Chapter 11: Bunkers and Safe Rooms [1]

Generally, a ***bunker*** is defined as "*a reinforced underground shelter, typically for use in wartime*." It is a form of shelter. It protects the body. Although bunkers can be above or below ground, typically, they are below ground. Being below ground helps protect those in the bunker. Also, the use of bunkers has spread to include natural as well as other man-made disasters and crises other than war.

A ***safe room*** is generally defined as "*a room in a house or other building that is invulnerable to attack or intrusion, and from which security operations can be directed*." Essentially, it is a bunker within the home. In contrast with the definition, it may not always be invulnerable to attack or intrusion. It may be designed to simply slow down and delay intruders until the police arrive. Depending on the situation, a safe room can be an inconspicuously looking hardened room or it can be an impenetrable concrete bunker.

In terms of Surviving the Unexpected Emergency Model, bunkers and safe rooms can be used for both natural and man-made disasters. Topically, a review of their protective ability can be group into tornados, crime and war. Of the natural disasters listed, tornados are the most likely natural disaster for which a bunker or safe room offers protection. Safe rooms are generally associated with home invasions. However, variations of a safe room can be used for protection from tornados also. Although bunkers are usually associated with war, they can also provide protection against tornados or crime. It is an issue of tailoring the facility to its intended use.

Tornados and Safe Rooms

Referring to the Surviving the Unexpected Emergency Model, tornados are the most likely natural disaster requiring a safe room or bunker. Figure 11.1 is a map of the United States showing the likelihood of tornados occurring.

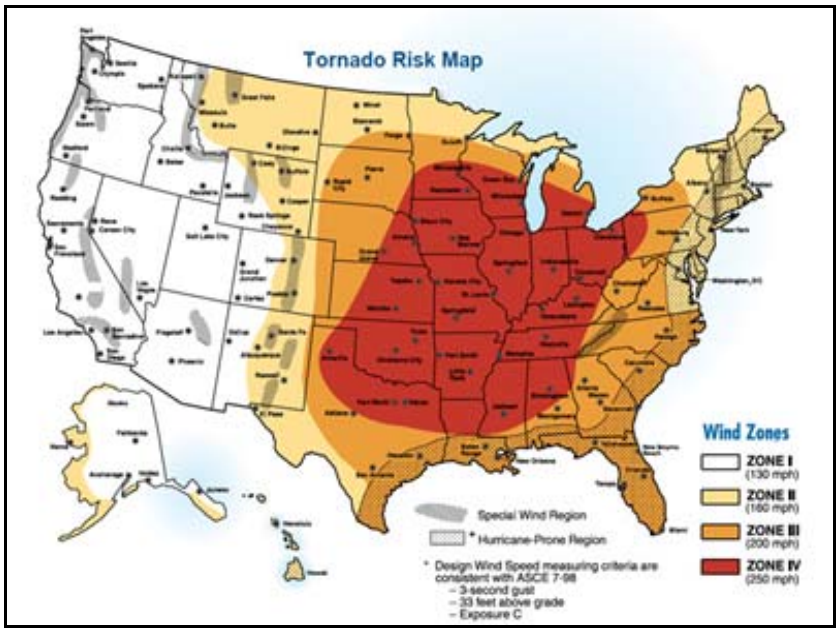

Figure 11.1 – Tornado map of the United States. Source: internet – [file:\SH-TornadoMap[55].jpg].

Since tornados are short term events, the main purpose of the shelter is to provide protection from the tornado. Food, water, sanitation and other amenities are not really needed. Protection can be either above or below ground. Figure 11.2 shows a

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typical prefabricated below-ground storm shelter. Given its size, it is clearly a short-term living arrangement.

In contrast, Figure 11.3 shows an above-the-ground storm shelter that has weathered the storm. Imagine sitting in this structure during the storm. It would be a harrowing experience to say the least. The sound of the tornado. Hearing the house being demolished around the structure. Hearing debris bouncing off the structure. Feeling helpless and knowing that your survival is totally dependent upon the structural integrity of the safe room.

Figure 11.2 – Typical below-the-ground storm shelter. Source: internet – [file:SH-Tornado01[50].jpg].

Crime and Safe Rooms

Safe rooms can offer protection against home invasions and to a lesser extent burglary. In general, the emphasis of a burglar is on robbing personal property when the home owners are not home. As a general rule, burglars operate during the day when people are not at home. They operate alone and seek to avoid confrontation. They are deterred by security signs on the lawn, bars on doors and windows, dogs, alarms, and of course, locks on the doors.

Figure 11.3 – An above-the-ground storm shelter. The experience would be harrowing. Source: internet – [file:\SH-Tornado02[63].jpg].

In contrast, home invasions occur when people are at home. They focus on both robbing personal property and on intimidating the occupants. They tend to operate as a group or gang. Usually, the home invasion is purposely done while the occupants are home and it often includes power, intimidation, control, terror, and possible physical injury or death to the occupants. Home invasions tend to focus on women, seniors, or wealth people. Generally, home invasions occur in the evening or on weekends. A burglary gone wrong can easily turn into a home invasion, but given their druthers, most burglars prefer homes without occupants.

In general, there has been a rise in home invasions. Part of the reason is that convenience stores and other traditional targets are less attractive and they have become more difficult targets. They have less cash on hand. They have installed surveillance systems, video camera, and silent alarms. Comparatively, homes have become an attractive alternative.

<b>**Home Invasion Strategies** – Essentially, home invasions can be divided into four phases: Entering the home, controlling the occupants, delaying capture, and calling the police. The premise of this strategy is that a safe room or hardened room can delay capture of one or more persons long enough to call the police and for the police to arrive onsite. To be successful, one or more people need to be able to access the room once a home invasion begins. Also, the room should contain a charged cell phone.

<c>***Entering the Home*** – Home invaders can use a variety of methods to enter the house. They can simply kick down the door or enter through an unlocked door. They can use trickery and deception by impersonating a delivery person with flowers or a package. Or they may simply knock on the door and people open the door not expecting that a home invasion is occurring.

Assume being surprised. Whether the home invaders knock down the door, impersonate a delivery person, or simply knock on the door, their entry into your home will create surprise and disorientation. Initially, surprise gives the invaders an advantage.

