and the access aisle (see above) or the access aisle and the accessible route to the accessible entrance? [ADA Standards §4.6.6]

Yes

No

If No, is there another area with a curb ramp and on an accessible route that could serve as the drop-off area?

If there is no curb ramp near the drop-off area, can a temporary ramp be used to connect the drop-off area access aisle to the accessible route to the accessible shelter entrance?

A6. If a curb ramp is provided, is the running slope of the ramp surface (not counting the side flares) no more than 1:12 or 8.33% [ADA Standards §4.7.2]

Yes

No

A7. Is the width of the curb ramp surface at least 36 inches (not counting the side flares)?  
[ADA Standards § 4.7.3]

Yes

No

A8. Does an accessible route connect the curb ramp to the shelter's accessible entrance?  
[ADA Standards § 4.1.2(1)]

Yes

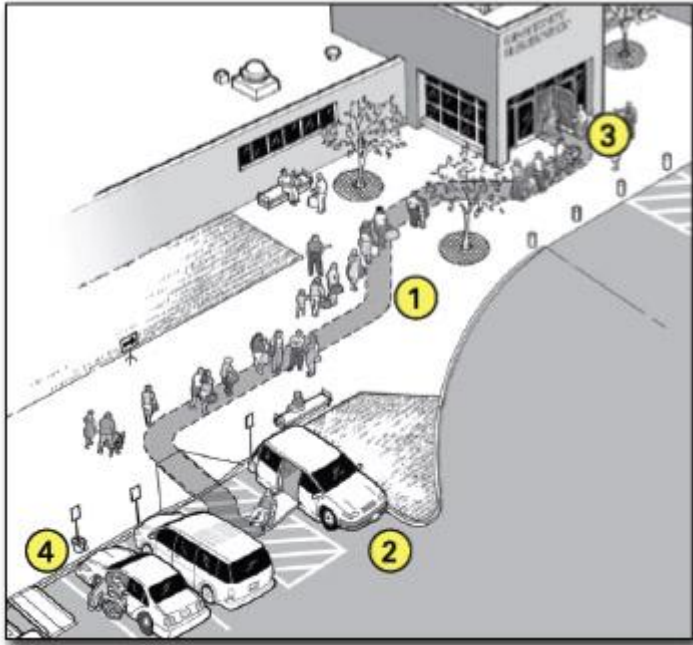
No

## **B. Parking**

### **1. Typical Issues**

During an evacuation, some individuals with a mobility disability may arrive at the shelter in a car or van. When parking areas are provided at the shelter site, accessible parking spaces must be provided. Individuals with disabilities who arrive at the shelter in their own car or van need to be able to park in an accessible parking space close to an accessible entrance. Accessible parking spaces need an adjacent access aisle that provides space for a person with a mobility disability to exit their vehicle. The access aisle connects directly to an accessible route that leads to an accessible building entrance. In order to be usable, the access aisle must be relatively level, clear of gravel or mud, and the surface must be in good condition without wide cracks or broken pavement.

An accessible route connects the permanent access aisle of each accessible parking space with the accessible entrance to the shelter. When an accessible route crosses a curb, a curb ramp must be provided. During an emergency, as a temporary measure, if additional accessible parking spaces are needed, a portable ramp can be provided in a parking space marked off by traffic cones to provide two additional accessible parking spaces (see page 18).



**An accessible entrance to an emergency shelter with accessible parking and additional temporary accessible parking spaces**

**Notes:**

1. Accessible route.
2. Accessible parking with van accessible parking space.
3. Accessible entrance to shelter.
4. Temporary accessible parking spaces.

**2. Parking Spaces Checklist**

B1. When parking areas are provided at the shelter site, count the total number of parking spaces provided in each area. Is the minimum number of accessible parking spaces provided, based on the total number of available parking spaces (see table below)? [ADA Standards § 4.1.2(5)(a)]

Yes

No

**Total Number of Parking Spaces in Each Parking Area**

**Required Minimum Number of Accessible Spaces**



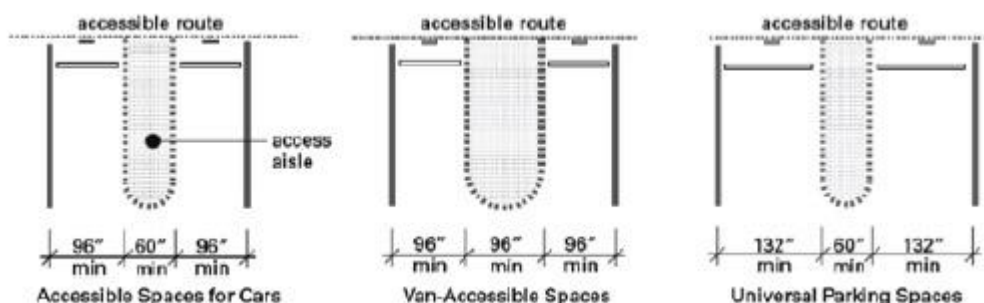
<b>1- 25</b>	1 van-accessible space w/min. 96-inch-wide access aisle (van space)
<b>26 - 50</b>	1 space w/min. 60-inch-wide access aisle + 1 van space
<b>51 - 75</b>	2 spaces w/min. 60-inch-wide access aisle + 1 van space
<b>76 - 100</b>	3 spaces w/min. 60-inch-wide access aisle + 1 van space
<b>101 - 150</b>	4 spaces w/min. 60-inch-wide access aisle + 1 van space

If more than 150 parking spaces are provided in a particular lot, see section 4.1.2 of the ADA Standards for the number of accessible parking spaces required.

B2. Does each accessible parking space have its own, or share, an adjacent access aisle that is at least 60 inches (5 feet) wide? [ADA Standards § 4.6.3]

Yes

No



**Accessible Parking Spaces Showing Minimum Width of Vehicle Space and Access Aisle**

B3. Is there at least one van-accessible parking space provided with an access aisle that is at least 96 inches (8 feet) wide or are universal parking spaces provided that are 132 inches (11 feet) wide for vehicle space with a 60-inch (5-foot) wide access aisle? [ADA Standards §§ 4.1.2(5), A4.6]

Yes

No

B4. For van-accessible spaces (particularly in a garage or parking structure), is there vertical clearance of at least 98 inches (8 feet - 2 inches) for the vehicle route to the parking space, the

parking space, the access aisle, and along the vehicle route to the exit? [ADA Standards § 4.6.5]

Yes

No

If No: Can the route be cleared by removing or raising low objects, or can each van accessible parking space be relocated?

B5. Are all accessible parking spaces, including the access aisle, relatively level (1:50 or 2%) in all directions? [ADA Standards §4.6.3]

Yes

No

If No: Look for a nearby area that is relatively level in all directions that could serve as an accessible parking space with an accessible route to the accessible entrance to the shelter.

B6. Does each accessible parking space have a sign with the symbol of accessibility that is visible when a vehicle is parked in the space? [ADA Standards §4.6.4]

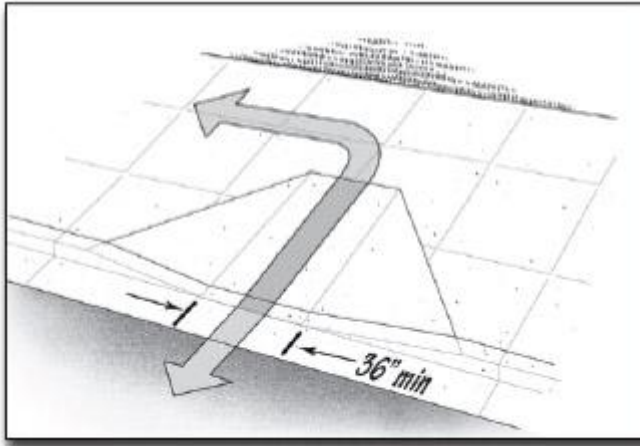
Yes

No

B7. If there is a curb between the access aisle and the accessible route to the building, is there a curb ramp that meets the following requirements: [ADA Standards §4.7]

Yes

No



**Curb ramp showing minimum 36-inch width for ramp section and 1:12 slope on ramp section.**

B7-a. Is the curb ramp surface at least 36 inches wide, excluding flared sides? [ADA Standards §4.7.3]

Yes

No

B7-b. Is the slope (up or down the ramp) no more than 1:12? [ADA Standards §4.7.2]

Yes

No

Note: 1:12 is one inch of vertical height for each 12 inches of length.

B8. Are the accessible parking spaces serving the shelter on the shortest accessible route to the accessible entrance? [ADA Standards §4.6.2]

Yes

No

B9. Does each access aisle connect to an accessible route from the parking area to the shelter's accessible entrance? [ADA Standards §4.6.2]

Yes

No

### 3. Temporary Solutions for Emergency Sheltering - Parking

**Problem:** Parking at the shelter facility either has no accessible parking, not enough accessible parking, or accessible parking spaces are not on level ground.

**Suggestion:** Find a fairly level parking area near the accessible entrance and mark the area for accessible parking spaces. Three regular parking spaces will make two accessible parking spaces with a shared access aisle. Provide a sign designating each accessible parking space. Ensure there is an accessible route from each access aisle to the accessible entrance.

If temporary accessible spaces are used, mark the temporary accessible parking spaces with traffic cones or other temporary elements. Traffic cones can also be used to mark off an access aisle if designated accessible parking spaces lack an access aisle or if the access aisle is too narrow. At least one accessible parking space should be a van-accessible parking space with an access aisle that is at least 96 inches wide.



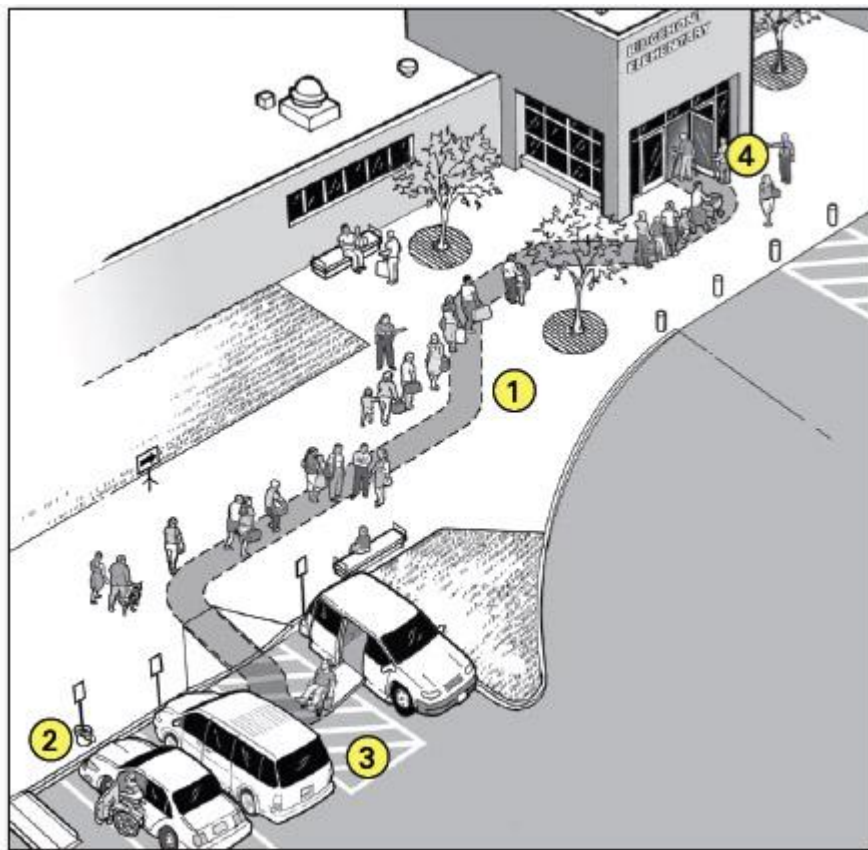
**Three standard parking spaces are converted into an accessible parking space with an access aisle. Cones mark the access aisle and a temporary curb ramp with edge protection connects to an accessible route to the shelter.**

#### C. Sidewalks and Walkways

##### 1. Typical Issues for Individuals Who Use Wheelchairs, Scooters, or other Mobility Devices

An accessible route connects accessible passenger drop-off areas, accessible parking spaces, and other accessible elements, like a route from a bus stop, to an accessible building entrance.

The accessible route is essential for people who have difficulty walking or who use wheelchairs or other mobility aids to get to the accessible entrance of the shelter. The accessible route must be at least 36 inches wide (it may narrow briefly to 32 inches wide where utility poles, signs, etc. are located along the accessible route). Abrupt level changes, steps, or steep running or cross slopes cannot be part of an accessible route. Where ramps are used, they cannot be steeper than 1:12. Ramps with a vertical rise of more than 6 inches must have handrails on both sides. Ramps must also have edge protection to stop wheelchairs from falling off the sides, and level landings at the top and bottom of each segment and where the ramp changes direction.



**An accessible entrance to a shelter with accessible parking and an accessible drop-off area**

**Notes:**

1. Accessible route
2. Accessible drop-off area
3. Accessible parking with van-accessible parking space
4. Accessible entrance to shelter

C1-a. Is an accessible route provided from accessible parking spaces to the accessible entrance of the shelter? [ADA Standards § 4.1.2(1), 4.3]

Yes

No

C1-b. Is an accessible route provided from public sidewalks and public transportation stops on the shelter site (if provided) to the accessible entrance for the shelter? [ADA Standards § 4.1.2(1)]

Yes

No

Note: The accessible route is at least 36 inches wide and may be a portion of a sidewalk.

C1-c. Is the accessible route at least 36 inches wide? [ADA Standards § 4.3.3]

Yes

No

If No, does the accessible route narrow to 32 inches for no more than 2 feet?

C1-d. Is the accessible route free of steps and abrupt level changes higher than 1/2 inch? [ADA Standards § 4.3.8]

Yes

No

Note: Level changes between 1/4 inch and 1/2 inch should be beveled (sloped) at 1:2 maximum.

C1-e. Where an accessible route crosses a curb, is a curb ramp provided? [ADA Standards § 4.3.8]

Yes

No

e-i. Is the curb ramp surface at least 36 inches wide, excluding flared sides? [ADA Standards § 4.7.3]

Yes

No

e-ii. Is the running slope (up or down the ramp) no more than 1:12? [ADA Standards §4.7.2]

Yes

No

Note: 1:12 is one inch of vertical height for 12 inches of horizontal distance.

