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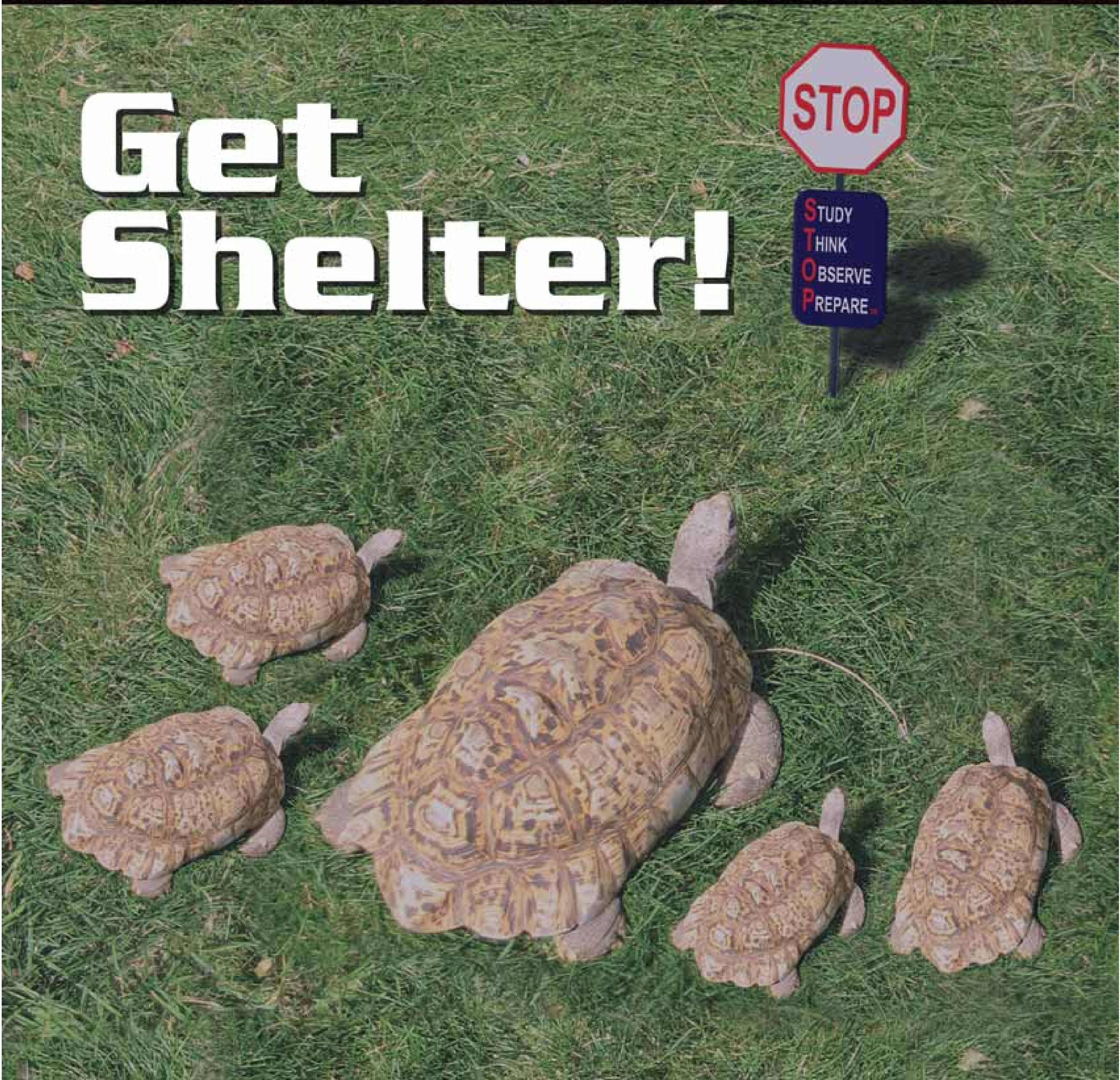
Get Shelter!



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Journal of Civil Defense™

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Get Shelter!

Natural and man-made disasters occur on a regular basis. Each area of the country has its own, unique risk factors and each person perceives these threats in a different way. Some people are driven to build shelters by national security issues, others by past experiences, and still others by religious beliefs.

Seldom do all family members have the same levels of concern, and it is sometimes frustrating to justify these protective measures to those we care about the most.