<c>***Controlling the Occupants*** – Using the element of surprise, the home invaders will immediately seek to obtain control of the inhabitants. The fewer people present, the easier this becomes for the invaders. A senior alone in the house is fairly easy to control once entry has been obtained.

<c>***Delay Capture*** – Initially, the invaders will enter the home and will seek immediate control over its occupants. One or more of the occupants needs to quickly recognize the situation and make their way safely to the safe room where they will call the police. This may involve some pre-planning and practice so that it is a practiced activity. Also, this means that the safe room needs to be located so that it is easily accessible in time of an emergency or invasion. Analyze likely points of entry such as the front or rear doors. Remember, for this strategy to work, at least one family member needs to make it safely to the safe room.

<c>***Call the Police*** – In most cases, once the police are called the invaders will leave. Leave a charged disposable cell phone in the safe room at all times. A land line can be used, but the invaders may cut the line prior to entering the building.

<c>***Rescue Curve*** – Consider this scenario in terms of the rescue curve. Creating the safe room is "*safety and prevention*." By design, the scenario advocates moving directly to "*rescue by others outside your group*," in this case the police. "*Self-rescue*" and "*rescue by others in your group*" can be considered getting one or more of the family members into the safe room. However, given the element of surprise, it may be challenging to have family members safely access the safe room. Also, if the family members fight back, it is "*rescue by others in your group*."

<b>**Creating an Inexpensive Safe Room** – As with many things, it is easy for safe rooms to become sophisticated, expensive and out of reach for most people. They can easily become reinforced concrete bunkers with heavy steel doors. They can easily become a special use room concealed secretly behind bookcases. They can easily become expensive wasted space in a small house where space is at a premium.

Return to the basic strategy advanced in the previous section, delay capture and call the police. A safe room needs to provide sufficient protection to delay capture before the arrival of the police. In most cases, the home intruders will leave once they realize the police are on their way.

The purpose of this section is to provide a practical and inexpensive safe room. Other than the three deadbolts, there is little visual evidence that the door is different from other doors. First, this section shows how a normal door is hung and why it offers little protection in a home invasion. In contrast, modifications can be made to inexpensively harden the door and walls of a room to create a safe room that will protect its occupants long enough until the police arrive.

<c>***Typical Interior Door Construction*** (Figure 11.4) – Walls are constructed using 2"x4" studs sheathed with sheet rock or wallboard. In many homes and buildings today, metal studs may have replaced the 2"x4" wood studs. Structurally, there is no difference. The wall may slow down a home invader, but it

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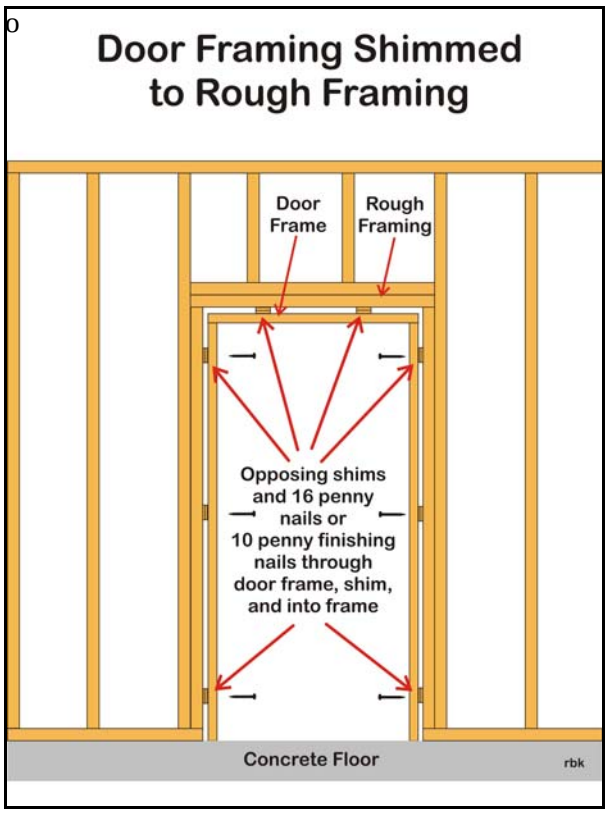

Figure 11.4: Framing Out the Door – Normally, the door frame is fastened to the rough framing with opposing shim, three sets on each side. Source: author – [file:\SH-DoorConstruction05.cdr].

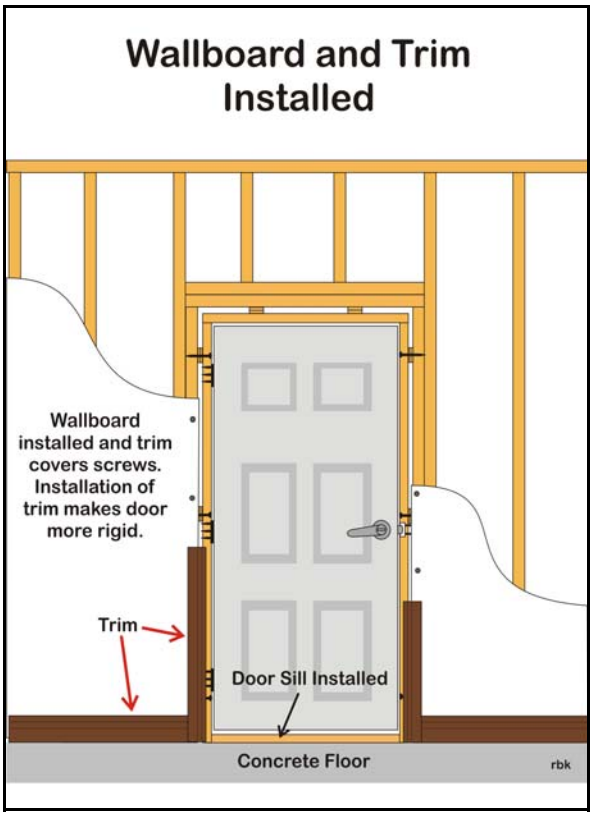

Figure 11.5: Wallboard and Trim Installed – Nailing the trim stiffens up the door. From a security standpoint the typical door installation is designed to prevent an intrusion. Source: author – [file:\SH-DoorConstruction02.cdr].

ffers little protection to a determined invader. A hammer can easily and quickly break through the wallboard and wall.