C1-f. If the slope of part of the accessible route is more than 1:20, does it meet the following requirements for an accessible ramp?

Yes

No

f-i. Is the running slope no greater than 1:12? [ADA Standards §4.8.2]

Yes

No

Note: For existing ramps, the slope may be 1:10 for a 6-inch rise and 1:8 for a 3-inch rise in special circumstances (see ADA Standards §4.1.6(3)).

f-ii. Are handrails installed on both sides of each ramp segment? [ADA Standards §4.8.5]

Yes

No

f-iii. Is the ramp width, measured between the handrails, at least 36 inches? [ADA Standards §4.8.3]

Yes

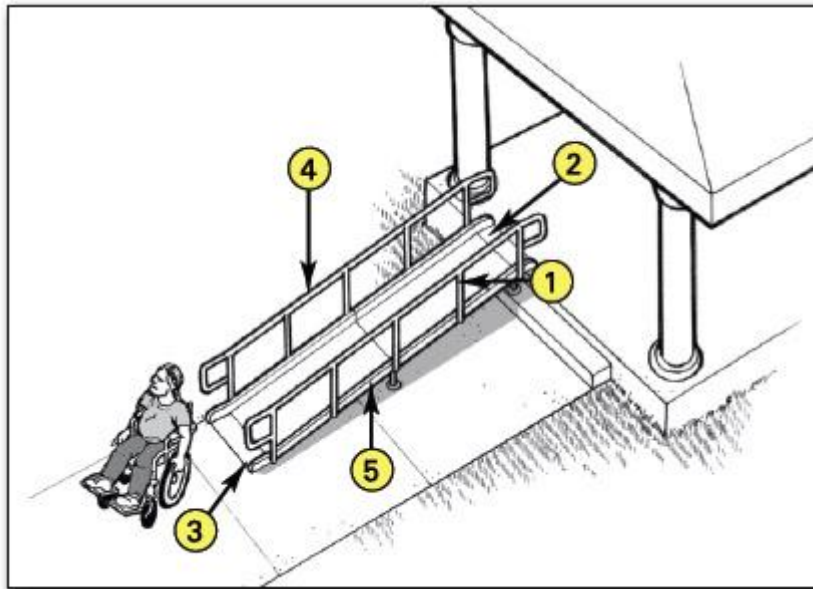
No

f-iv. Does the ramp have a level landing at the top and bottom of each ramp section that is at least 60 inches long? [ADA Standards §4.8.4]

Yes

No

Note: The level landing may be part of the sidewalk or walking surface.



**Accessible ramp features**

**Notes:**

1. At least 36 inches between handrails
2. Top landing part of walk
3. Bottom landing part of walk
4. Handrail height 34 to 38 inches
5. Edge protection.

f-v. If a ramp is more than 30 feet long, is a level landing at least 60 inches long provided at every 30 feet of horizontal length? [ADA Standards §4.8.4]

Yes

No

*Note: if the running slope is less than 1:16 but more than 1:20, each ramp segment may be up to 40 feet long followed by a level landing.*



f-vi. Is there a level landing, at least 60 inches x 60 inches, when a ramp changes direction?  
[ADA Standards §4.8.4]

Yes

No

f-vii. Are the handrails mounted 34 to 38 inches above the ramp surface? [ADA Standards § 4.8.5]

Yes

No

f-viii. If the ramp or landing has a vertical drop-off on either side, is edge protection provided?  
[ADA Standards §4.8.7]

Yes

No

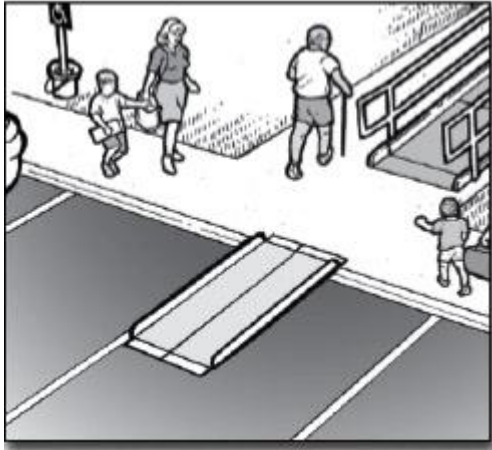
### **Temporary Solutions For Emergency Sheltering - Ramps**

**Problem:** The sidewalk connecting parking to the shelter entrance is too steep to be accessible.

**Suggestion:** Check to see if there is another accessible route to the accessible entrance. Sometimes there is a less direct route that is accessible. During an evacuation it will be helpful to put up signs or to have volunteers stationed at the accessible parking spaces to direct people along this less direct, but nonetheless accessible, route.

**Problem:** The accessible route crosses a curb but no curb ramp is provided.

**Suggestion:** Install a portable ramp with a slope no steeper than 1:12 with edge protection. Store the portable ramp on site so it can be easily accessed in an emergency.



**A portable ramp with edge protection is installed over a curb to provide an accessible route.**

**Problem:** There are two steps where the sidewalk connects to the accessible entrance.

**Suggestion:** Install a portable ramp with a slope no steeper than 1:12 with edge protection and handrails on both sides of the ramp. Store the portable ramp and components on site so everything can be easily accessed in an emergency.

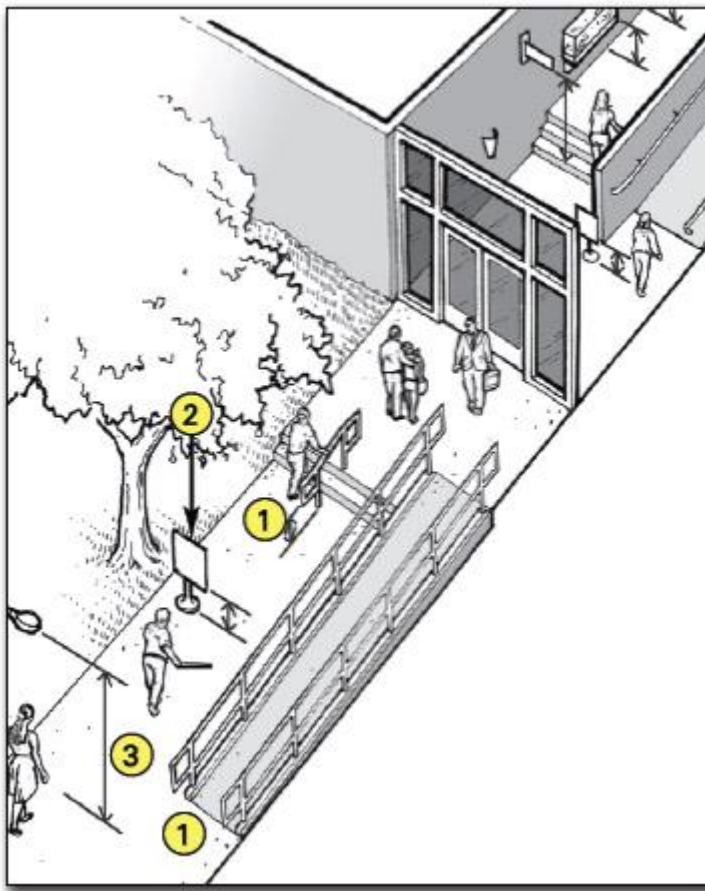


**A portable ramp with edge protection and handrails is installed over two steps to provide an accessible route.**

## **2. Typical Issues for Individuals Who Are Blind or Have Low Vision**

Objects that are wall mounted, that project into a pedestrian route from the side, or that are overhead can be hazards to people who are blind or who have low vision. These objects must

be positioned so people will either detect the objects before they run into them or safely pass under them. Examples may include handrail extensions on stairs and ramps, post- or wall-mounted signs, drinking fountains, and low hanging tree limbs. Pedestrian routes open to people during the time that the facility is being used as an emergency shelter, such as sidewalks, courtyards, and plazas, must be free of overhanging objects that are less than 80 inches above the route. Objects more than 27 inches and less than 80 inches above the route and that protrude from the side more than 4 inches are also a hazard. Since people can walk on any sidewalk, not just the accessible routes, all exterior pedestrian routes serving or leading to the shelter areas must be checked. The following questions apply to sidewalks and walkways leading to the emergency shelter.



**Common objects along pedestrian routes to a shelter that can be hazards to people who are blind or have low vision.**

**Notes:**

1. The bottom of the handrail extensions turn down to 27 inches or less above the route so a person who is blind or has low vision can detect the hazard before running into it.
2. Signs or other objects in the pedestrian route can be a hazard if the bottom is more than 27 inches but less than 80 inches above the route.

3. Objects that overhang the pedestrian route must be at least 80 inches above the route.

C2-1. Are all sidewalks and walkways to the shelter free of any objects (e.g., wall-mounted boxes, signs, handrail extensions) with bottom edges that are between 27 inches and 80 inches above the walkway and that extend more than 4 inches into the sidewalk or walkway? [ADA Standards §§ 4.4, 4.2.1(3), 4.1.3(2)]

Yes

No

If No, can the object be lowered, removed, or modified or can the route be moved so that the object can be avoided?

C2-2. Are the undersides of exterior stairs enclosed or protected with a cane-detectable barrier so that people who are blind or have low vision will not hit their heads on the underside? [ADA Standards §4.4.2]

Yes

No

If No, can a barrier or enclosure be added below the stair or can the route be relocated away from the stair?



**When the underside of a stair is open, it is a hazard to people who are blind or have**

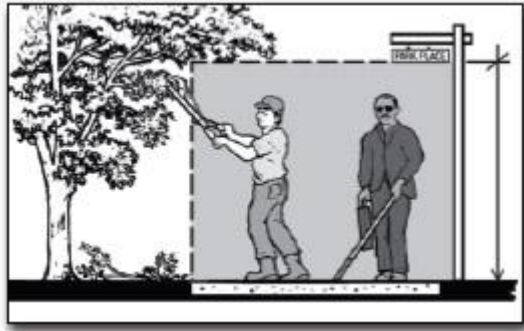
**low vision. Enclosing the area below the stair or installing a cane-detectable barrier helps this woman to stop before hitting her head.**

C2-3. Are all objects that hang over the pedestrian routes at least 80 inches above the route?  
[ADA Standards §4.4.2]

Yes

No

If No, can the objects be removed or relocated, or can a cane-detectable object be added below that is at no higher than 27 inches?



**Overhead sign and tree branches are least 80 inches above the walk.**

### **Temporary Solutions For Emergency Sheltering - Protruding Object Hazards**

**Problem:** Objects protrude too far from the side into the route causing a hazard for people who are blind or who have low vision.

**Suggestion:** When people who are blind or who have low vision use a cane to detect hazards, objects located at 27 inches or lower are detectable. When an object is located higher than 27 inches above the ground it is a hazard if the object protrudes more than 4 inches into the circulation path. To make a protruding object cane-detectable:

- Place an object below, or on either side of, the protruding object that is not higher than 27 inches above the ground.
- If the protruding object can be moved, lower the object so that its bottom is not more than 27 inches above the ground.
- Prune or alter the protruding object so it does not protrude above the route.

### **D. Entering the Emergency Shelter**





**Examples of signs for inaccessible shelter entrances directing people to the accessible entrance.**

D1. Is there at least one accessible entrance connected to an accessible route? [ADA Standards §4.1.3(1)]

Yes

No

Notes: If this entrance is not the main entrance, it needs to be kept unlocked when other shelter entrances are unlocked.

If there are inaccessible entrances serving the shelter, signs will be needed at inaccessible entrance(s) to direct evacuees to the nearest accessible entrance.

D2. Does at least one door or one side of a double leaf-door provide at least 32 inches clear passage width when the door is open 90 degrees? [ADA Standards §4.13.5]

Yes

No

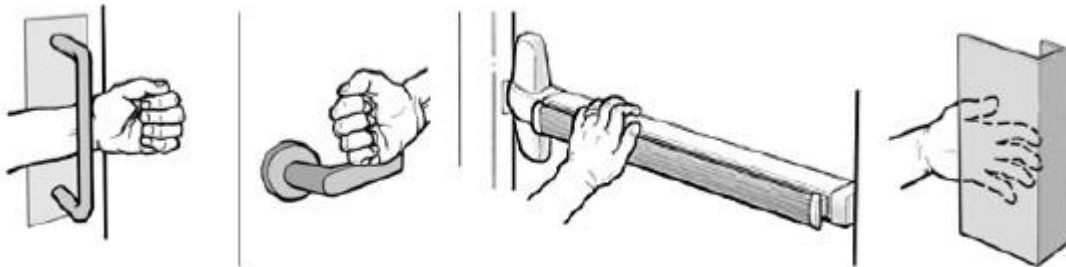
If No, does another entrance have an accessible door or can both doors be propped open during the evacuation? Other possible solutions are to enlarge the door opening, use a swing clear hinge, or, if a double-leaf door, replace with uneven width doors.

D3. Is the hardware (e.g., lever, pull, and panic bar) usable with one hand without tight grasping, pinching, or twisting of the wrist? [ADA Standards §4.13.9]

Yes

No

If No, leave door propped open, add new accessible hardware, or adapt/replace hardware.



**Examples of handles and door hardware that can be used without tight grasping, pinching, or twisting.**

D4. On the latch, pull side of the door, is there at least 18 inches clearance provided if the door is not automatic or power-operated? [ADA Standards §4.13.6, Fig. 25]

Yes

No

If No, leave the door propped open or find another accessible entrance.

D5. If there is a raised threshold, is it no higher than 3/4 inch at the door and beveled on both sides? [ADA Standards §§4.1.6(3)(d)(ii), 4.13.8]

Yes

No

If No, replace threshold with one with beveled sides or add a sloped insert.

D6. If an entry has a vestibule, is there a 30-inch by 48-inch clear floor space inside the vestibule where a wheelchair or scooter user can be outside the swing of a hinged door? [ADA Standards §4.13.7]

Yes



No

If No, leave the inner door permanently open, remove inner door, or modify the vestibule.