We have been asked, numerous times, to expound on the following statements that have been genuinely made by others:

1. **I would not want to be the only one to survive.**
2. **I may not be at home when I need the shelter.**
3. **There are no more "real" threats to our country.**
4. **The government will take care of us.**

We hope our answers will help them to see your concerns and that they will act accordingly. The following is our response to these concerns:

1. I would not want to be the only one to survive.

Our Answer:
According to the worst-case scenario forecasts prepared by the Department of Defense in 2002, the short-term casualties that would be derived from a full onslaught nuclear attack (Russia and/or China) would approximate 30% - 35% of our population with an additional 30% - 35% of our population dying over the following 6-8 weeks from starvation, dehydration, disease, inclement weather, contamination, attack, etc. In this forecasted worst case, 30% of our citizens would survive to start over and rebuild our country. At over 290 million people and growing, this means that almost 100 million Americans would survive. Yes, we would be starting over and it would be hard at times. We would be living in a 3rd world country for a period of time. But, unlike our pioneer ancestors, we still have the knowledge and information from before, to build upon.

2. I may not be at home when I need the shelter.

Our answer:
Government war strategists are in agreement that a full-scale nuclear attack would most probably occur during the night or early morning or during a national holiday. 'Night time' in America is 'Day time' in the countries of our most likely enemies. Our enemies would want to strike while we are asleep.

Most people do not work or live in the vicinity of prime targets, providing time for them to return to their shelters in the event of a full-scale nuclear or terrorist attack.

People who have prepared shelters are aware of their surroundings and in tune to escalating crises and the warning signs. They have also pre-planned expedient sheltering and evacuation routes.

3. There are no more "real" threats to our country.

Our answer:
We have been preparing and building shelters for over 21 years, but we are continually amazed at the number of people who don't recognize or believe that any "real" threats exist. Upon further questioning we most often find that the vast majority of these people do not read a daily newspaper nor watch a daily news broadcast. They are consumed with sporting events and spend their money on useless toys.

Many people refuse to consider the possibility of an attack, because they believe nuclear war is not survivable. If there is nothing one can do, one tends to do nothing. They receive all their information from the media, which tells them this philosophy is true.

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If we can educate these people to the real and fundamental effects of nuclear weapons, they may see that nuclear war is, in fact, very survivable and prepare accordingly.

4. The government will take care of us.

Our Answer:
There is a wide spread misconception that public shelters exist throughout the country. Some countries, such as Switzerland, Finland, Sweden, North Korea, China and Russia have provided shelters for a good portion of their population. It has been estimated by American strategists that about 30% of the population of the world have radiation and blast shelters. Russia has constructed multiple underground industrial communities. Switzerland, has provided 100% of their population with hardened NBC shelters.

Our own government has provided hardened underground facilities for high ranking government officials and their families as well as for our critical mission personnel.

My Family Members are my 'critical mission personnel'. Where are the shelters for my family? The answer to this question is that we, as citizens, have not been willing to demand this level of protection for ourselves, nor have we been willing to be taxed to this level of protection. Legislation providing shelters will not occur until we demand it. Current localized disasters have proven that our government is there to assist us, but not to save us in widespread emergencies. More and more Americans are awakening to the reality that the world has become a dangerous place, and as a result, they are building shelters for themselves and their loved ones.

The government's answer to providing for the common defense of the country is in the policy of deterrence. Deterrence is not defense. The concept of deterrence by 'Mutual Assured Destruction' is a misnomer. This form of deterrence exists only if neither side can defend themselves against weapons of mass destruction and both sides have equal numbers of offensive type weapons. Russia has both passive defense in the form of shelters, and active defense in the form of anti-ballistic missiles. America has neither. Further frustrating this policy is the fact that Russia continues to modernize every aspect of their strategic nuclear arsenal while we are dismantling our own. Our government has identified 28 terrorist organizations that have no country of claim. Deterrence against these terrorist organizations does not exist because there is no country to target or threaten with a retaliatory strike. Our government has identified seven terrorist nations. Deterrence against 3rd world terrorist nations does not exist either, because the government leaders of those nations do not value the lives of their own citizens.

Mutual assured destruction (MAD) was never formerly accepted as government policy, but for the past 40 years, the concept has driven most all of our national defense decisions. Most everyone now agrees, however, that deterrence is no longer a viable concept. The greatest defense against modern day threats, in our opinion, is a strong national NBC shelter program and a nationwide anti-ballistic missile shield.

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Assessing Your Risk

Most people consider the risk of a nuclear attack to be very small. No such attack has ever occurred in our country; therefore, they consider the probability of such an event to be near zero. Keep in mind, however, that a true risk assessment must incorporate both probability and consequence.