Typical interior door construction offers little protection against an intruder. A rough door frame is framed using 2x4s (Figure 11.4). On an interior door, this is usually two 2x4s back-to-back. In some cases, people will install a header which is usually two 2x10"s standing on their sides.

Next, the door frame is installed within the rough frame (Figure 11.4). If the door is pre-hung, the entire door is installed. Using opposing wooden shims, the door frame is shimmed on the sides until it is plumb. Usually, the door frame is shimmed and fastened at three points on each side of the frame using ten penny finishing nails driven through the shims into the rough frame. In a secure door, FEMA recommends five points of fastening on each side of the door rather than the typical three points.

The hinges are fastened to the door frame with wood screws (Figure 11.5). Normally, the hinges are connected to the door frame but not directly into the rough framing. From a home intrusion perspective, this creates a weak point in the door. Interior doors usually open outwardly. This places the hinges facing outward. An intruder can easily take a hammer and nail and pop the pins out of the hinges. The door can be opened. Most likely, the intruder will simply break down the door.

The door knob is installed (Figure 11.5). The receptacle is installed with two screws into the door jam. The screws may or may not screw into the rough frame. This creates one point of contact on this side of

the door and in terms of security, it is a vulnerable point. When breaking down a door in the movies, the police usually kick down the door knob side of the door. It is the obvious weak point. A home intruder will normally break down the door on the door knob side also.

Finishing the door, the wallboard is hung on the walls and the trim is nailed to the door jam and wall. Installing the trim stiffens up the door considerably. For normal use, this door installation is perfectly satisfactory.

As noted, normal construction is susceptible to a home intruder breaking into the room. The intruder can take a hammer and easily pound a hole through the wallboard. Another approach is that most interior door locks are designed to be opened with a pin or small nail inserted into the door knob from the outside. This prevents people or children from purposely locking themselves in a room. Another method of entry is that the intruder can easily remove the pins from the hinges and remove the door from its hinges. Most likely, the intruder will simply kick down the door on the door knob side and enter the room as shown in the movies.

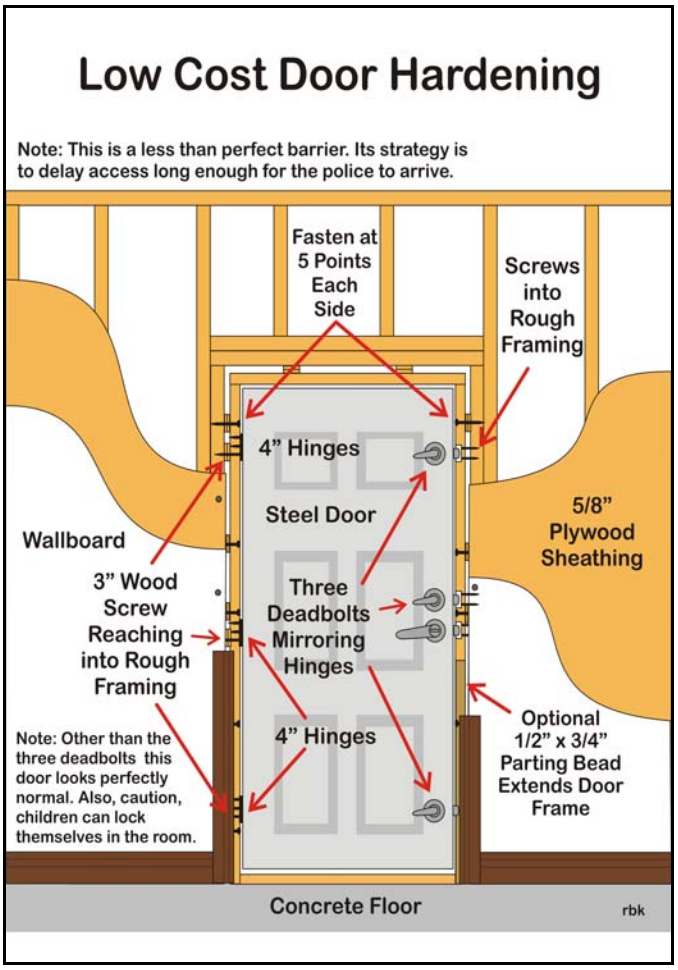

Figure 11.6: Low Cost Door Hardening – The design is to delay intrusion long enough for the police to arrive. The 5/8" plywood sheathing delays entry through the wall. The steel door, three deadbolts and other measures makes this door hard to break down. Source: author – [file:\SH-DoorConstruction01.cdr].

<c>***Hardened Door and Walls*** (Figure 11.6) – The strategy is to delay long enough for the police to arrive. The safe room needs to provide sufficient protection until the police arrive. Consider the following approach to hardening the door and walls to create a safe room. It is not impenetrable, but it can provide considerable protection and in most cases it will offer sufficient protection until the police arrive. Also, it is inexpensive and other than the three deadbolts, it looks like any other interior door.

Sheath the wall studs with 5/8" exterior plywood sheathing and apply the wallboard directly over the plywood. The plywood can be applied on either one or both sides of the studs. If the room is serving a dual function as a tornado room, sheath both sides. Sheathing the studs makes for a rigid and sturdy construction. Also, the sheathing binds everything together. In addition, if a pre-hung door is being used, the door jam can be extended using a 1/2"x3/4" parting bead to accommodate the additional thickness of the plywood sheathing.

The following steps are used to harden the door. Buy a standard steel door. It can be a four or six panel door that looks identical to the other interior doors. It may be an exterior door. Use three four inch hinges. If the door opens outward, it is imperative that the hinges have closed pins or interlocking hinges when closed. This prevents removing the door by removing the hinge pins. At least one of the screws fastening

the hinge to the door jam should be of sufficient length to extend through the door jam and into the rough framing. Generally, it is a good idea to shim between the door jam and rough framing for this screw.