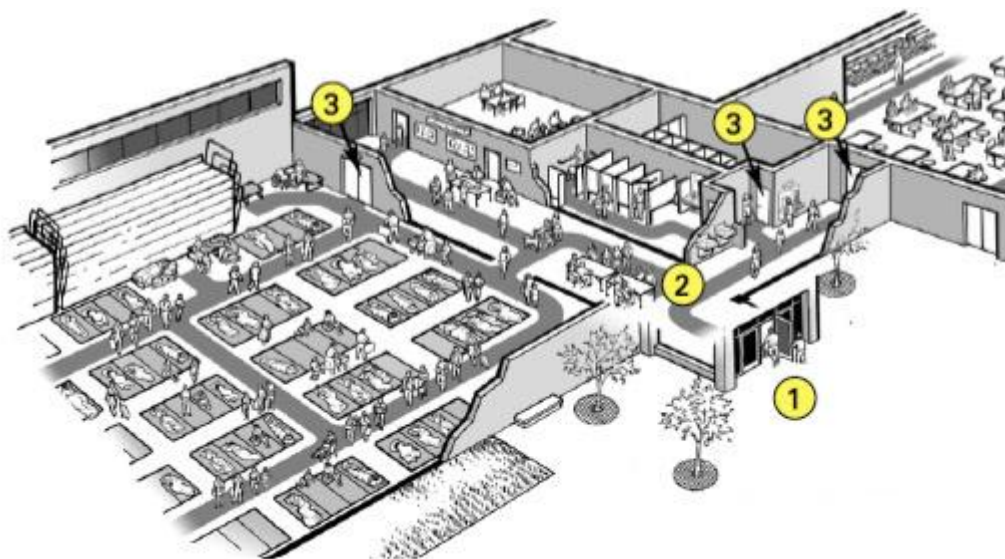
## E. Hallways and Corridors

### 1. Typical Issues for Individuals Who Use Wheelchairs, Scooters, or Other Mobility Devices

The interior accessible route connects the accessible entrance with the various service and activity areas within the shelter. Typically made up of hallways, corridors, and interior rooms and spaces, the accessible route is essential for people who have difficulty walking or who use wheelchairs or other mobility aids to get to all of the service and activity areas of the shelter.

An accessible route is at least 36 inches wide and may narrow briefly to 32 inches wide where the route passes through doors or next to furniture and building elements. High thresholds, abrupt level changes, steps, or steep running or cross slopes cannot be part of an accessible route. Where ramps are used, they cannot be steeper than 1:12. Ramps with a vertical rise of more than 6 inches must have handrails on both sides. Ramps must also have edge protection to stop wheelchairs from falling off the sides, and level landings at the top and bottom of each segment and where a ramp changes direction.

Where an accessible route is different from the route used by most evacuees, signs will be needed at key decision points to direct individuals with disabilities to the various activity areas.



**Interior of a shelter showing the accessible route from the accessible entrance to all service and activity areas.**

**Notes:**

1. Accessible Entrance
2. Accessible Route connects the accessible entrance with shelter service and activity area
3. Accessible door to service and activity areas

E1-a. Is there an accessible route, at least 36 inches wide, that connects the accessible entrance to all shelter areas (it may narrow to 32 inches wide for up to 2 feet in length)? [ADA Standards §4.3.2(3)]

Yes

No

E1-b. Is the accessible route free of steps and abrupt level changes over 1/2 inch?

Yes

No

Note: level changes between 1/4 inch and 1/2 inch should be beveled). [ADA Standards §§ 4.1.3(1), 4.3.8]

E1-c. Does the accessible route from the accessible entrance to all activity areas change levels using a ramp, lift or elevator? [ADA Standards §§4.1.3(1), 4.3.8]

Yes

No

If No, go to question E1-g.

c-i. If Yes, is a ramp or sloped hallway provided?

Yes

No

If Yes, go to question E1-d.

c-ii. Is an elevator or lift provided?

Yes

No

If Yes, and the elevator or lift is part of the accessible route to a shelter area, is back-up electrical power available to operate the elevator or lift for the duration of shelter operation should the normal electrical service be disrupted?

If Yes and an elevator is provided, see question E1-e.

If Yes and a lift is provided, see question E1-f.

If No, then either provide back-up electrical power to operate the lift or elevator during the power outage or locate shelter services exclusively on accessible levels that may be reached by people with a mobility disability without using an elevator or lift.

E1-d. Where the slope of the accessible route is greater than 1:20, does this area meet the following requirements for an accessible ramp?

Yes

No

d-i. Is the slope no greater than 1:12? [ADA Standards § 4.8.2]

Yes

No

Note: For existing ramps, the slope may be 1:10 for a 6-inch rise and 1:8 for a 3-inch rise in special circumstances]. [ADA Standards § 4.1.6(3)]

d-ii. Are handrails installed on both sides of each ramp segment? [ADA Standards § 4.8.5]

Yes

No

d-iii. Is the ramp width, measured between handrails, at least 36 inches? [ADA Standards § 4.8.3]

Yes

No

d-iv. Are the handrails mounted 34 to 38 inches above the ramp surface? [ADA Standards § 4.8.5]

Yes

No

d-v. If a ramp is longer than 30 feet, is a level landing at least 60 inches long provided every 30 feet? [ADA Standards §4.8.4]

Yes

No

d-vi. Does the ramp have a level landing that is at least 60 inches long at the top and bottom of each ramp section or where the ramp changes direction? [ADA Standards §4.8.4]

Yes

No

d-vii. If the ramp or landing has a vertical drop-off on either side of the ramp, is edge protection provided? [ADA Standards §4.8.7]

Yes

No

E1-e. Is an elevator provided to each of the levels on which each sheltering service or activity area is located?

Yes

No

e-i. Are the centerlines of the call buttons mounted 42 inches above the floor? [ADA Standards §4.10.3]

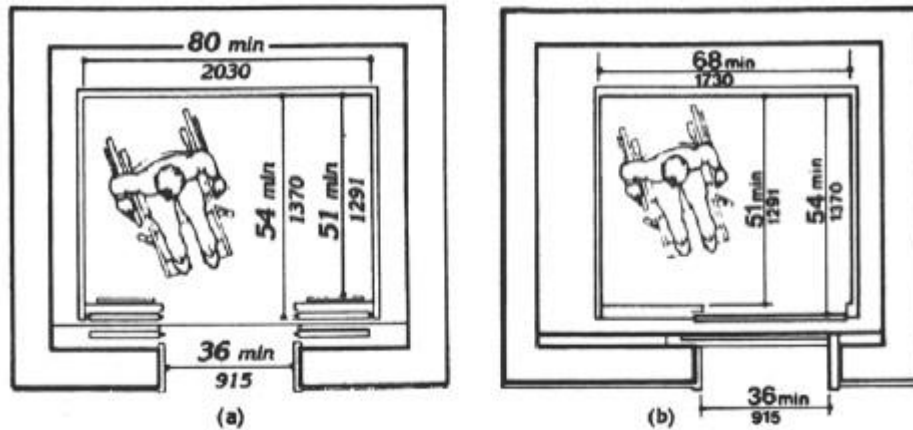
Yes

No

e-ii. Does the floor area of the elevator car have space to enter, reach the controls, and exit? [ADA Standards §4.10.9, Fig. 22]

Yes

No



**Fig. 22**  
**Minimum Dimensions of Elevator Cars**

*Note: See Figure 22 for acceptable floor and opening dimensions. Floor dimensions of at least 48 inches by 48 inches may be allowed in existing facilities built before the ADA went into effect.*

e-iii. Can the elevator be called and operated automatically without using a special key or having to turn on the elevator from a remote location? [ADA Standards § 4.10.2]

Yes

No

e-iv. Are the highest floor control buttons mounted no more than 54 inches above the floor for a side reach or 48 inches for forward reach? [ADA Standards § 4.10.12 (3)]

Yes

No

e-v. Are raised letters and Braille characters used to identify each floor button and each control? [ADA Standards § 4.10.12]

Yes

No

e-vi. Are signs mounted on both sides of the elevator hoist way door opening (for each elevator and at each floor) that designate the floor with 2-inch minimum-height raised letters and Braille characters centered at 60 inches above the floor? [ADA Standards §4.10.5]

Yes

No

e-vii. Is the elevator equipped with audible tones or bells or verbal annunciators that announce each floor as it is passed? [ADA Standards §4.10.13]

Yes

No

E1-f. If a wheelchair lift is provided, does it meet the following?

Yes

No

f-i. Is the lift operational at the time of the survey? [ADA Standards §4.11.3]

Yes

No

f-ii. Is the change in level from the floor to the lift surface ramped or beveled? [ADA Standards §§4.11.2, 4.5.2]

Yes

No

f-iii. Is there at least a 30-inch by 48-inch clear floor space on the wheelchair lift? [ADA Standards §§4.11.2, 4.2.4]

Yes

No

f-iv. Does the lift allow a person using a mobility device unassisted entry, operation (is key available, if required), and exit?

Yes

No

f-v. Are the controls and operating mechanisms mounted no more than 54 inches above the floor for a side reach or 48 inches for a forward reach? [ADA Standards §§ 4.11.2, 4.27.3]

Yes

No

f-vi. Are the controls and operating mechanisms usable with one hand without tight grasping, pinching, or twisting? [ADA Standards §§ 4.11.2, 4.27.4]

Yes

No

E1-g. At each location on the way to each shelter activity area where the accessible route passes through a door, does at least one door meet the following requirements?

Yes

No

g-i. Is the clear width for the door opening at least 32 inches measured when the door is open 90 degrees? [ADA Standards §§ 4.1.3(7), 4.13.5]

Yes

No

g-ii. Is the door hardware (e.g., lever, pull, push, panic bar) usable with one hand, without tight grasping, pinching, or twisting of the wrist, to allow people who may not be able to easily use one or both hands to fully operate the hardware? [ADA Standards § 4.13.9]

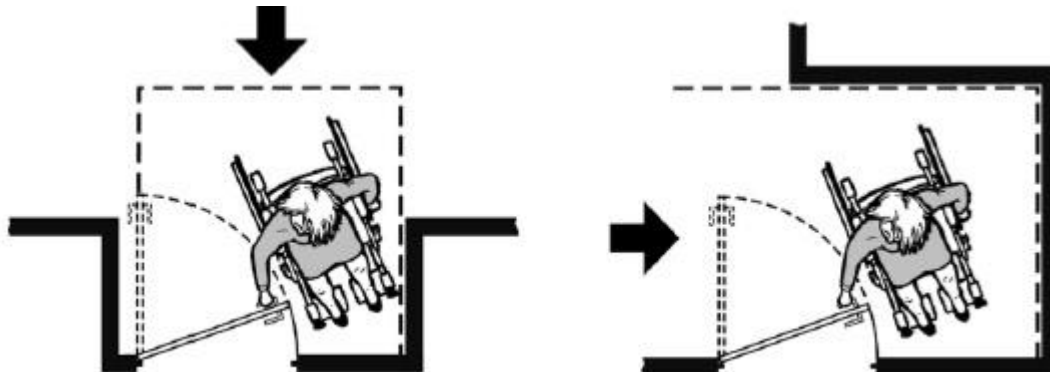
Yes

No

g-iii. Is there clear maneuvering floor space in front of each accessible door (see ADA Standards § Fig. 25) and, on the pull side, is there at least 18 inches clear floor space beyond the latch side of the door (see space configurations in Figure 25)? [ADA Standards § 4.13.6]

Yes

No



**A clear floor space on the latch side of the door (pull side) allows a person using a wheelchair or scooter to pull the door open and then enter. The size of the clear floor space varies depending on the direction of approach (shown by the arrows) and the door swing.**

g-iv. Is no more than 5 pounds force needed to push or pull open the door? [ADA Standards § 4.13.11 (2)(b)]

Yes

No

Note: Fire doors are still considered to be accessible if they have the minimum opening force allowable by the appropriate administrative authority.

g-v. If the answers to questions g-ii thru g-iv are No, can the door be propped open?

Yes

No

If an activity area is not on an accessible route and cannot be made accessible, find another area that is on an accessible route where that activity may be provided.

## **2. Typical Issues for People Who are Blind or Have Low Vision**

Individuals who are blind or have low vision may walk along any route or through any shelter activity area, not just the accessible routes. That means any area where people using the shelter can walk, including hallways, corridors, eating areas, and sleeping areas, must be free of objects that cannot be detected by a person who is blind or has low vision. Objects that are



wall mounted, that project into a pedestrian route from the side, or that are overhead must be located so that individuals who are blind or have low vision will either detect the objects before they run into them or safely pass under them. These routes must be free of overhanging objects that are less than 80 inches above the floor and side objects that protrude into the route more than 4 inches when the bottom of the object is more than 27 inches above the floor. Items to watch for include wall-mounted fire extinguishers and wall-mounted display cases when the bottom is more than 27 inches above the floor, wall sconces and light fixtures that protrude more than 4 inches off the wall, and open staircases, exit signs, overhead signs, banners, and arched doorways that are lower than 80 inches above the floor.



**Overhead and wall-mounted objects that may be hazards along a pedestrian route**

**Notes:**

1. Wall-mounted drinking fountains are a hazard when the front projects more than 4 inches beyond the wall and the bottom is more than 27 inches above the floor.
2. Wall-mounted objects cannot project more than 4 inches beyond the wall if the bottom is not in the cane-detectable area below 27 inches off the floor.
3. Overhead objects must be at least 80 inches off the floor.

The following questions apply to pedestrian routes serving or leading to the shelter activity and common use areas.

E2-a. Are pedestrian routes leading to or serving each service or activity area of the shelter free of objects that protrude from the side more than 4 inches into the route with the bottom of the object more than 27 inches above the floor? [ADA Standards §4.4.1]

Yes

No

Note: These objects may be wall mounted or free standing. Items to check include wall-mounted fire extinguishers, light fixtures, coat hooks, shelves, drinking fountains, and display cases.

E2-b. Are pedestrian routes leading to or serving each of the service or activity areas free of overhead objects with the bottom edge lower than 80 inches above the floor? [ADA Standards §4.4.2]

Yes

No

E2-c. Are any interior stairs along these routes configured with a cane-detectable warning or a barrier that prevents travel into the area with less than an 80-inch high head clearance so that people who are blind or who have low vision cannot hit their heads on the underside or stair frame? [ADA Standards §4.4.2]

Yes

No

If No, list the objects that are a hazard and their location. Remove or relocate the object or place a detectable object on the floor below each object to remove the hazard.



**When the underside of a stair is open, it is a hazard to people who are blind or have low vision. Enclosing the area below the stair or installing a cane detectable barrier helps the person to avoid the area.**

#### **F. Check-In Areas**

A shelter usually has one or more check-in areas located near the entrance to the shelter. When check-in areas are provided, then at least one accessible check-in location should be provided. The accessible check-in area should be at the accessible entrance or signs should give directions to the accessible check-in area.