Most of our national security strategists agree that the possibility of a nuclear attack from terrorist countries and terrror organizations grows daily. The technology is well known and the nuclear fuel for such weapons is available on the 'black market'. China and North Korea have made veiled nuclear threats against our borders; terrorist organizations claim to have 'suitcase bombs'; and Russia and China continue to modernize every aspect of their strategic nuclear arsenal. Edward Teller, the father of the Hydrogen Bomb, was quoted, "Every day we go without a nuclear terrorist attack is a gift". The probability of a nuclear event is greater than most people think.

The consequences of a nuclear attack, in loss of human life and collateral damage, would be huge. The relatively few lives lost in the U.S. from hurricanes, flood, or the recent 9/11 terrorist attack would pail to the tens of millions of lives lost from a potential nuclear attack. When multiplying both the growing probability factor, with the huge consequence factor, we see a resulting risk that is extremely large. We believe this assessment easily justifies the expense and effort of installing hardened NBC shelters.

There are certain classes of facilities that attract nuclear warheads in the first rounds of an attack. Obviously, any facility connected with America's nuclear forces will be brought under attack in the first salvo including ICBM fields and launch control facilities, command and control centers such as NORAD in Colorado Springs, and the Air Force command center in Omaha. Air Force bases hosting long-range bombers, refueling/tanker aircraft, and continental air defense fighter aircraft are obvious first tier targets. But consider this; Any airport with a runway capable of handling commercial jet aircraft (737's, 757's, 767's, and 777's) would be a recipient of at least one nuclear warhead, most likely fused to burst at or near the ground so as to crater the runway, or at least heave gobs of contaminated material onto and around the runway. Strategists plan this to deny recovery of surviving bombers or tankers. Any city of more than 200,000 population will most likely have runways of this length, nearby. The resulting fallout will kill many thousands of citizens and military personnel. Blast and fire will be a factor for a radius of 6 to 12 miles depending on weapon yield, weather, height of burst, etc. Be aware that weapons and delivery systems malfunction and can miss the intended target (but inevitably hit someone else). Also remember that a "rain-out" can occur increasing the gamma dose-rate by a factor of ten or more, (possibly 10,000 rads per hour) effectively killing everyone in the local area not shielded with an earth cover more than 5 feet thick.

A correctly designed and installed shelter will effectively protect the health of its occupants in this environment, and will do so within one-half mile of the center of the detonation. In addition, the sheltered will be relatively comfortable, not just alive.

NUCLEAR WEAPONS EFFECTS

A basic understanding of nuclear weapons effects is needed in order to design an appropriate and effective NBC (Nuclear/ Biological/Chemical) shelter. Each effect must be considered when choosing the building medium, geometry and shielding material for the structure.

Thermal Radiation Effect:
The heat from the fireball is emitted in the form of thermal radiation. At 8 miles from the detonation, only minimal structural damage takes place. Flash burns caused by the thermal pulse at that distance, however, would produce severe burns to unprotected individuals. If there is any warning of incoming missiles, the best available shelter should be taken. Ditches, culverts, basements, or large structures would provide some shielding against thermal pulse. Underground shelters will give total protection from the thermal pulse. The old civil defense adage to "*Duck and Cover*" is still good advice.

Electro Magnectic Pulse (EMP) Effect:
All nuclear explosives induce sudden electrical pulses of energy, which can damage or destroy unprotected electrical and solid-state electronic equipment within line-of-sight of the explosion. The size of the area affected by an EMP increases with the height of the burst. In a nuclear explosion 50 miles above the ground, the affected area on the surface of the earth will have a radius of about 600 miles. A high altitude EMP (HEMP) from a nuclear explosion detonated at an altitude of 200 miles could produce a rapid electrical energy pulse on the order of 60,000 volts per square meter and could affect and even disable equipment within the entire continental United States. Smaller EMP pulses produced at lower altitudes could cause cascading failures in an already stressed electric power infrastructure (transmission lines, transformers, etc). Transportation would be paralyzed, food refrigeration and distribution would cease and water purification and sewer systems would fail.

Terrorist countries and their organizations understand our vulnerability and could use relatively unsophisticated missiles armed with nuclear weapons to produce a high altitude EMP (HEMP). **See JCD volume #38, Issue #3.**

Blast Effect & Overpressure:
The pressure of blast is measured in pounds per square inch (psi). Normal ambient atmospheric pressure is about 15 psi. Any pressure over and above this level is considered to be 'overpressure'.