<b>**<u>Vault Type Door</u>** (Figure 11.7) – The previous section utilized a standard metal door. Typically, it is a wood core with a thin metal veneer. This type of door can easily be upgraded to a vault door for approximately $4,000. It is a heavier gauge steel and it has multiple tenons that extend into mortices in the steel frame. In addition, the door usually meets the FEMA specifications described in the next section. The door can look like a normal interior six panel door or they can look like a typical vault door. In addition, these doors find usefulness in gun vaults or rooms designed as gun vaults.

Figure 11.7: Vault Type Door – A steel door, note the one vertical and five lateral mortices. Also, the door is a typical six panel door. Source: internet – [file:\SafeDoor01[86].jpg].

<b>**<u>FEMA Specifications</u>** (Figure 11.8) – Figure 11.8 provides the recommended door specification for safe rooms. Examination of the door reveals three dead bolts mirroring the hinges. The door is no wider than three feet and it is constructed out of 12 gauge or 14 gauge steel depending on the doors internal reinforcement. In addition, the door uses three heavy duty 4" hinges. The FEMA specifications are important for commercial producers of safe room doors who need to conform to the recommended specification to sell their product.

Examination of the door in Figure 11.6 reveals that the basic construction of that door incorporates the basic features of the FEMA door. Again, it provides a low cost alternative that is reasonably secure.

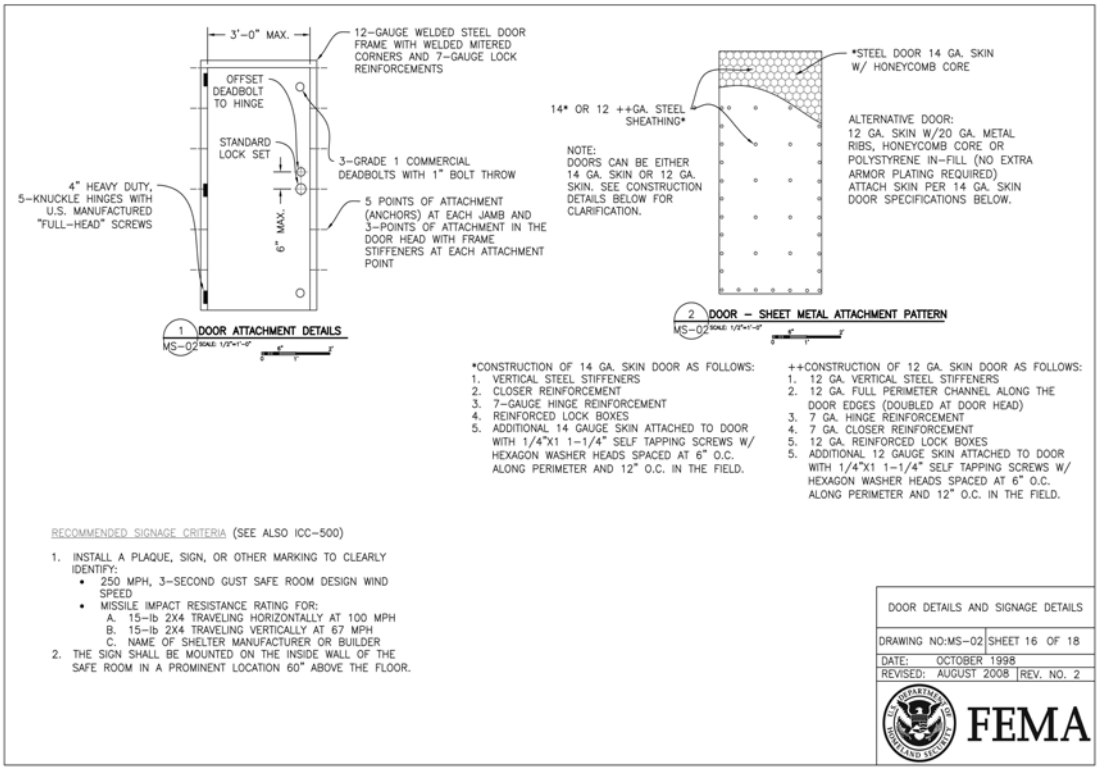

Figure 11.8: FEMA Door Specifications – Source: internet – [file:\FEMA_SafeDoor02[685].jpg].

Figure 11.9: Book Shelf Entrance – Door Closed – The book shelf is a concealed door hiding the safe room or gun vault. There is a secure vault type door protecting the room. Source: internet – [file:\SafeDoor05[44].jpg].

Figure 11.10: Book Shelf Entrance – Door Opened – The book shelf is opened revealing the open vault type door and safe room. Source: internet – [file:\SafeDoor06[44].jpg].

<b>**Concealed Safe Rooms** (Figure 11.9 and Figure 11.10) – Normally, bookshelves or other pieces of furniture can be used to conceal the entrance to a safe room or gun vault. The bookshelves are not the secure door. They only camouflage or conceal the secure door to the safe room or gun vault located behind the bookshelf.

In the opinion of this author, concealed rooms have more practicality for gun vaults and in large homes not lacking for space. It is an issue of access and convenience. A safe room with a constantly opened bookshelf to provide convenient access to the room quickly loses the element of concealment. Also, in a home invasion, the invaders have the element of surprise and they usually know there are people somewhere in the building. Also, a concealed entrance can delay accessing the safe room. It should not reduce quick access into the room by family members fleeing the invaders and seeking security in the safe room.

Gun vaults tend to be smaller and they are accessed less often than a safe room that is doubling as a normal bedroom. A concealed bookcase door makes more sense for this type of use.