If a permanent reception counter is used for check in, make sure to provide a writing surface at an accessible height for people who use a wheelchair, scooter, or other mobility device. This may be a part of the reception counter that is no higher than 36 inches above the floor, a folding shelf or an adjacent table, or a clip board.



**An accessible check-in location using a folding table with a height that people who use wheelchairs can easily reach.**

F1. Is there an accessible route that connects the accessible entrance to areas that are likely to be used to register people as they arrive at the shelter? [ADA Standards §4.3]

Yes

No

F2. If there is a built-in reception or other type of counter, does it have a section that is at least three feet long that is no higher than 36 inches above the floor or is there a nearby surface that is not higher than 36 inches above the floor? [ADA Standards §7.2]

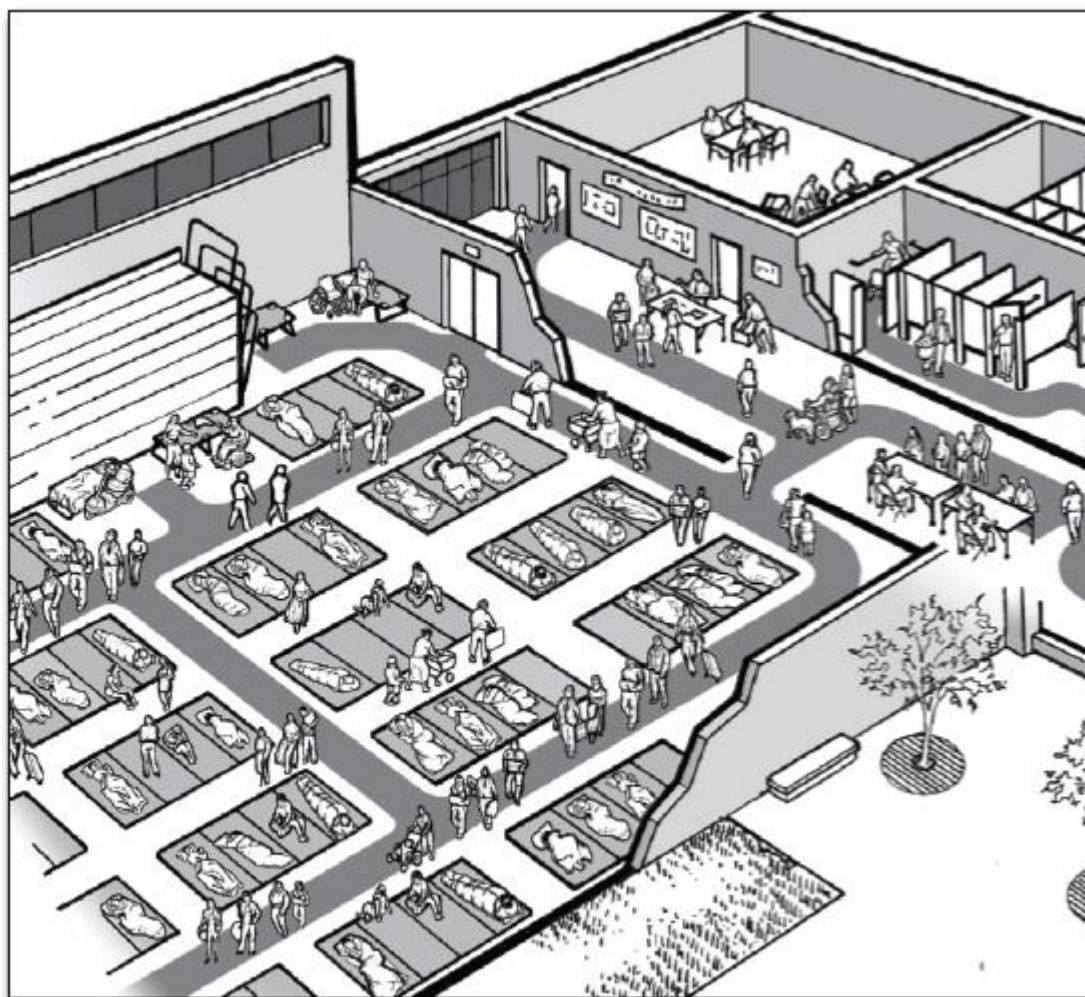
Yes

No

## **Living at the Emergency Shelter**

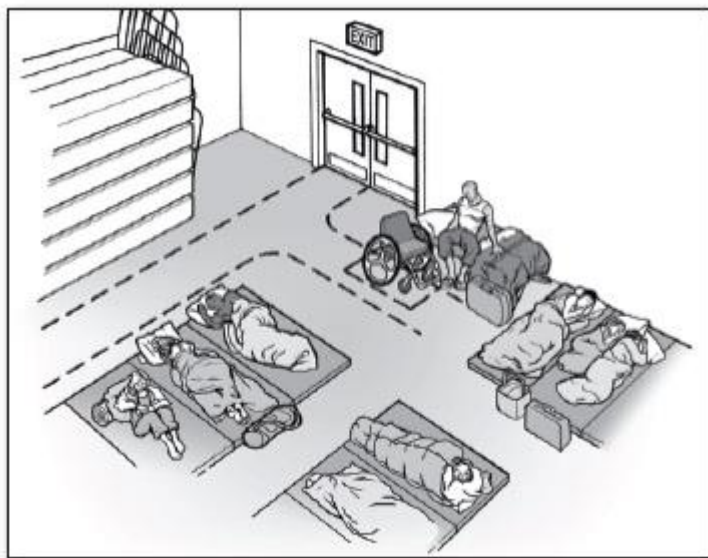
### **G. Sleeping Areas**

Each accessible sleeping area needs to be on an accessible route connecting it to other activity areas in the shelter, including toilet rooms and bathing areas. An accessible route with adequate circulation and maneuvering space provides access in the sleeping areas for people who use wheelchairs or scooters and this route serves each accessible bed or cot.



**Interior of one section of a shelter's sleeping area. The shaded pathway indicates the accessible route, which provides access to accessible beds, cots, and other activity areas in the space plus the toilet rooms and other activity areas in the shelter.**

Accessible cots have a sleeping surface at approximately the same height above the floor as the seat of a wheelchair (17 to 19 inches above the floor). When placed in several sections of the sleeping area, individuals who use a wheelchair, scooter, or other mobility device will be able to sleep near their family or other companions. An accessible route is needed to provide access to each accessible cot and a clear space at least 36 inches wide is needed along the side of the cot to make it possible to transfer between the mobility device and the cot. A preferred location for accessible cots is to have one side against a wall. This helps to stabilize the cot and the wall can act as a backrest when the person sits up on the cot.



**An accessible cot positioned against a wall. Dashed lines indicate the accessible route and clear floor space next to the cot.**

G1. Is there an accessible route, at least 36 inches wide, that connects each sleeping area with other shelter activity areas?

Yes

No

Note: it may narrow to 32 inches wide for up to 2 feet in length. [ADA Standards §4.3.2(3)]

G2. Is the accessible route free of steps and abrupt level changes over 1/2 inch?

Yes

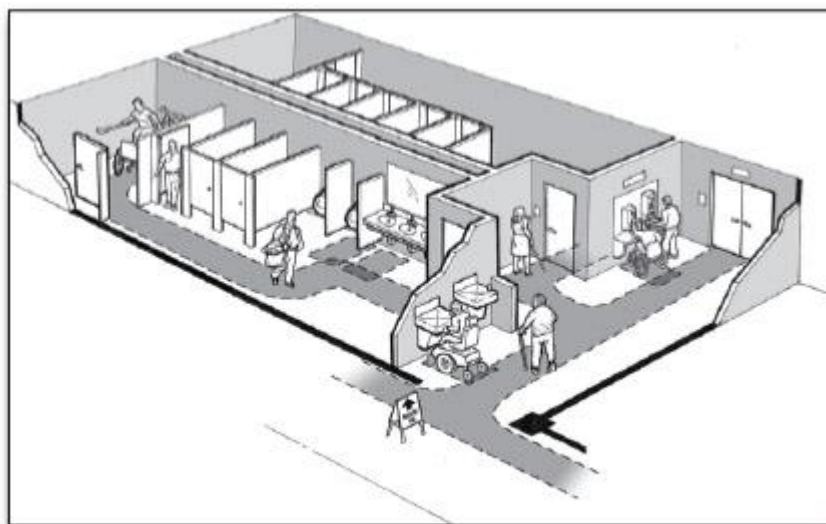
No

Note: level changes between 1/4 inch and 1/2 inch should be beveled). [ADA Standards §§ 4.1.3(1), 4.3.8]

Note: Although the facility survey cannot check the accessibility of the cots because they will not be installed until the shelter is in use, planning for setting up the sleeping area and for arranging the cots and mats should include providing space for an accessible route and clear floor space at each accessible cot. Cots used by people who are blind or who have low vision should be in an easily locatable area.

## H. Restrooms and Showers

At least one set of toilet rooms serving the shelter must be accessible to individuals who use a wheelchair, scooter, or other mobility device. In large shelters where more than one set of toilet rooms is needed to serve the occupants, it may be necessary to provide additional accessible toilet facilities or to establish policies to assure that individuals with disabilities have access to the accessible facilities.



**Interior of an accessible toilet room showing accessible route, clear floor space at accessible fixtures, and the wide accessible toilet stall.**

H1. If a sign is provided at the toilet room entrance (e.g. Men, Women, Boys, Girls, etc.), is a sign with raised characters and Braille mounted on the wall adjacent to the latch? [ADA Standards §4.30.6]

Yes

No

If No, install a sign with raised characters and Braille on the wall adjacent to the latch side of the door and centered 60 inches above the floor and leave the existing sign in place on the door if removing it will damage the door.

Note: an additional sign may be mounted on the toilet room door but this cannot be considered to be the accessible sign which must be mounted on the wall adjacent to the latch side of the door.

H2. Does the door to the toilet room provide at least 32 inches clear passage width when the door is open 90 degrees? [ADA Standards §4.13.5]

Yes

No

H3. Is the hardware (e.g., lever, pull, panic bar) usable with one hand without tight grasping, pinching, or twisting of the wrist? [ADA Standards §4.13.9]

Yes

No

If No, can the door be propped open without compromising privacy, or can the hardware be modified by adding new accessible hardware, or adapting or replacing hardware?

H4. On the pull side of the door, is there at least 18 inches clearance provided on the latch side if the door is not automatic or power-operated? [ADA Standards §4.13.6, Fig. 25]

Yes

No

H5. If there is a raised threshold, is it no higher than 3/4 inch at the door and beveled on both sides? [ADA Standards §§4.1.6(3)(d)(ii), 4.13.8]

Yes

No

NA

If No, replace threshold with one with beveled sides or add a sloped insert.

H6. If the entry has a vestibule, is there a 30-inch by 48-inch clear floor space inside the vestibule where a wheelchair or scooter user can be outside the door swing? [ADA Standards §4.13.7]

Yes

No

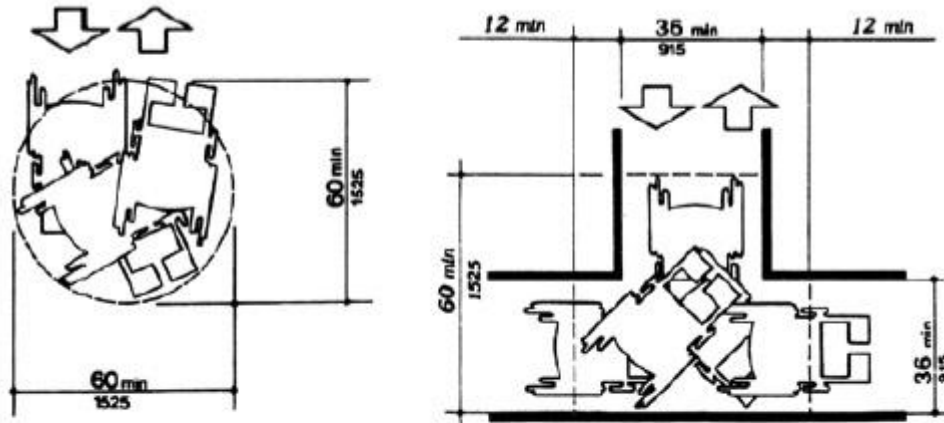
If No, possible solutions include leaving the inner door open or removing the outer door.



H7. Inside the toilet room, is there an area where a person who uses a wheelchair or other mobility device can turn around - either at least 60-inch diameter circle or a “T”-shaped turn area as shown in the figures below? [ADA Standards §§ 4.22.3; 4.2.3]

Yes

No



Minimum spaces for turning

Minimum spaces for turning

H8. If lavatories are provided, does at least one have at least a 29 inch high clearance under the front apron with the top of the rim no more than 34 inches above the floor? [ADA Standards § 4.19.2]

Yes

No

H9. Are the drain and hot water pipes for this lavatory insulated or otherwise configured to protect against contact? [ADA Standards § 4.19.4]

Yes

No

H10. Does this lavatory have controls that operate easily with one hand, without tight grasping, pinching, or twisting of the wrist? [ADA Standards § 4.19.5]

Yes

No

H11. If mirrors are provided, is the bottom of the reflecting surface for the mirror at this lavatory no higher than 40 inches above the floor or is a full length mirror provided? [ADA Standards §4.19.6]

Yes

No

H12. For at least one of each type of dispenser, receptacle, or equipment, is there clear floor space at least 30 inches wide x 48 inches long adjacent to the control or dispenser (positioned either parallel to the control or dispenser or in front of it)? [ADA Standards §§4.23.7; 4.27.2; 4.2.5 and Fig 5; 4.2.6 and Fig 6]

Yes

No

H13. Is the operating control (switch, lever, button, or pull) of at least one of each type of dispenser or built-in equipment no higher than 54 inches above the floor (if there is clear floor space for a parallel approach) or 48 inches (if there is clear floor space for a front approach)? [ADA Standards §§4.23.7; 4.27.3; 4.2.5 and Fig 5; 4.2.6 and Fig 6]

Yes

No

H14. Are all built-in dispensers, receptacles, or equipment mounted so the front does not extend more than 4 inches from the wall if the bottom edge is between 27 inches and 80 inches above the floor? [ADA Standards §§4.23.7; 4.27; 4.4.1; Fig. 8]

Yes

No

### **Toilet Stalls**

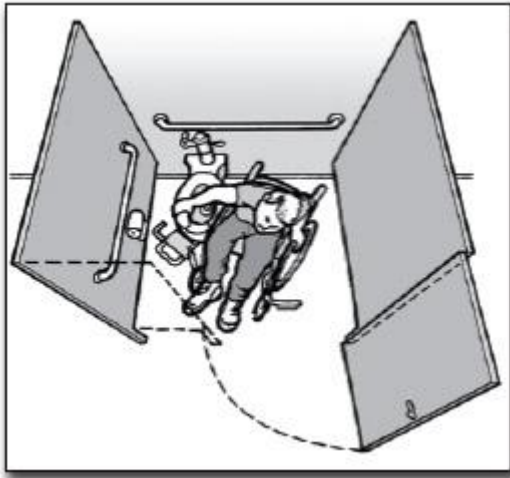
H15. Is at least one wide toilet stall provided with an out swinging door, side and rear grab bars, and clear space next to the toilet? [ADA Standards §4.17]

Yes

No

If No, check to see if another toilet room provides a wide accessible toilet stall, note its

location for shelter planners, and answer all toilet room questions with respect to that toilet room.