The blast overpressure from a one-megaton (1 MT) weapon at 5 miles is approximately 4 psi, and the wind velocity is about 140 mph. It is generally believed that people within a 5 mile radius could survive this level of blast outside a hardened blast shelter if they could find adequate protection from the blast wind and falling debris. Structures such as culverts, ditches, tunnels, caves and mines could serve as an expedient shelter. Many people are in areas considered by planners to be under the 4-psi overpressure range (further than 5 miles from ground zero) and could be saved if they would seek shelter in their basements.

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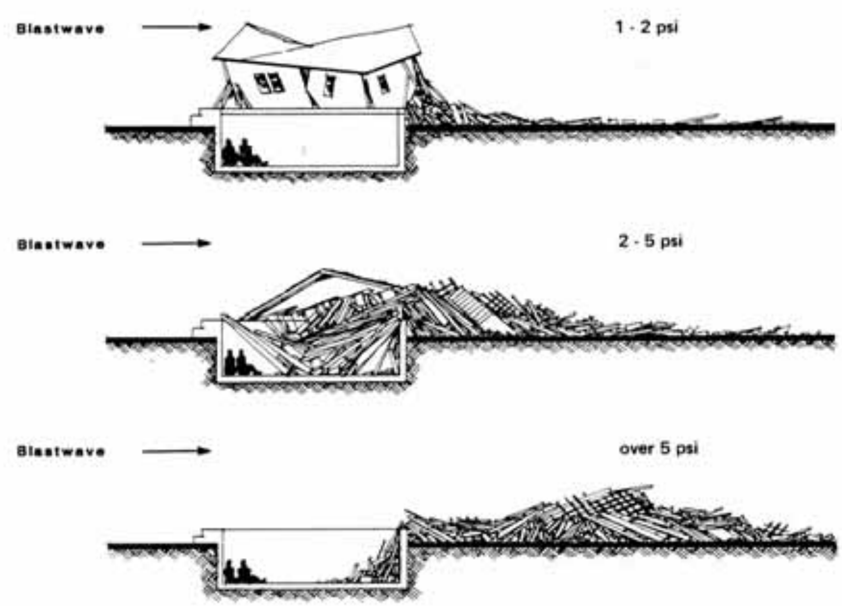

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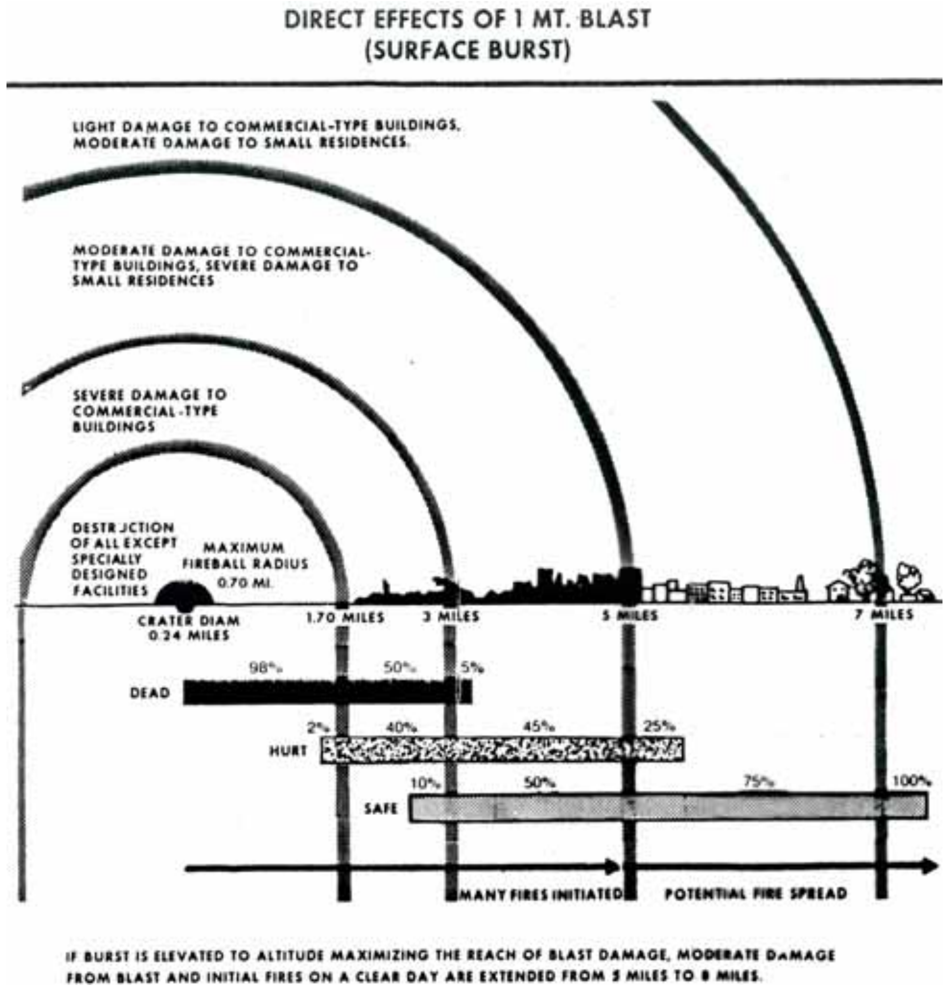