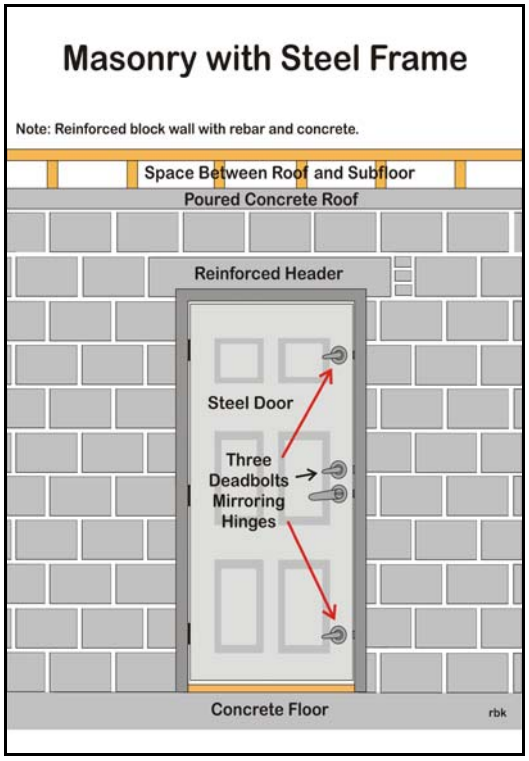

Figure 11.11: Masonry – For maximum protection, use poured concrete or concrete block filled with concrete with both horizontal and vertical steel reinforcing rods. Source: author – [file:\SH-DoorConstruction07.cdr].

<b>**Masonry** (Figure 11.11) – Maximum protection usually involves a reinforced concrete wall. This is poured concrete with both horizontal and vertical steel reinforcement in the concrete. An alternative is to use concrete block and fill the empty space in the block with concrete. Again, concrete block filled with concrete is reinforced both vertically and horizontally with steel reinforcing rods. Normally, the ceiling is poured concrete

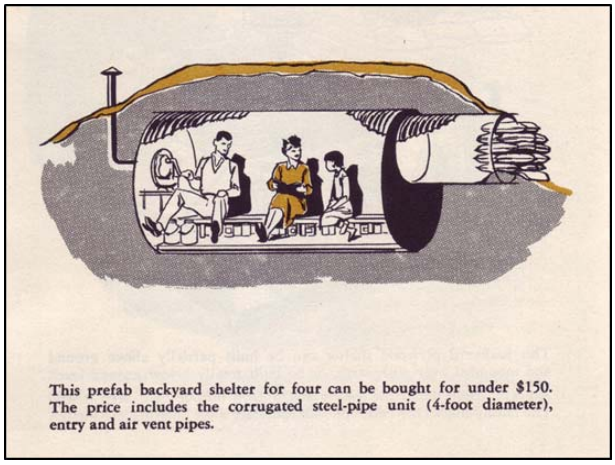

Figure 11.12: 1950s Bunker – The caption reads "This prefab backyard shelter for four can be bought for under $150. The price includes the corrugated steel-pipe unit (4-foot diameter), entry and air vent pipes." Source: Department of Defense – [file:\SH-Bunker01[76].cdr].

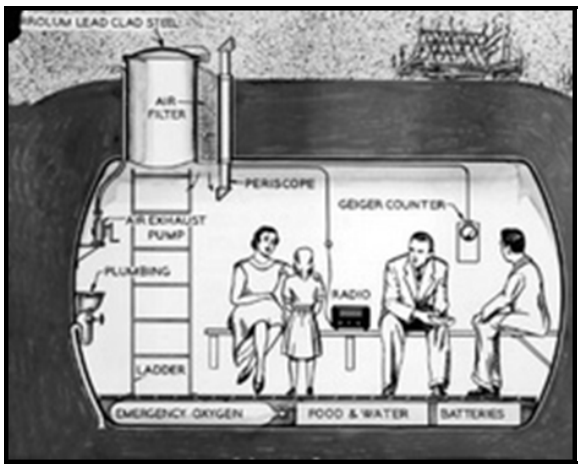

Figure 11.13: 1950s Bunker – In time of a nuclear war, the bunker is a close living area. Note the Geiger Counter hanging on the wall. Think food, water, sanitation, etc. in terms of living conditions. Source: Department of Defense – [file:\SH-Bunker02[65].cdr].

with steel reinforcement rods.

Reinforced concrete offers a significant improvement in protection over a plywood sheathed wall. However, it should be noted that a concrete wall on anything other than ground floor would need considerable reinforcement to support the weight of its structure. This may preclude its use in retrofitting a safe room to an existing structure.

Bunkers

From a design perspective, safe rooms can quickly and seamlessly merge into bunker designs. In the beginning of this chapter, bunkers were essentially defined as underground protection in case of war. Whether underground or above ground, most people would expand the definition of a bunker to include above ground and uses other than war.

<b>**1950s Bunkers** (Figure 11.12, Figure 11.13, and Figure 11.14) – During the 1950s in the height of the cold war, home bunkers became a topic of discussion. Three bunker designs were chosen from the internet for discussion.

In a nuclear war, Underground Bunkers (2017) indicates that the major killer after the initial blast is from fallout. An underground bunker helps to provide protection from fallout and they recommend as a thumb rule to remain two weeks underground. The length of time underground is a function of the distance from the initial blast zone, time, and other factors such as prevailing winds. The closer to the blast zone the longer the time underground. People several miles away may be

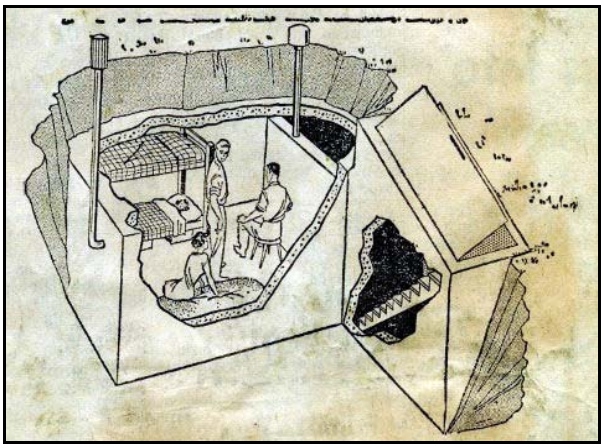

Figure 11.14: 1950s Bunker – A slightly larger bunker with beds. Note the space behind the entrance steps is wasted space that could be used for storage if access can be provided. Source: Department of Defense – [file:\SH-Bunker[66].cdr].

able to leave their shelter after 72 hours. In most cases after two weeks, initial radiation levels will have diminished to 1% of their initial levels. Hence, the thumb rule of two weeks underground.