**Overhead view of an individual using a wheelchair positioned beside a toilet in a wide accessible stall.**

H16. Is the toilet stall at least 60 inches wide and 56 inches deep (wall mounted toilet) or 59 inches deep (floor mounted toilet)? [ADA Standards §4.17.3]

Yes

No

If No, note the width and depth of the stall. \_\_\_\_\_

H17. Is at least 9 inches of toe clearance provided under the front wall and at least one side wall of the toilet stall? [ADA Standards §4.17.4]

Yes

No

H18. Is the centerline of the toilet 18 inches from the adjacent side wall? [ADA Standards § 4.16.2; 4.17.3]

Yes

No

H19. Is the top of the toilet seat 17 inches to 19 inches above the floor? [ADA Standards § 4.16.3]

Yes

No

H20. Is the flush valve located on the wide side adjacent to the lavatory or is an automatic flush valve provided? [ADA Standards §4.16.5]

Yes

No

H21. Is a horizontal grab bar at least 40 inches long securely mounted on the adjacent side wall 33 to 36 inches above the floor with one end no more than 12 inches from the back wall 33 to 36 inches above the floor? [ADA Standards §4.16.4; 4.17.6]

Yes

No

H22. Is a second horizontal grab bar at least 36 inches long securely mounted on the back wall with one end no more than 6 inches from the side wall 33 to 36 inches above the floor? [ADA Standards §4.16.4; 4.17.6]

Yes

No

H23. Is the door to the toilet stall located diagonally opposite, not directly in front of, the toilet or on the opposite side wall from the wall with the long grab bar? [ADA Standards §4.17.3]

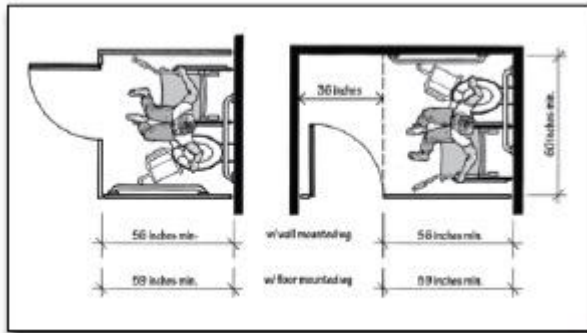
Yes

No

H24. Unless the wide stall is located at the end of a row of toilet stalls, does the door to this wider stall open out? [ADA Standards §4.17.3]

Yes

No



**Plan views showing minimum sizes of wide accessible toilet stall**

H25. Is the clear width of the door at least 32 inches (measured between the face of the door and the edge of the opening) when the door is open 90 degrees? [ADA Standards § 4.13.5]

Yes

No

H26. If there are 6 or more stalls in the restroom, is one of those stalls (in addition to the wider stall noted above) exactly 36 inches wide with an out swinging stall door that provides at least 32 inches of clear width? [ADA Standards § 4.22.4]

Yes

No

H27. Does this 36-inch wide stall have horizontal grab bars on both of the side partitions that are at least 36 inches long and 33 to 36 inches above the floor? [ADA Standards § 4.22.4]

Yes

No

H28. Is the surface of the toilet seat in this 36-inch-wide stall 17 to 19 inches above the floor? [ADA Standards §§ 4.16.3; 4.22.4]

Yes

No

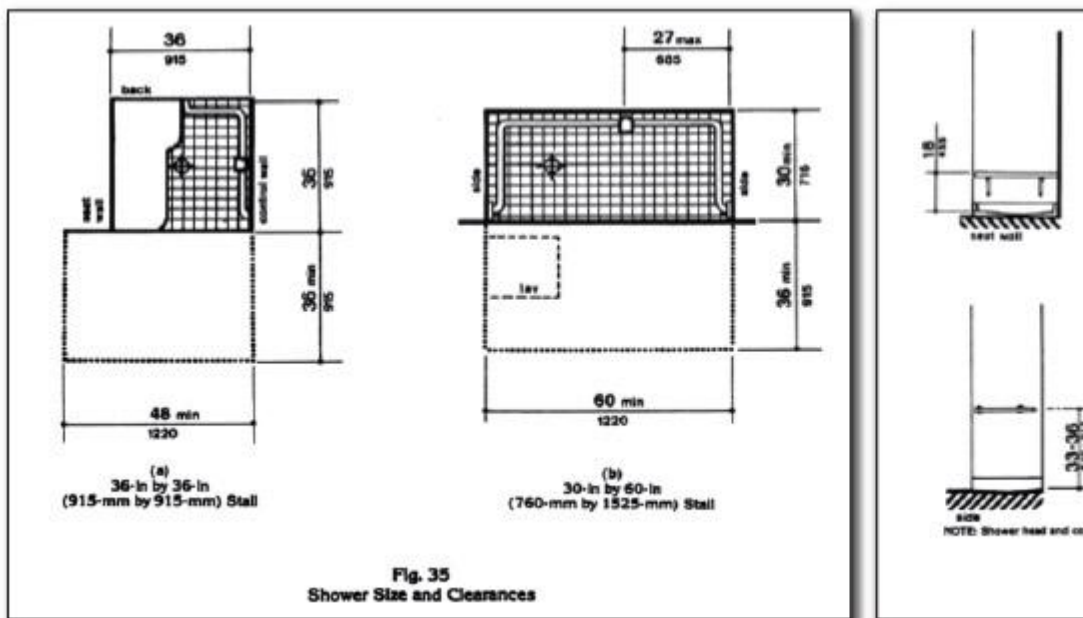
H29. If a coat hook is provided is it mounted no higher than 54 inches above the floor for a side approach or 48 inches above the floor for a front approach? [ADA Standards § 4.25.3]

Yes

No

Note: For many emergency shelters, evacuees are not expected to use shower or bathing facilities due to the short period they may stay at the shelter. If planning for the shelter operation includes offering shower or bathing facilities, then those facilities should be on an accessible route and checked for accessibility. For information on the requirements for accessible showers or bathtubs see the ADA Standards for Accessible Design which is available online at [www.ada.gov](http://www.ada.gov).

**The following are figures illustrating some accessible shower features from the ADA Standards.**



**Accessible Shower Stall  
Minimum Size and Clearances**

**Accessible Shower Stall Grab Bars  
and Seat, Shower, and Control Area**

## I. Public Telephones

When public telephones are provided, then one or more accessible public telephones should be provided in areas serving shelter activity and service areas. Whenever accessible telephones are provided, each should be on an accessible route. In shelters it is common to provide additional telephones on tables or desks and some of these telephones should be accessible.

A text telephone (also commonly known as a TTY) is a device that allows individuals who are deaf or hard of hearing or who have a speech disability to communicate over a telephone.

Having at least one TTY in any building that has at least four pay phones, provides access for people who are deaf or hard of hearing.

I1. If at least one public telephone or one bank of telephones is provided, does at least one of each type of telephone (e.g., pay telephone, intercom telephone, other telephone) have the following?

Yes

No

I1a. For a side approach (clear floor space at least 30 inches long x 48 inches wide), is the coin slot no higher than 54 inches above the floor? [ADA Standards §4.31.2, Fig. 44 (a)]

Yes

No

I1b. For a front approach (where clear floor space at least 30 inches wide x 48 inches long), is the coin slot no higher than 48 inches above the floor? [ADA Standards §4.31.2, Fig. 44 (b)]

Yes

No

I2. Does the phone have volume controls? [ADA Standards §4.31.5]

Yes

No

I3. If three or more telephones are located in one bank serving the shelter, are a shelf and an electrical outlet provided at one telephone for use of a portable TTY? [ADA Standards §4.31.9 (2)]

Yes

No

I4. If four or more pay telephones are provided on the site, is there a TTY (text telephone) provided at the shelter?

Yes

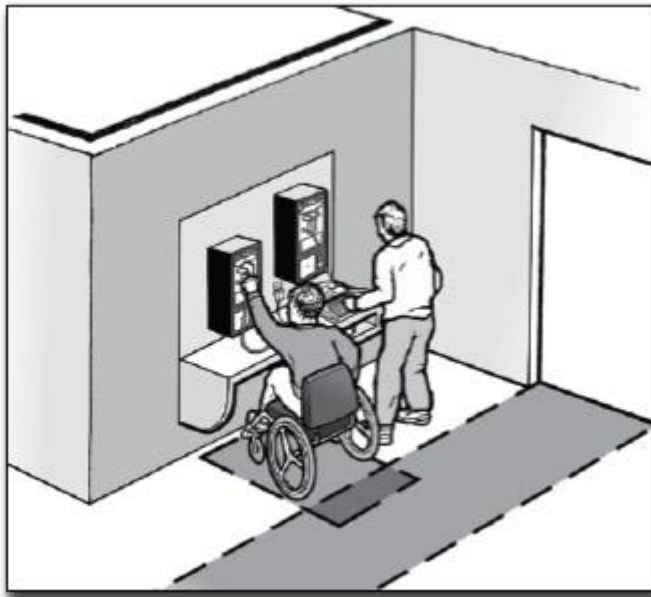
No

If yes, location \_\_\_\_\_

I5. Is there a sign at each pay phone or pay phone bank for the shelter directing people to the nearest TTY? [ADA Standards § 4.30.7 (3); 4.31.9(3)]

Yes

No



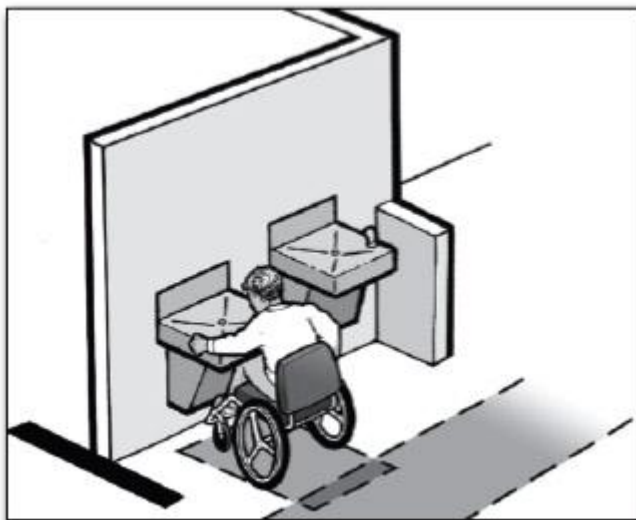
**A bank of two public telephones. The accessible telephone is on the left and the telephone on the right is equipped with a TTY.**

### **J. Drinking Fountains**

Approximately 50% of the drinking fountains serving the shelter must be accessible and located on an accessible route. Accessible drinking fountains must have enough space for a person using a wheelchair, scooter, or other mobility device to use the drinking fountain. The spout and controls of the drinking fountain must be near the front edge. The controls must be usable with one hand without tight grasping, pinching, or twisting of the wrist. The other 50% of drinking fountains serving the shelter must be configured for use by people who have difficulty bending or stooping while standing.

When an object, such as a drinking fountain, protrudes more than four inches into the circulation path, the bottom edge must be at 27 inches above the floor or lower so the drinking fountain is not a hazard to people who are blind or have low vision.





**A person who uses a wheelchair is drinking from an accessible drinking fountain. Beside the accessible drinking fountain is a standard height fountain that is usable by people who have difficulty bending or stooping. The short wall beside the standard height drinking fountain is cane-detectable to guide people who are blind or have low vision away from the standard height fountain which, otherwise, would be a protruding object hazard.**

**The following questions apply to 50% of the drinking fountains that are provided.**

J1. If the drinking fountain is a wall-mounted unit, is there clear floor space at least 30 inches wide (36 inches if it is in an alcove) x 48 inches long in front of the drinking fountain and at least 27 inches high under the fountain so that a person using a wheelchair can get close to the spout and controls? [ADA Standards § 4.15.5 (1), Figs. 4 (e) and 27 (b)]

Yes

No

J2. If the drinking fountain is a floor-mounted unit, is there clear floor space at least 30 inches long x 48 inches wide (60 inches if it is in an alcove) for a side approach to the drinking fountain so that a person using a wheelchair can get close to the spout and controls even though the fountain has no clear space under it? [ADA Standards § 4.15.5 (2), Figs. 4 (e), 27 (c) and (d)]

Yes

No

J3. Is the top of the spout no higher than 36 inches above the floor and at the front of the fountain or water cooler? [ADA Standards §4.15.2]

Yes

No

J4. Does the water rise at least 4 inches high when no more than 5 pounds of force is applied to the controls of the fountain? [ADA Standards §§4.15.3 and 4.15.4]

Yes

No

J5. Are the controls on or near the front of the unit and do they operate with one hand without tight grasping, pinching, or twisting of the wrist? [ADA Standards §4.15.4]

Yes

No

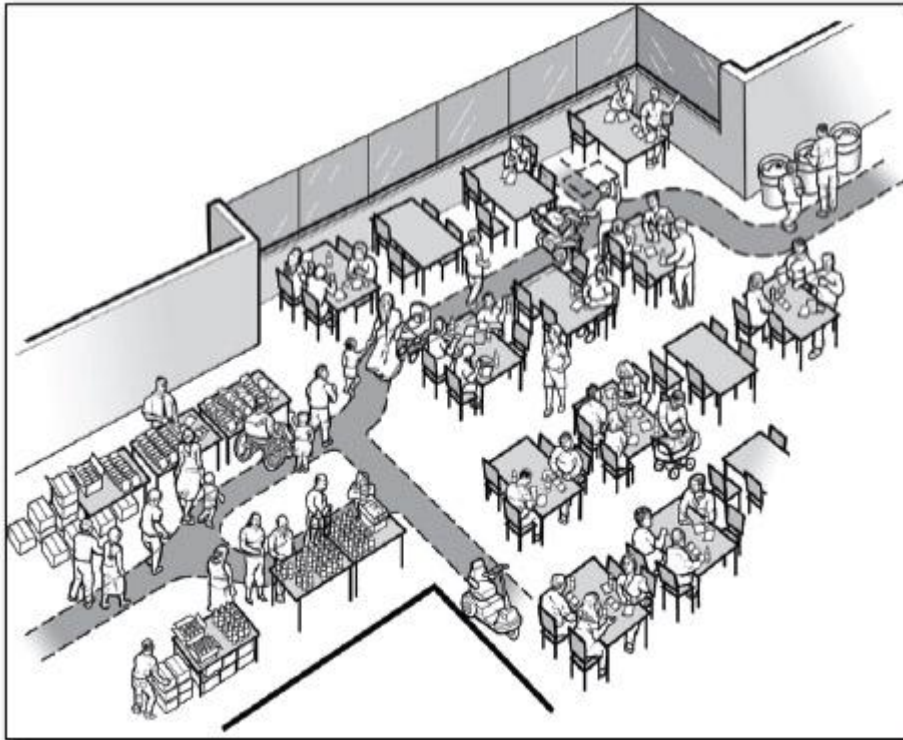
J6. Is the bottom of the apron of the fountain 27 inches above the floor so that it provides the space needed for a person who uses a wheelchair to pull up under it but is not a hazard to people who are blind or have low vision and use a cane to detect hazards? [ADA Standards §§4.15.5 (1) and 4.4.1]

Yes

No

### **K. Eating Areas**

An accessible route, at least 36 inches wide and without steps or steep slopes, must be provided to and throughout the food service and eating areas of the shelter. The accessible route allows people who use wheelchairs, scooters, and other mobility devices to get to all of the food and drink items in the shelter and to accessible tables and seating.