At overpressures over 4-psi a residential basement shelter WILL NOT provide adequate blast protection and the home will be destroyed. As the overpressure passes beyond the shelter, there is a negative pressure of approximately 5-psi. All doors should be designed to withstand both positive and negative expected pressures. The Swiss standard for public shelters dictates building to overpressures between 15-psi and 45-psi:

- A 15-psi shelter will withstand blast and blast winds at 1.6 miles from a one-megaton (1 MT) yield weapon, .8 miles from a 100 kiloton (KT) weapon and .4 miles from a 10 KT weapon.
- A 45-psi shelter will withstand blast and blast winds at .9 miles from a 1 MT yield weapon, .4 miles from a 100 KT weapon and .2 miles from a 10 KT weapon.
- A 200-psi shelter will withstand blast and blast winds at .5 miles from a 1 MT yield ground burst weapon and ground zero from a 1 MT air burst.

Radiation & Fallout Effect:

If the fireball of the weapon touches the ground, the blast is defined as a ground burst. Strong winds cause dust, dirt, and other particles to be sucked up into the fireball. This debris is mingled with fission products and radioactive residues, making it radioactive itself. As it cools, the debris falls from the cloud onto the ground. This material is called radioactive fallout. Gamma radiation from the fallout is a highly penetrating electro-magnetic radiation and poses a sustained exposure threat for the first 2 weeks after a ground burst. Gamma radiation is measured in Roentgens (rads). Roentgens and rads are used interchangeably.

Initial Radiation:

Initial radiation decreases with distance and is negligible beyond 1 1/2 miles from the explosion. The initial nuclear radiation is propagated outward from the fireball of the explosion in a similar way as light. It does not accumulate like fallout radiation and is no longer a threat after the first few seconds following the explosion. The following initial radiation intensities are created by a 10 KT yield nuclear explosion:

- At a distance corresponding to 2 atmosphere pressure (30 psi) for a 10 KT explosion, explosion height zero: 20,000 Roentgens.
- At a distance corresponding to 3 atmospheres pressure (45 psi) for a 10 KT explosion: low air burst, 70,000 Roentgens.

Larger yield weapons detonated in the air create less initial radiation threat than smaller yield weapons. Larger yield weapons are designed to be detonated at a higher altitude for an air burst. The greater burst height of these larger weapons increases the distance from the ground, thus decreasing the intensity of the

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initial radiation in the 15 and 45 psi areas. Weapons smaller than 10 KT are designed to be detonated in the air at lower levels than the larger yield weapons, thereby increasing the intensity of the initial radiation.

Initial radiation from most medium and large yield weapons (100 KT – 1 MT) occurs in overpressure ranges greater than 45 psi. Concrete shelters built to a 15 and 45 psi level will not survive in that zone. The permissible radiation levels for the concrete shelters have been set for a total accumulation of 100 Roentgens. For bomb yields larger than 10 KT (within the 15 and 45 psi blast level) the initial radiation protection offered is greater than necessary; for smaller yield weapons it may be too little.

<u>Fallout:</u>
Radiation from fallout is the most far-reaching of all the weapons effects. This radiation falls for hours or days. An accumulation of 600 Roentgens over a two week period is usually lethal. **In a full-scale nuclear attack on the United States, even areas of low fallout risk are expected to accumulate total radiation doses as high as 3,000 Roentgens (with some areas as high as 20,000 Roentgens), over a two week period.** The maximum dosage rate is expected to be as high as 5,000 Roentgens per hour. Shelters should provide protection against this radiation so that the radiation dosage inside the shelter is generally negligible. A minimum protection factor of 1,000 is necessary to keep this radiation to an acceptable level (minimum level for 15 psi shelter).

Time - Radiation diminishes with time in a process called radioactive decay. For every seven-fold increase in time after detonation, there is a ten-fold decrease in the radiation exposure level. For example; after 7 hours, radiation levels will reduce to 10 percent of initial levels. After 49 hours (about 2 days), radiation will be only 1 percent of the initial level.