Also affecting the time required in the bunker are those areas targeted and resulting in fallout. In a nuclear attack, Figure 11.15 indicates the areas that would largely be affected by fallout. The missile silos in the mid-west states would be targeted by enemy missiles resulting in large amounts of fallout.

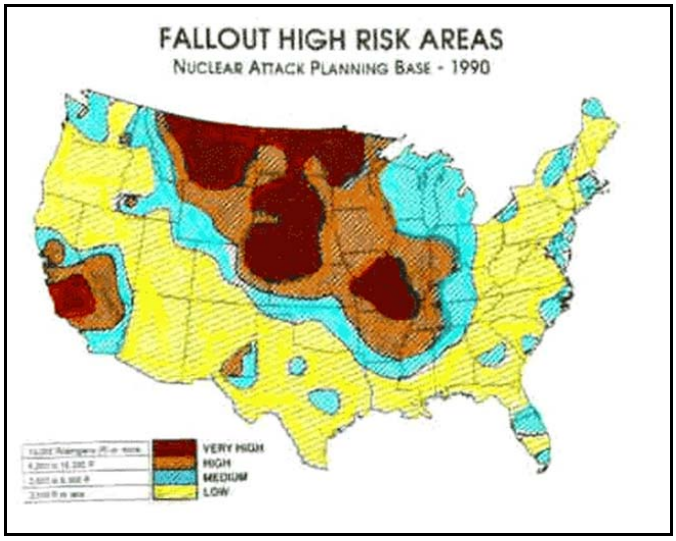

Figure 11.15: High Risk Fallout Areas – Source: internet – [file:\FallOutMap[90].jpg].

<c>***Backyard Bunkers*** – The bunker pictured in Figure 11.12 is designed to be a low cost bunker that can easily be constructed in the backyard. The caption reads "*This prefab backyard shelter for four can be bought for under $150. The price includes the corrugated steel-pipe unit (4-foot diameter), entry and air vent pipes.*" The $150 is in 1950s dollars and would be considerably more today. Three days (72 hours) in this bunker would be survivable. However, two weeks in the pictured bunker would be more problematic. Underground Bunkers (2017) recommends a minimum of three feet of earth on top of the bunker. As pictured, this bunker may be a little shy on soil overhead.

Analyze the bunker in terms food, water, sanitation and the other planning elements in the *Surviving the Unexpected Emergency Model*. At one gallon per person per day, this family of three should have a minimum of 42 gallons of water in the bunker. This would be 82 two-liter bottles or a 55 gallon drum. Consider sanitation. A five pound bucket toilet would most likely suffice or a chemical toilet might be a good alternative. Three days would be survivable. Two weeks more problematic.

Figure 11.13 pictures what is most likely a commercial pre-fabricated bunker. It contains an air filter, periscope, and Geiger counter. Analysis of planning resources would be similar to those for the bunker pictured in Figure 11.12.

The third 1950s bunker is pictured in Figure 11.14. A larger space, bunk beds have been installed. However, two comments. The door and stairwell offer little protection in terms of exposure from fallout. Second, note the considerable amount of under-utilized space behind the stairs. If the stairs can be hinged and raised with a pulley system, there is considerable storage space available for food, water and other supplies.

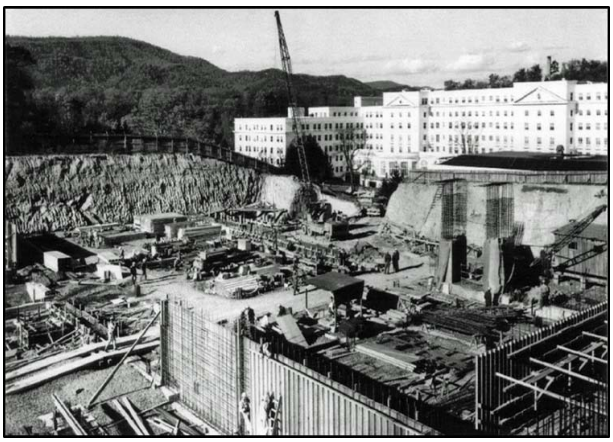

Figure 11.16: Greenbrier Bunker Construction – The 112,500 square foot bunker was built below the Greenbrier resort in Sulphur Springs, West Virginia in 1959. Source: Dept. of Defense – [file:\GreenbrierConstruction[104].jpg].

Figure 11.17: Food Supplies – The bunker maintained sixty days of food supplies for 1,100 members of Congress and their families. Source: Dept. of Defense – [file:\GreenbrierFood[92].jpg].

<c>***Greenbrier*** – At the other end of the spectrum is the bunker at Greenbrier in Sulphur Springs, West Virginia. During the height of the cold war in the 1950s, the government built a secret bunker for Congress at the Greenbrier resort, in Sulphur Springs, West Virginia. Authorized in 1956, construction began in 1959 of the 112,500 square foot bunker that would withstand a nuclear attack (Figure 11.16). It was designed to support 1,100 people including members of Congress and their families. The bunker contained a power plant, decontamination chambers, communications equipment, meeting rooms, and a great hall for joint sessions. Sixty days of food supplies were rotated through the facility (Figure 11.17). It had medical facilities and dormitories for sleeping facilities. The bunker was protected by four 25-blast doors that could withstand a nuclear blast (Figure 11.18).

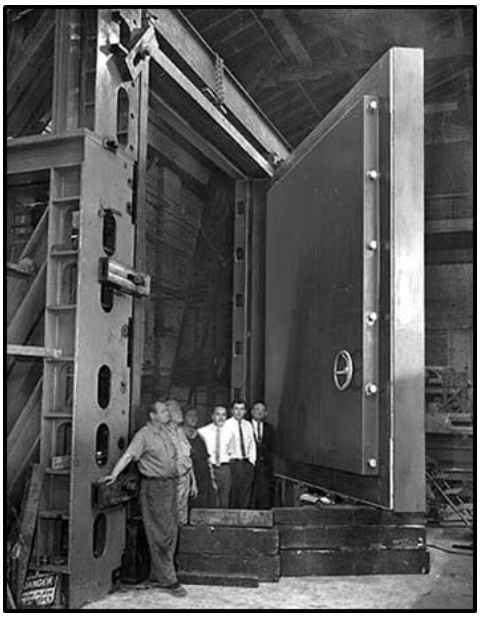

Figure 11.18: Blast Doors – Four 25 ton blast door protected the underground facility against a nuclear attack. Source: Department of Defense – [file:\GreenbrierDoor[49].jpg].