**A serving and eating area in a shelter are shown above. The shaded pathway illustrates the accessible route connecting the entrance, serving areas, accessible seats and tables, and the exit.**

K1. Is there an accessible route, at least 36 inches wide, that connects each of the shelter activity areas with the food service and eating areas (it may narrow to 32 inches wide for up to 2 feet in length)? [ADA Standards §4.3.2(3)]

Yes

No

K2. Is there an accessible route that is at least 36 inches wide that connects accessible tables with serving, condiment, and dispenser areas? [ADA Standards §5.3; 4.3.8]

Yes

No

K3. In each eating area, if tables with fixed seats are provided, do at least 5% of each type of table with fixed seats have accessible locations with knee space at least 27 inches high, at least 19 inches deep, and at least 30 inches wide with a table top 28 to 34 inches above the floor? [ADA Standards §5.1]

Yes

No

Note: If movable tables and chairs are used as shown, then locate at least 5% of the tables adjacent to an accessible route. Tables can be relocated as needed during operation of the shelter.

K4. If built-in food, drink, condiment, and tableware dispensers are provided, are dispensers and operating controls mounted no higher than 54 inches above the floor if clear floor space is provided for a side approach? [ADA Standards §5.5]

Yes

No

K5. If the operating controls are set back 10 to 24 inches from the front edge of the counter or table are they no higher than 46 inches above the floor? [ADA Standards §5.5]

Yes

No

K6. If food service lines are provided, is an accessible route provided (at least 36 inches wide) and are the tray slides no higher than 34 inches above the floor? [ADA Standards §5.5]

Yes

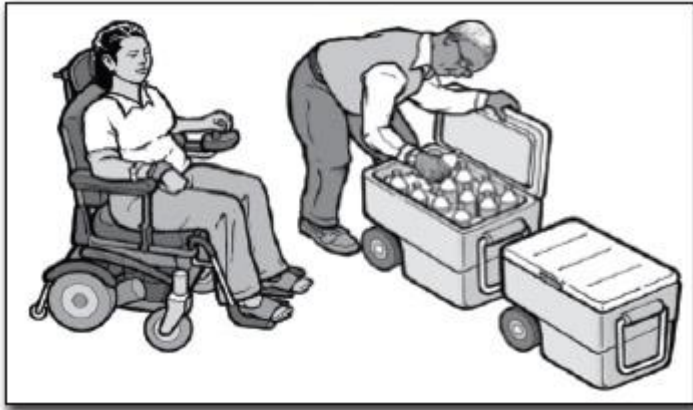
No

## **Other Issues**

### **L. Availability of Electrical Power**

Emergency shelters should have a way to provide a back-up power supply when the electrical service is interrupted. The back-up power is needed to provide refrigeration of medicines, operation of supplemental oxygen and breathing devices, and for charging the batteries of power wheelchairs and scooters. Individuals whose medications (certain types of insulin, for example) require constant refrigeration need to know if a shelter provides supplemental power for refrigerators or ice-packed coolers. Individuals who use medical support systems, such as supplemental oxygen, or who require periodic breathing treatments using powered devices rely on a stable source of electricity. These individuals must have access to electric power from a generator or other source of electricity while at a shelter.

In general, in each community or area where a shelter is provided, a facility must have one or more back-up generators or other sources of electricity so that evacuees with a disability who rely on powered devices can have access to electrical power while at the shelter.



L1. Is there a backup source of electrical power for the facility?

Yes

No

L2. Is there a refrigerator or other equipment, such as coolers with a good supply of ice, at the shelter?

Yes

No

### **M. Single-User or “Family” Toilet Room**

In many schools and large facilities where emergency shelters are often located, single-user toilet rooms may be provided for staff. In those facilities built or altered since the ADA went into effect, single-user toilet rooms should have accessible features that could be useful during shelter operation. These features include an accessible entrance and turning and maneuvering spaces. These rooms should also have been built to allow grab bars, accessible controls, and accessible hardware to be easily installed.

As part of the planning for operating an emergency shelter, facilities operators should consider using an available staff toilet room, if provided, as a single-user or “family” toilet room. When provided in addition to large accessible toilet rooms, this type of facility permits a person with a disability to receive assistance from a person of the opposite sex.

M1. If a sign is provided at the toilet room entrance (e.g. Men, Women, Boys, Girls, etc.), is a sign with raised characters and Braille mounted on the wall adjacent to the latch side of the door and centered 60 inches above the floor? [ADA Standards §4.1.3(16)(a)]

Yes

No

If No, install a sign with raised characters and Braille on the wall adjacent to the latch side of the door and centered 60 inches above the floor and leave the existing sign in place on the door if removing it will damage the door.

Note: an additional sign may be mounted on the toilet room door but this cannot be considered to be the accessible sign which must be mounted on the wall adjacent to the latch side of the door.

M2. Does the door to the toilet room provide at least 32 inches clear passage width when the door is open 90 degrees? [ADA Standards §4.13.5]

Yes

No

M3. Is the hardware (e.g., lever, pull, etc.) usable with one hand without tight grasping, pinching, or twisting of the wrist? [ADA Standards §4.13.9]

Yes

No

If No, add new accessible hardware or adapt/replace hardware.

M4. On the latch, pull side of the door, is there at least 18 inches clearance provided if the door is not automatic or power operated? [ADA Standards §4.13.6; Fig. 25]

Yes

No

M5. If there is a raised threshold, is it no higher than 3/4 inch at the door and beveled on both sides? [ADA Standards §§4.1.6(3)(d)(ii); 4.13.8]

Yes

No

If No, replace threshold with one with beveled sides or add a sloped insert.

M6. Inside the room is there an area for a person who uses a wheelchair to turn around - either a 60-inch diameter circle or a "T"-shaped turn area? [ADA Standards §§ 4.22.3; 4.2.3]

Yes

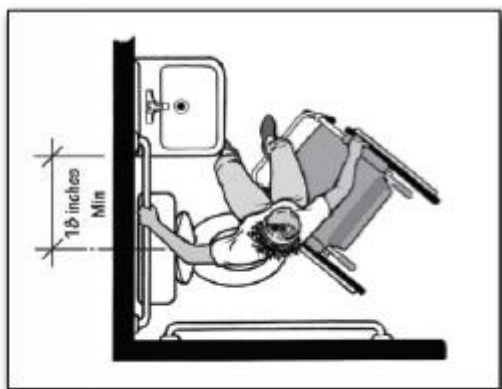
No

M7. If the door swings into the room, does the door swing not overlap the required clear floor space for the toilet or lavatory? [ADA Standards §§ 4.22.2; 4.2.4.1]

Yes

No

Note: In the figure below the clear floor space for the toilet extends at least 66 inches from the back wall.



**Plan view showing the minimum amount of space required between the toilet and the adjacent lavatory.**

M8. Is there at least 18 inches between the center of the toilet and the side of the adjacent lavatory? [ADA Standards § 4.16.2; Fig. 28]

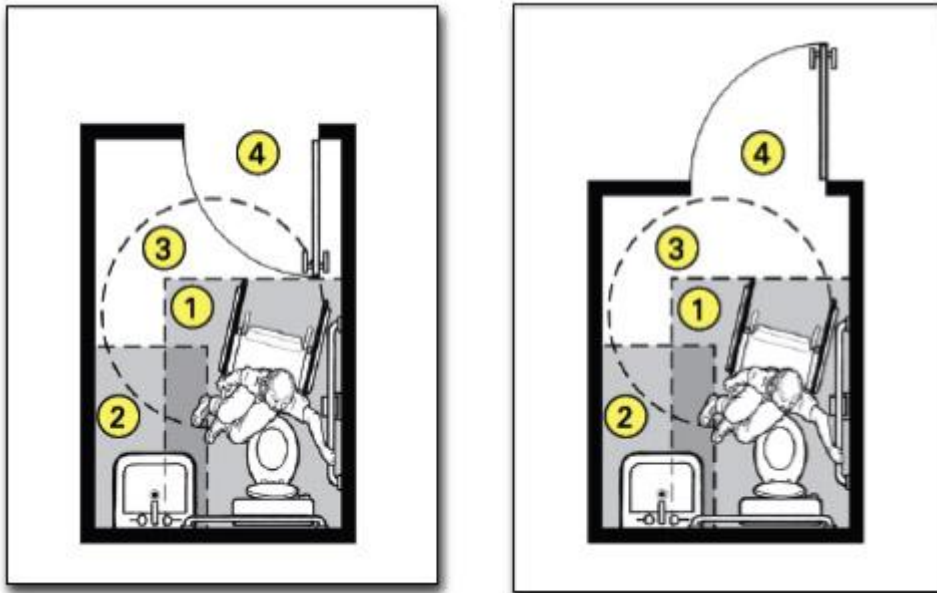
Yes

No

M9. Does the lavatory have at least a 29-inch-high clearance under the front edge and the top of the rim no more than 34 inches above the floor? [ADA Standards § 4.19.2]

Yes

No



**Plan view of a single-user toilet room showing the door swing not overlapping the dark toned area indicating the clear floor space for the toilet and lavatory. The door swing may overlap the turning space indicated by the circular area.**

**Notes:**

1. 48-inch minimum by 66-inch minimum clear floor space for toilet
2. 48-inch minimum by 30-inch minimum clear floor space for lavatory
3. 60-inch minimum turning space
4. door swing

M10. Are the drain and hot water pipes for the lavatory insulated or otherwise configured to protect against contact? [ADA Standards §4.19.4]

Yes

No

M11. Does that lavatory have controls that operate easily with one hand, without tight grasping, pinching, or twisting of the wrist? [ADA Standards §4.19.5]

Yes

No



M12. If a mirror is provided, is the bottom of the reflecting surface no higher than 40 inches above the floor or is a full length mirror provided? [ADA Standards §4.19.6]

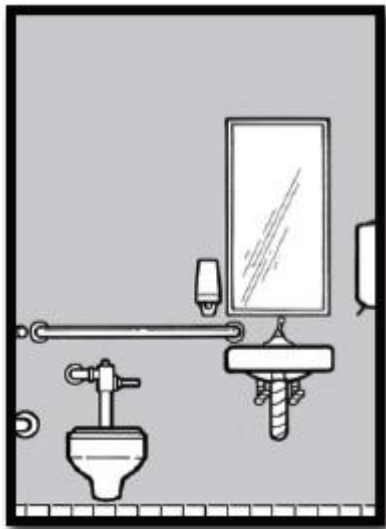
Yes

No

M13. For each type of dispenser, receptacle, or equipment, is there clear floor space at least 30 inches wide x 48 inches long adjacent to the control or dispenser (positioned either parallel to the control or dispenser or in front of it)? [ADA Standards §§4.23.7; 4.27.2; 4.2.5 and Fig. 5; 4.2.6 and Fig. 6]

Yes

No



**front view of toilet, lavatory,  
mirror and soap dispenser**

M14. Is the operating control (switch, lever, button, or pull) for each type of dispenser or built-in equipment no higher than 54 inches above the floor (if there is clear floor space for a parallel approach) or 48 inches (if there is clear floor space for a front approach)? [ADA Standards §§4.23.7; 4.27.3; 4.2.5 and Fig. 5; 4.2.6 and Fig. 6]

Yes

No

M15. Are all built-in dispensers, receptacles, or equipment mounted so the front does not extend more than 4 inches from the wall if the bottom edge is between 27 inches and 80 inches above the floor? [ADA Standards §§4.23.7; 4.27; 4.4.1; Fig. 8]

Yes

No

M16. Is the centerline of the toilet 18 inches from the adjacent side wall? [ADA Standards §§ 4.16.2; 4.17.3]

Yes

No

M17. Is the top of the toilet seat 17 to 19 inches above the floor? [ADA Standards §4.16.3]

Yes

No

M18. Is the flush valve located on the side adjacent to the lavatory? [ADA Standards § 4.16.5]

Yes

No

M19. Is a horizontal grab bar at least 40 inches long securely mounted on the adjacent side wall 33 to 36 inches above the floor with one end no more than 12 inches from the back wall? [ADA Standards §§4.16.4; 4.17.6]

Yes

No

M20. Is there a horizontal grab bar at least 36 inches long securely mounted behind the toilet 33 to 36 inches above the floor with one end no more than 6 inches from the side wall? [ADA Standards §§4.16.4; 4.17.6]