Distance - Radiation levels diminish with distance as well as time. Gamma radiation is directional. In small diameter entrances to shelters (diameters under 48 inches) each 90 degree turn will diminish (attenuate) the raidiation by 90%. For proper attenuation, entrance tunnels should have a minimum length of 22 feet.

Shielding - Shielding also attenuates radiation levels. Three inches of concrete will attenuate half of the gamma radiation from fallout. One 'half-value' thickness of shielding gives a protection factor (PF) of 2. This rule is multiplicative. A total of 9 inches of concrete will provide three halving thicknesses, for a PF of (2x2x2=8). **It cannot be emphasized enough that in a wide-spread nuclear attack in the United States, over a two-week period, almost all areas of the U.S. are expected to receive more than the 600 rad, or lethal level. <u>EIGHT OR NINE INCHES OF CONCRETE IN A SHELTER ROOF IS JUST NOT ENOUGH SHIELDING!</u>**

Ten layers of any halving thickness (30 inches of concrete or 48 inches of soil) provides a protection factor of over 1,000. A minimum protection factor of 1,000 is recommended for all NBC shelters.

Questions or comments on this information should be directed to Sharon Packer (sharon@tacda.org).

RADIATION PENALTY TABLE

Acute Effects	Accumulated Exposure (R) 1 Week	Accumulated Exposure (R) 1 Month	Accumulated Exposure (R) 4 Months
Medical Care Not Needed	150	200	300
Some Need Medical Care Few if Any Deaths	250	350	500
Most Need Medical Care 50% + may die	450	600	600
Lethal Dose	600		

The accumulated exposure should not exceed those in the first row. If radiation levels reach 10/R/hr in the sheltered area, the doses in the first row will probably be exceeded. In this eventuality, the shielding in the sheltered area should be increased. In a full scale attack, about 35% of our population would be expected to exceed the above doses. A PF of 500 is recommended for all fall out shelters.

EXPOSURE AT 30 MILES DOWNWIND
(500 KT surface burst, 15 mph wind)
(Roentgens)

Time	In Open	In Shelter PF 15	In Shelter PF 40
1 Week	3450	230	86
1 Month	4100	273	103
4 Months	4500	300	113

A PF of 40, in this scenario will give the minimum protection not to exceed row one of the Penalty Table above.

Corrugated Steel or Steel Plate Shelters

Thermal: Excellent | **Blast:** Excellent | **Residual Radiation:** Excellent | **Initial Radiation:** Excellent | **Chemical/ Biological:** Excellent

Thermal Pulse:
Underground shelters of all geometries and building mediums will defeat the thermal pulse and protect the people sheltering underground. The shelter doors, however, if in close proximity to the fireball, can be severely damaged by the radiant heat in the first few seconds of the detonation. Shelters near blast targets should have sacrificial covers placed on top of the doors. Even a piece of plywood will protect a steel door. The wood will burn before it is blown away by the blast; but, it will stay in tact long enough to cast a shadow for the door and protect it from the damage caused by the thermal effect.

Blast:
Shelters built with arched tops will carry much greater loads than flat-topped structures. The depth of cover assuring maximum blast protection is equal to the diameter of the shelter (a 9 ft. diameter shelter should be covered with 9 ft. of dirt, etc). Earth arching, at that ratio, provides protection to a 200-psi level, and steel shelters within a 1 ½ mile radius of a 1-megaton (MT) weapon should not fail if installed correctly at that depth.

Gamma Radiation:
Four feet of dirt cover or 3 feet of concrete is sufficient cover, in most cases, to protect occupants from gamma radiation. The entrances, however, allow large amounts of gamma radiation to enter the shelter, and steel shelter doors offer small protection. All entrances should incorporate at least one 90-degree turn, each of which will attenuate 90% of the gamma radiation. Long vertical and horizontal runs will diminish the remaining 10% to acceptable levels. A good rule of thumb is that the total length of the entrance should be about 22 ft. and the 90-degree turn should come as close to the center of the entrance as possible. This rule will hold up to diameters of about 4 ft. Larger diameter entrances will need longer entrances.

Entrances:
All shelters should have two entrances to assure escape in the event one entrance is blocked by debris. All entrances must be protected with steel blast doors.