<b>**Contemporary Pre-fabricated Shelters**– Modern bunkers are constructed from fiberglass, steel and concrete. They can be made in modules and assembled onsite or they are manufactured in parts and assembled onsite. Figure 11.19 is a tubular design manufactured out of fiberglass. It can easily be carried on a flatbed truck from the manufacturer to the site where it is buried in the ground.

Figure 11.20 and Figure 11.21 shows the interior of the bunker in Figure 11.19. The photos are taken looking toward each end of the bunker of the bunker in Figure 11.19. Compared with the 1950s examples, this bunker is a lot more spacious. Careful inspection of the two interior scenes suggest that its confined layout is similar to recreation vehicles and trailers. Floor plans are discussed in more depth in the next section.

Figure 11.19: Fiberglass Bunker – Prefabricated bunker can carried to the site on an 18 wheeler and backfilled in the ground. Source: Internet – [file:\TubularFiberglassShelter[62].jpg].

Figure 11.20: Fiberglass Bunker – Interior – One of two interior pictures. Source: Internet – [file:\TubularInterior01[62].jpg].

A larger fiberglass bunker is shown in Figure 11.22. Except for the end units (Figure 11.23), the units come in two parts that are bolted together onsite and placed on top of a concrete slab. The entire bunker is covered with the dirt originally excavated from the site. The shovel in the background gives a sense of scale. The interior of the end unit shown in Figure 11.23 helps to provide a sense of spaciousness.

Figure 11.21: Fiberglass Bunker – Interior – One of two interior pictures. Source: Internet – [file:\TubularInterior02[70][49].jpg].

Figure 11.22: Fiberglass Bunker – Providing scale, note the large shovel in the background. When complete, the entire unit will be buried. Source: Internet – [file:\ModularFiberglassBunker01[70].jpg].

Figure 11.23: Large Fiberglass Bunker – End Unit – The end unit attempts to create a spacious interior setting. Source: Internet – [file:\ModularFiberglassBunker02[90].jpg].

Steel is a commonly used material for bunker construction. In the internet literature, there is a heated debate over the advantages of using steel over fiberglass. Most of the steel bunkers resemble modified cargo containers. In fact, cargo containers can be modified into bunkers. The steel bunker shown in Figure 11.24 is constructed from a series of interlocking containers to provide a spacious living space of 6,500 square feet in the bunker.

Figure 11.24: Modular Steel Bunker – When backfilled, the modular steel construction creates a 6,000 square foot bunker. Source: Internet – [file:\ModularSteelBunker[80].jpg].

<b>**Floor Plans** (Figure 11.25 and Figure 11.26) – In terms of *Surviving the Unexpected Emergency Model*, the type of experience and its duration will determine the amount of space needed for and the design of the safe room or bunker. Generally, the rule is that as time increases in a safe room or bunker, the more functions and resources that will need to be provided to the inhabitants. Tornados are short lived. Protection for an hour or two hours is needed. Storage of food, water, and sanitation are not normally an issue. Sleeping areas are not an issue. Other than a flashlight, not a lot is needed to survive an hour or two underground in a bunker.

Assuming the typical home invasion scenario depicted in this chapter, the same can be said for the design and supplying of a safe room. It needs to provide sufficient protection from the home invaders until the police arrive. Hopefully, this would be an hour at most. This section suggests adapting a bedroom or other room to the purpose of creating a safe room. Since the bedroom serves a dual purpose, the floor plan of the safe room is that of a bedroom.

As the duration of the experience increases, safe room design merges with bunker design and they essentially become one and the same. In general, bunker design has much in common with RV trailer and 5th wheel designs. Both are designed to maximize space utilization within limited spaces.

<c>***Avoid Hallways*** – The purpose of a hallway is to connect spaces (i.e. rooms) with each other. Generally, the larger the rooms or the more rooms present, the more the need for hallways to connect them. A hotel is an example of many rooms connected by a hallway. Although they may be necessary, they are, in general, wasted space. In confined areas such as safe rooms, bunkers, RV trailers, and 5th wheel designs, the use of hallways may be an indication of a poor design and an inefficient use of space.

Figure 11.25 is a diagram of a commercially available bunker floor plan. The hallways have been identified. If the floor plan can be redesigned to eliminate the hallways, more space will be available. The author redesigned the floor plan to eliminate the hallways. The analysis of the revised floor plan is discussed in the next section titled “walking the plan.”

<c>***Walking the Plan*** – The floor plan is a diagram of the actual layout. Walking the plan is just that. It is walking the floor plan as if it were the actual layout. Move about the layout. Sit in the chairs. Prepare food in the kitchen. Turn and place the prepared food on the table. As is illustrated by the two examples below, it is important to examine floor plans critically. Walking the plan helps to critically evaluate the layout because once the structure is built, it is difficult to change walls.

Walk the original floor plan in Figure 11.25. Walk down the steps. Enter the bunker. Pass by the lounge and TV. The placement of the TV helps to define the lounge area. Work the kitchen area. Prepare dinner. It is a tight fit for anyone working the kitchen area with those sitting at the table. It is a potential problem. Perhaps a smaller table would solve the problem? Walk into the storage area for food or other items. Storage and access are conveniently located. To access the master bedroom, walk down the hallway, enter through a door, and walk down another hallway. Also, note that there is little separation between the master bedroom and the bunk bed rooms which may not be desirable.