Yes

No

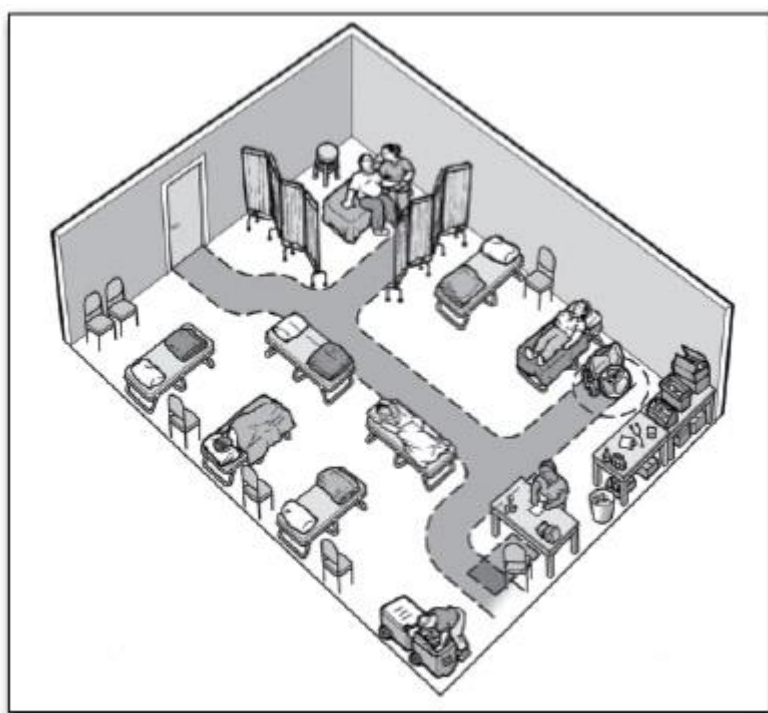
M21. If a coat hook is provided, is it mounted no higher than 54 inches above the floor for a side approach or 48 inches above the floor for a front approach? [ADA Standards §4.25.3]

Yes

No

#### **N. Health Units/Medical Care Areas**

In many schools, where emergency shelters are often located, nurses' rooms or other types of health care facilities may be provided. These health care facilities should be on an accessible route and have accessible features, including an accessible entrance, an accessible route to the different types of services offered within the medical care unit, turning and maneuvering spaces, and cots or beds that are at a height to which people who use mobility devices can easily transfer.



**An overhead view of a medical care area with a shaded pathway showing the accessible route shown and clear floor spaces.**

N1. Is there an accessible route, at least 36 inches wide, that connects each of the shelter activity areas with the health units and medical care areas (it may narrow to 32 inches wide for up to 2 feet in length)? [ADA Standards §4.3.2(3)]

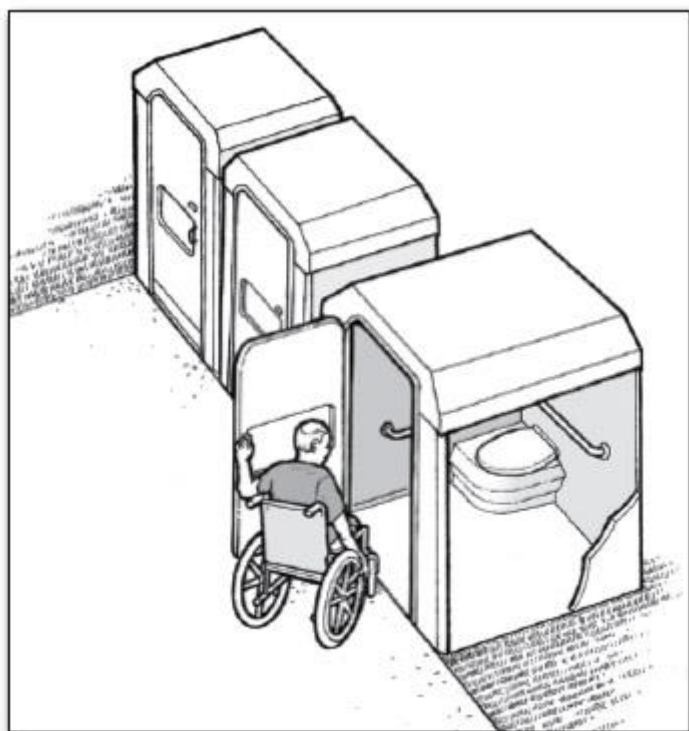
Yes

No

#### **O. Accessible Portable Toilets**

Portable toilets are often used at emergency shelters to supplement permanent toilet facilities. When portable toilets are provided, at least one must be a unit with accessible features that is located on an accessible route connecting it with the shelter. For the entrance to an accessible portable toilet to be usable, there must either be no step or a ramp must be installed that extends from the hinge side of the door to at least 18 inches beyond the latch side of the door.

Accessible portable toilets should have similar features to a standard accessible toilet stall including an accessible door, side and rear grab bars, clear space next to the toilet, and maneuvering space.



**A person using a wheelchair enters an accessible portable toilet. The unit is positioned to provide a level entry from the accessible route.**

Appendix B

Brochure of Vertebrae Bathroom System Product

VERTEBRAE®

Bathrooms are a space for refreshing both the body and mind, and is one of the few places where we are alone for a few moments in the day. We tend to the needs of our bodies whilst our imagination can run free to envisage our future.

Environments and the objects within consist of materials, forms and colours, which influence the way we feel, think and communicate. Space also has the same effect, and is an increasingly desired commodity within our cities, homes, leisure and work place.

When we experience new pleasures we feel an over powering sense of well being and generally become revitalised and inspired. Yet some of life's greatest pleasures come from the simplest of objects and actions.

Vertebrae unites the functions of the bathroom with an original, simplistic, unified and vertical solution.

Inspired by nature.

In humans the cervical vertebrae has seven individual vertebrae, connecting the spine to the skull, which allow the head to rotate, with each containing a hole which the vertebral artery passes through. The Vertebrae vertical bathroom consists of seven rotating modules, each supported on the modular column, which allows the services to pass through and connect to the relevant module.

Intrigued by architecture.

The Lloyds building in London by Richard Rogers combines an industrial aesthetic with clean, crisp, smooth lines and curves. Each of the Vertebrae module's surfaces, curves and lines harmonize to form a sculpture which traverses the floor and ceiling.

Influenced by design.

The late Italian designer Joe Colombo and his great works, ranging from the futuristic living systems to the visual simplicity of the Boby Trolley.

Transforming the preconceptions of bathroom design and pioneering a new way forward for space optimization.

The world's first vertical bathroom...

Designed to utilize vertical space the Vertebrae reduces the amount of floor space required for a bathroom. The product is suited for wet rooms, within apartments, corporate or leisure environments.

Architects and developers can reclaim a few square metres on their existing bathroom footprint and use this space for a larger living area, or fit another one or two apartments on plan, increasing the financial return.



Employers within corporate environments can increase their staff output and loyalty by offering employees a place to refresh themselves after, winning that big contract, a strenuous day, or a morning cycle to work.

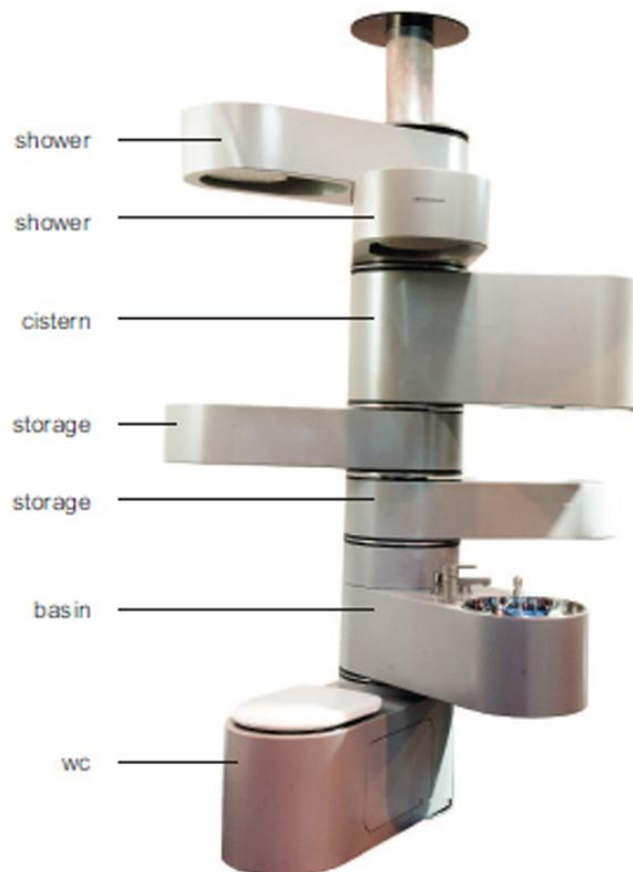
Boutique hotels can take advantage of the bespoke design service and collaborate on the design of their own Vertebrae, with luxury extras, culminating in offering their clients the exclusivity they so desire.

Ideal for residential new build or renovation projects. When it comes to bathrooms your dream space deserves the latest in bathroom innovation, style and colour.



The Vertebrae shown has seven compact modules that rotate around a modular structural services column. Comprising a WC, basin, storage x 2, cistern with mirror (not shown) and shower x 2. The modules also have removable panels to allow access to services for connection and maintenance.

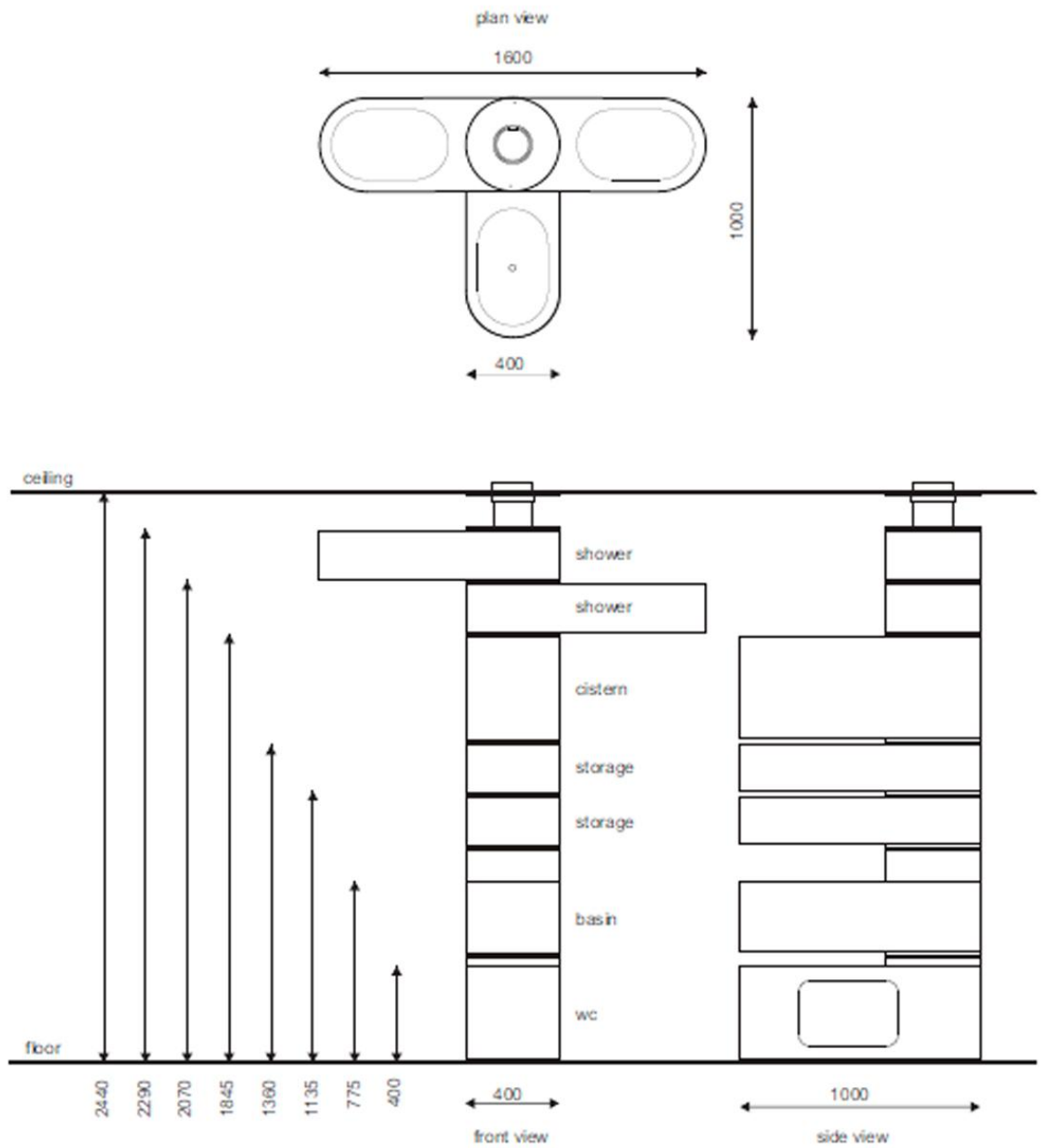
Each module is hand crafted from 3mm aluminium, with polished hand welded seams, finished with a durable powder paint finish. Including both the standard and special ranges, there are approximately 175 colours available, with matt or gloss finishes.

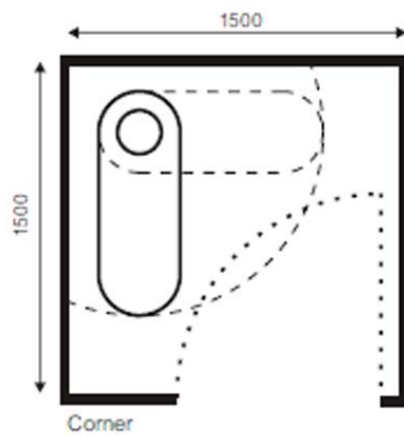


All the services are fed from the top of the product through a hole in the ceiling, down the inside of the modular structural services column and into the relevant module for connection. The WC and basin waste pipes can be directed through a hole in the floor (hidden), or out of the rear of the WC module and through the wall (exposed).

When installing the product, the modules are stacked on top of one another, with each one being fixed to the module above and below. A top column and locking ring secure the overall product. This product must be installed in a sealed wet room with an adequate slope to the floor for drainage purposes.

Product dimensions.