Initial Radiation:
Initial radiation occurs within 1 ½ miles of the detonation. All shelters near potential targets should have at least 8 feet of dirt cover to properly attenuate this type of radiation. After entering the shelter, a six-foot plug of shielding should be placed into the horizontal runs of all entrances. The shielding for initial

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radiation should have a high-hydrogen content (such as barrels of water or bags of rice). Entrances should not exceed 48 inches in diameter, as it is not practical to fill larger diameter entrances with shielding. A 90-degree turn in the entrance gives very little protection from initial radiation.

Size:

Huge amounts of dust, debris, smoke and large radioactive particles circulate in the air for several hours after the blast. Design the shelter for a minimum of 88 cubic feet per person of free air space to allow sufficient volume to 'shut down' air supplies for 5 hours after the blast or during fires. Allow for adequate space to store a one-year's supply of food and a 3 weeks supply of water, as well as other supplies.

Temperature Control:

Depths of cover that provide initial radiation protection (7 to 8 feet) also provide stable and comfortable interior air temperatures, assuring survival from extreme weather conditions and protection of food and supplies. Shelters with 7 to 10 feet of dirt cover, remain at a constant temperature between 45 F. and 65 F. Cloud and smoke cover from a large nuclear attack could cause cold conditions to occur for long lengths of time, even in mild climates. Extremely warm conditions could occur for short periods of time because of fires started from the thermal pulse, heating the ground to several feet and causing discomfort for the shelterees. More of an issue, is the heat generated by the people inside the shelter. Each person radiates the same amount of heat as a 100-watt light bulb. Insulating material should not be placed against the walls, as the steel walls of the shelter will act as a "heat sink".

Construction Material:

Construction material that will MOVE and BEND with earth motion, assures protection from catastrophic failure associated with earthquakes and ground shock from nuclear blasts. Corrugated steel allows for a great deal of movement, without the risk of structural damage.

Corrugated Steel Shelters

Corrugated steel is 6 times stronger than steel plate. Corrugated steel shelters can, therefore, be constructed at 1/6th the thickness of steel plate shelters. Shelters up to 8 ft. in diameter and all entrances should be constructed at a minimum of 16-gauge steel. Nine- foot shelters require 14-gauge material, and ten foot shelters require 12-gauge material. All end plates for shelters 8 to 10 ft. in diameter should be constructed of 3/8th inch steel plate. Ends should overlap the shelter body by about ½ inch. All steel plate shelter ends and welds must be painted with epoxy to inhibit rusting. Corrugated steel does not need to be painted, as it is already galvanized. Corrugated steel should not be used on end plates, as it is too thin.

Ventilation & Filtration:

Do not use plastic, corrugated steel, fiberglass, or PVC for air pipes. All air pipes should be constructed of 4 to 6-inch diameter quarter-inch wall steel pipe to best assure proper air volume. Steel pipes will also give protection from fire, thermal pulse, high winds and flying objects. Electrical wiring can be placed in smaller diameter steel pipe.

All ventilation systems must have hand-crank power capability. Do not rely solely on electricity or batteries to run the air systems. Pre-filters must be placed in line prior to processing of NBC contaminates, assuring protection of the HEPA filter from smoke, dirt, insects and larger radioactive particles. Pre-filters must be placed at least 72 inches above the floor, to keep radiation from exposing the air handlers. Hoses, metal and paint in the filtration system must be resistant to war gases of all types. Air filtration systems should have both high efficiency particulate filter (HEPA) and charcoal filters. All intake pipes must be fitted with air rate meters, to assure the proper residence time of the contaminated air within the filter.

Blast Valves:

Blast valves should be placed on ALL penetrations (air pipes, vents and conduits for electrical wiring or antennas). This will assure

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blast protection and continual positive air pressure in the event of chemical or biological attack. Conduits for wiring, if not greater than 1 ½ inch diameter, can be filled with foam type insulation, or special conduit can be purchased for this purpose.

Sanitation:

Holding tanks and septic tanks are acceptable in areas of low or no blast areas. The tanks, however, are extremely vulnerable to ground slap from blast, and may crack or rupture during earthquakes. Flying debris from high winds during tornados, hurricanes or blast could break the lids of these tanks, and if they are at, or near the surface, the contents of the septic tank will be forced back into the shelter. Do not install flush toilets unless there is an unlimited supply of water.

Water supplies should be interior to the shelter in all areas of high blast and the use of "chemical toilets" is highly recommended. Use separate toilets for solid waste and urine. Cover solid waste with a disinfectant solution or kitty litter. Solid waste should be stored in barrels in double plastic bags, until it is safe to remove and bury it outside. Urine can be poured into the gray-water drain.