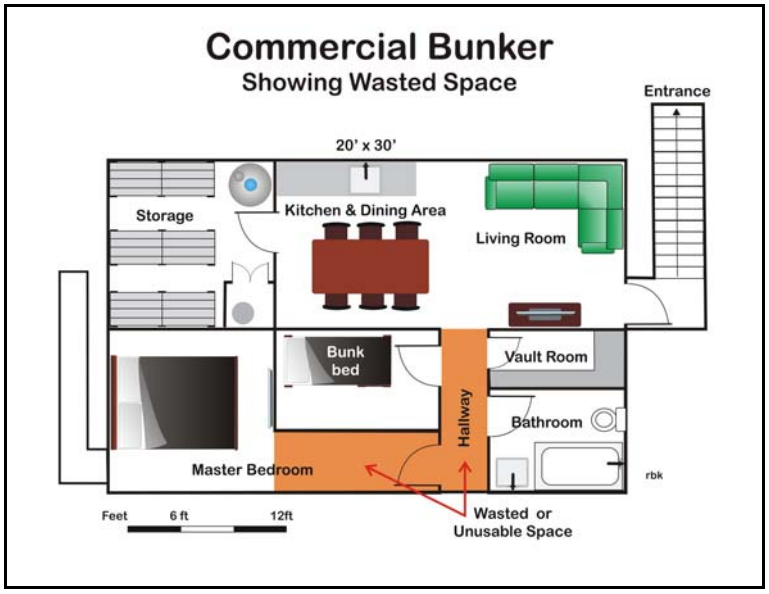

Figure 11.25: Bunker Floor Plan with Wasted Space – Examine spatial relationships and "walk-the-plan." Hallways connect spaces and they may be an indication of wasted space in a confined area such as a bunker. Source: author – [file:\SH-Bunker02.cdr].

Now walk the redesigned floor plan in Figure 11.26. The hallways have been eliminated which adds space to the main living area. The master bedroom, bathroom, and bunk bed rooms are identical in size. The vault room is slightly larger. Eliminating the hallways creates a larger common area. The dining area table can be moved slightly allowing a person to actually work in the kitchen area while people are sitting at the table. Also, the bathroom provides some separation between the master bedroom and the bunk bed room.

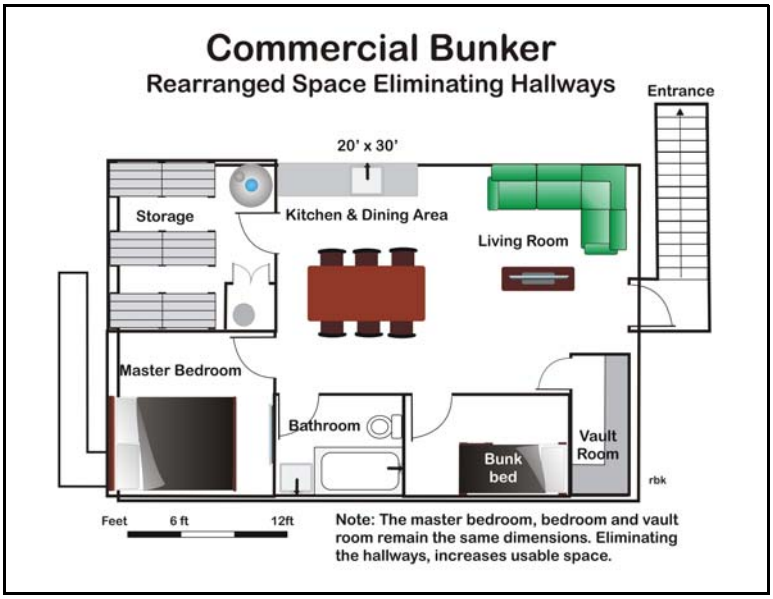

Figure 11.26: Bunker Floor Plan Redesigned – This is the redesign floor plan in Figure 11.8 to eliminate the hallways. Note the increased space and the separation of the master bedroom from the bunk beds. Hallways are dead space. Source: author – [file:\SH-Bunker03.cdr].

<c>***Minimize Utilities*** – In a 20'x30' bunker, minimizing utilities is not usually a critical issue. Typically, most electrical wires are stretched to the kitchen. From an efficiency perspective, the location of the main electrical box in close proximity to the kitchen minimizes electrical costs.

In modern buildings, find the drinking fountain and find the restrooms. Locating the drinking fountain and restrooms in close proximity minimizes plumbing costs. Water and drains need to be provided to both the kitchen and bathroom. In a 20'x30' bunker the relocation of the bathroom in Figure 11.26 will most likely have little effect on plumbing.

<b>**Innovative Designs** – Perhaps the most innovative bunker is the conversion of abandoned missile silos into a bunker (Figure 11.27). The bunkers are already hardened to nuclear attack and offers extensive space that can be converted into living space.

<b>**Home as a Bunker** – Intuitively, people think their home would be a good safe place because during normal times it offers protection. Analyzing the types of experiences in *Surviving the Unexpected Emergency Model*, the home does not normally make a good bunker for most of the natural and man-made disasters. Also, the chapter on protection discusses the home as a fortress.

Figure 11.27: Converted Missle Silo – A converted missile silo is spacious enough to create an underground communal living situation. Source: internet – [file:\MissileSiloBunker02[76].jpg].

Hurricanes can destroy the house and if the bunker is in the basement, the basement can easily flood. Houses built in flood plains are prone to flooding. An earthquake can crumble the house on top of the bunker. A house prone to a tsunamis is also pone to flooding and collapse. Volcanoes destroy everything in their path including homes and bunkers. Wildfires will burn the house to the ground above the bunker and if the fire is big enough it will bake everything in the ground or suck all the oxygen out of the air.

Man-made disasters include crime, terrorism, and war. Regarding crime, a safe room or bunker can provide adequate protection. Both were discussed in this chapter. The discussion of terrorism and war is deferred to the chapter on protection. However, for most people, the home will offer their source of protection during times of terrorism or war, no matter how imperfect the home may be in terms of providing protection.

Summary

This chapter focuses on bunkers and safe rooms. It discusses safe rooms and bunkers in terms of the *Surviving the Unexpected Emergency* model. In terms of the model, the discussion includes designing safe rooms and bunkers for tornados, crime and war. A major focus is on designing a practical and inexpensive safe room for protection during a home invasion. A primer on bunker design is provided also. The bunker discussion emphasizes protection during a war situation.

References

Department of Defense (1965) *Family Shelter Series*.

Underground Bomb Shelter, (2017). How Long Should You Stay in Your Shelter. http://undergroundbombshelter.com/new-articles/batten-down-the-hatches-how-long-should-you-stay-in-your-shelter.htm