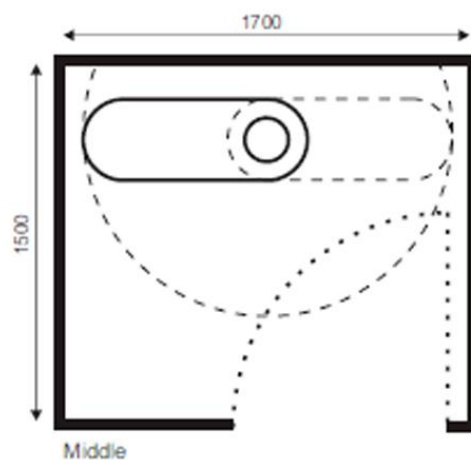


**Space requirements.**

The Corner installation allows the modules to rotate up to 100 degrees. This scenario is for one user at a time.

This scenario is for small spaces and the minimum floor space requirement is approximately;

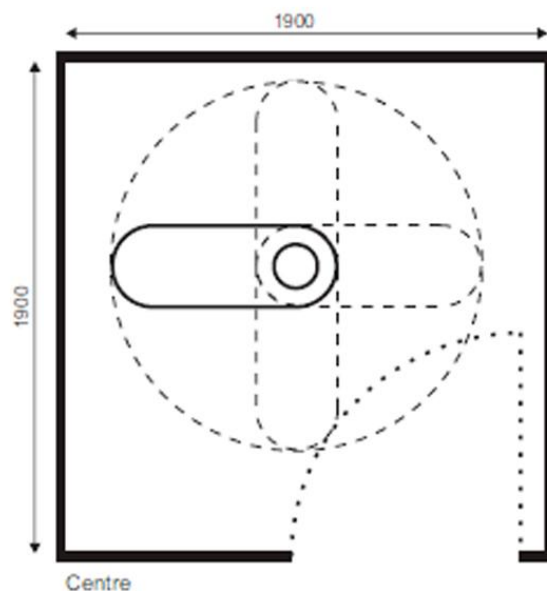
$$1.5\text{m} \times 1.5\text{m} = 2.25 \text{ sq/m.}$$



The Middle installation allows the modules to rotate up to 200 degrees. This is the maximum rotation for any module supplied with services.

When opened out, the product width is no larger than a standard bath length. This scenario allows two people to shower simultaneously using a floor space of:

$$1.5\text{m} \times 1.7\text{m} = 2.55 \text{ sq/m.}$$



The Centre installation allows the storage modules to be rotated continuously, with the remaining modules restricted at 200 degrees, due to services.

This scenario is suitable for an approximate standard bathroom floor space of:

$$1.9\text{m} \times 1.9\text{m} = 3.61 \text{ sq/m.}$$



Detail view showing one of the two shower modules. Fitted with a large 200mm diameter shower head featuring rubber nozzles to prevent the build up of limescale and hard water deposits etc. Chrome plated finish.

The shower controls are situated on the basin module and can be accessed whilst showering, when the remaining modules are in the closed position.



Storage module with a robust polycarbonate cover and rubber seal.

Basin module with stainless steel hemispherical bowl, soap dispenser, single lever mixer tap and thermostatic shower valve with on/off flow control, 3 way diverter, and temperature control.

The 3 way diverter feeds the two overhead showers and a separate pull-out hand shower (not shown).



WC module, with a soft close toilet seat and lid, and a robust stainless steel toilet pan.

The two access doors on the side of the module open to reveal the toilet paper and toilet brush, and allow for the connection of services.

### Availability

The Vertebrae is available in a large selection of RAL colours, or we can match to suit your unique colour preference.  
Discounts are available for bulk orders. Retail enquiries are also welcome.  
Product available late 2011.

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## Appendix C

### Design Process of Self-design Folding Furniture





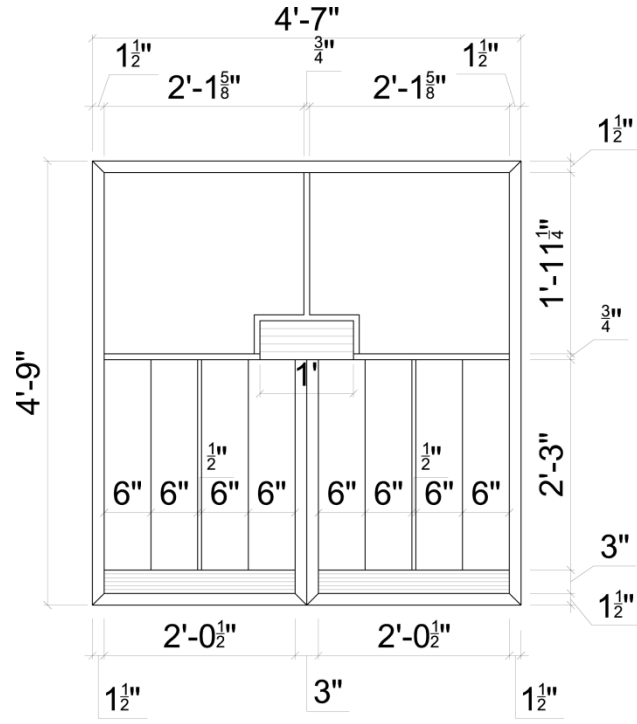




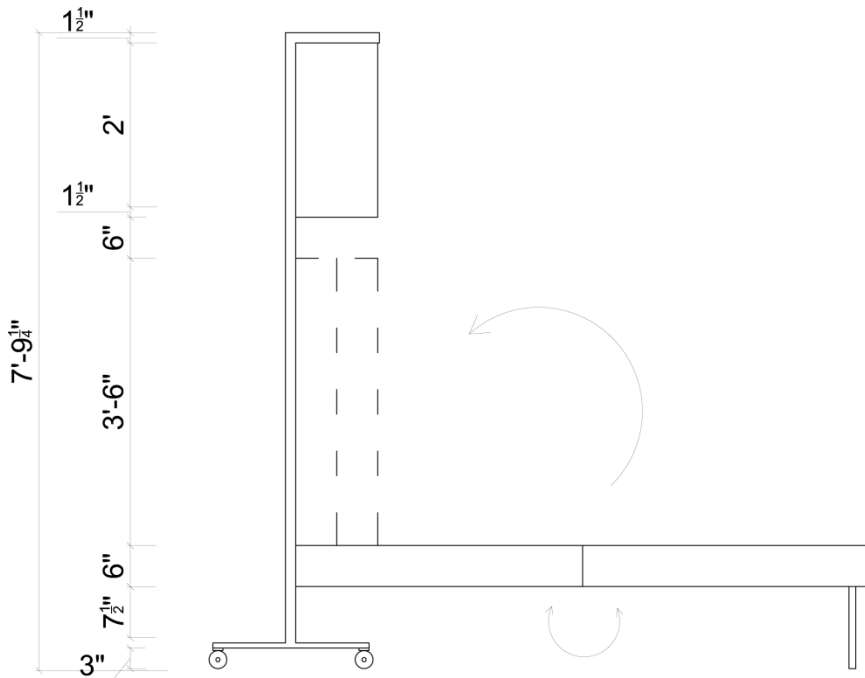


## Appendix D

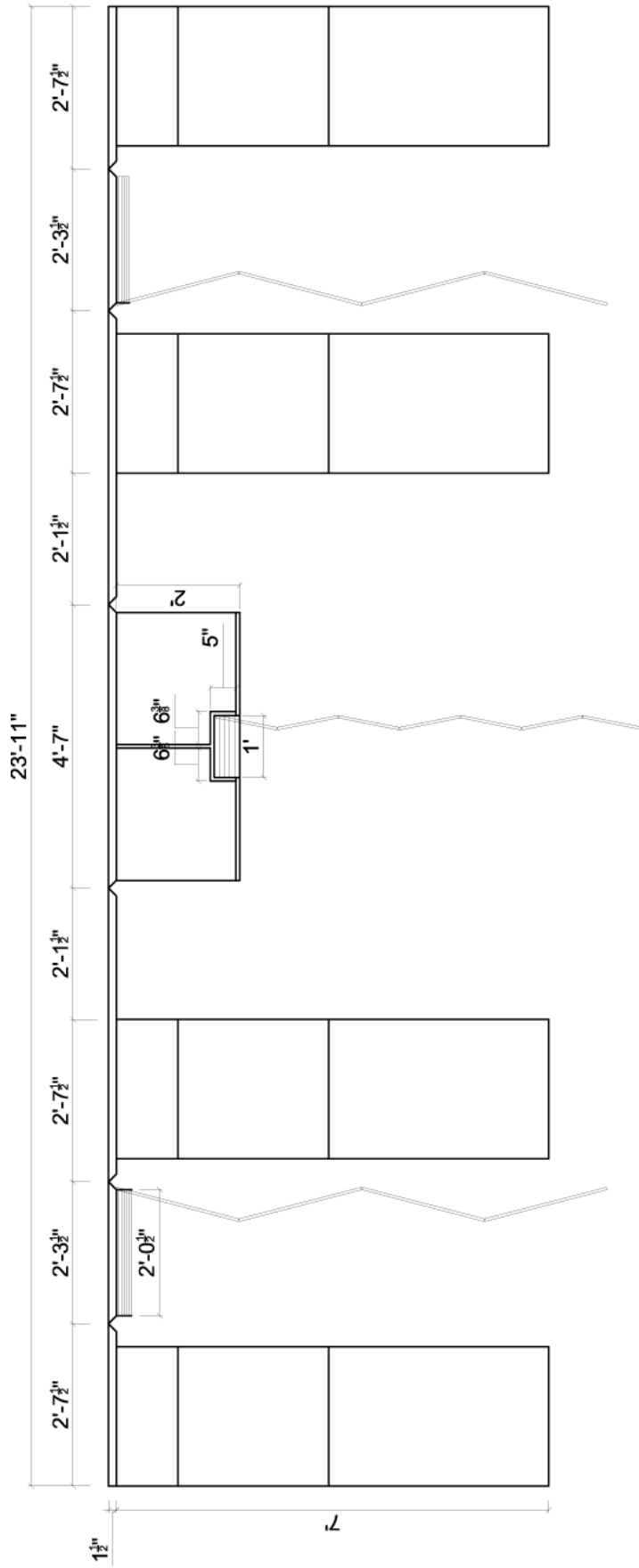
### High Resolution Drawings



FLOOR PLAN-FOLDED

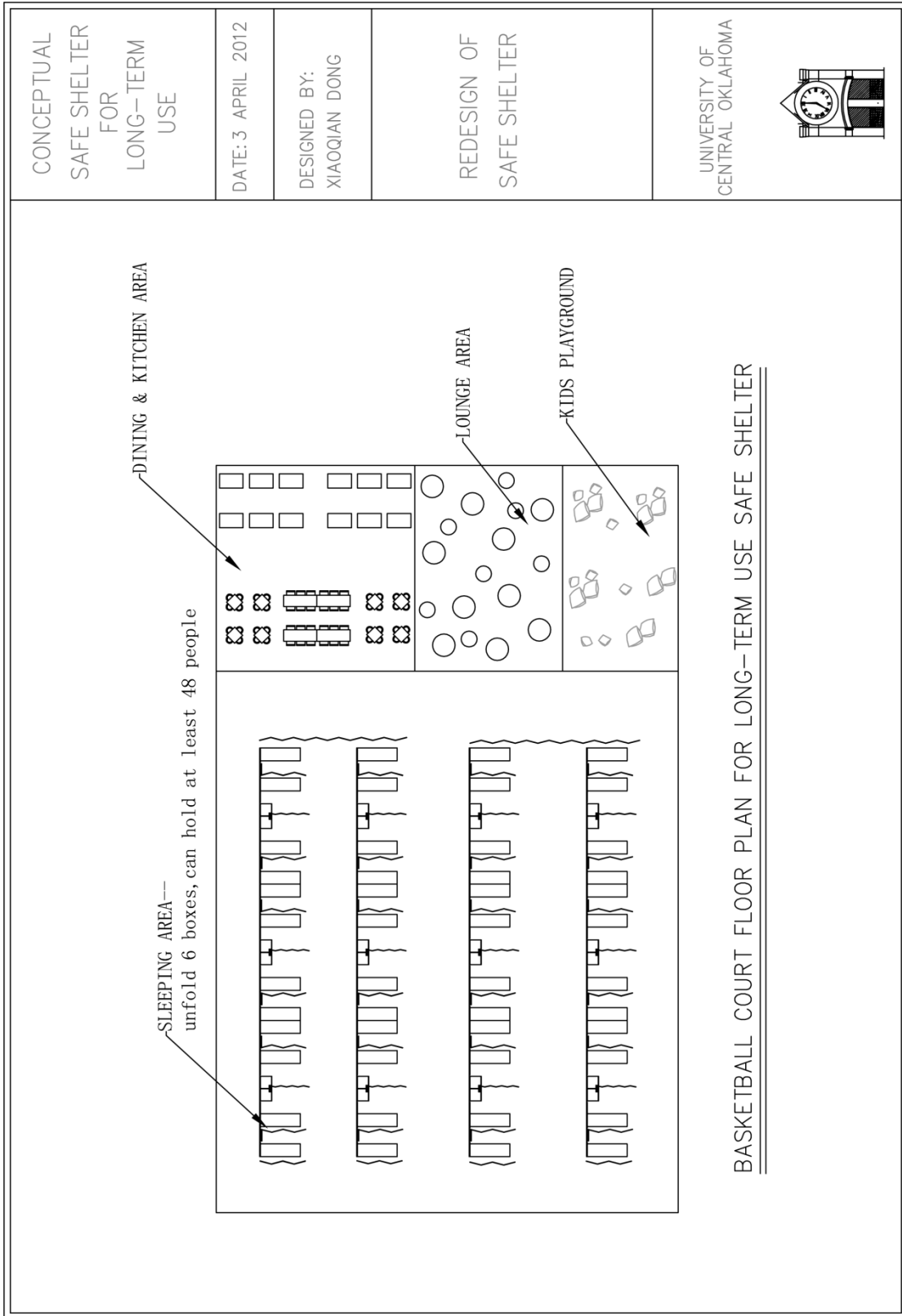


ELEVATION



FLOOR PLAN—UNFOLDED





BASKETBALL COURT FLOOR PLAN FOR LONG-TERM USE SAFE SHELTER

CONCEPTUAL  
SAFE SHELTER  
FOR  
LONG-TERM  
USE

DATE: 3 APRIL 2012

DESIGNED BY:  
XIAOQIAN DONG

REDESIGN OF  
SAFE SHELTER

UNIVERSITY OF  
CENTRAL OKLAHOMA