Furniture:

In areas of high blast potential, keep furniture to a minimum. Use hammocks for sleeping and secure all items to the wall. In areas of low blast potential, it is acceptable to build shelves, kitchens, cabinets and bunks into the shelter.

Power Systems:

A 12-volt battery system has many advances over a 48-volt system. The 48-volt systems are very expensive and replete with problems. The 12-volt chargers and inverters are reasonably priced and very dependable. Small 12-volt bayonet type lights can be purchased from radio shack. LED lights may be vulnerable to EMP and if purchased, should be stored in a faraday cage until after all danger of blast has past.

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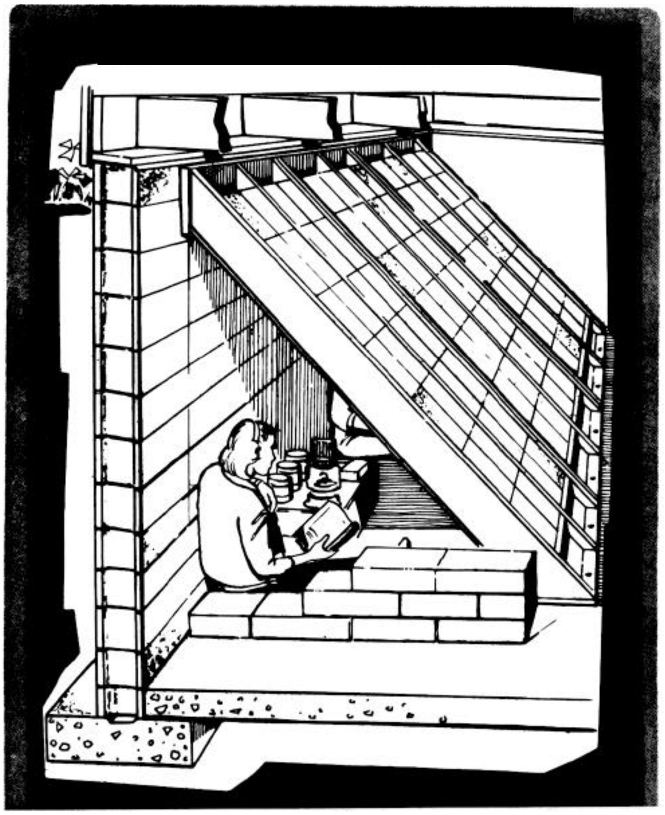
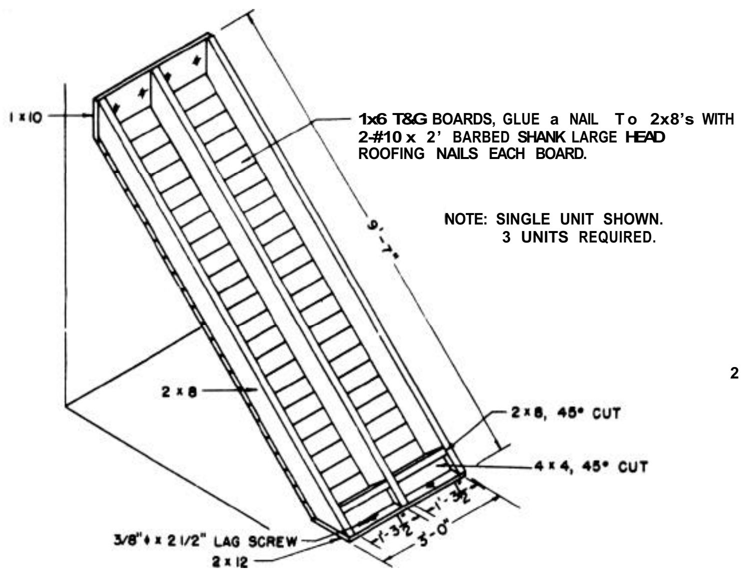
April 1980



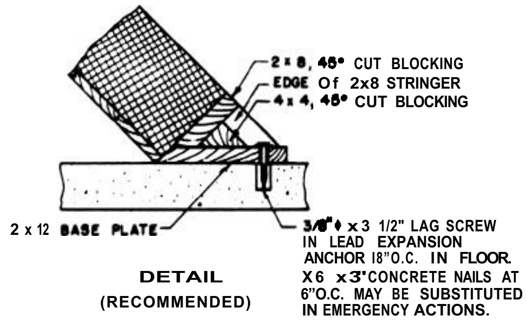
Pre-built wood components stored in the basement may be assembled and filled with bricks or concrete blocks for emergency protection.

HOME FALLOUT SHELTER
lean-to shelter-basement location plan f

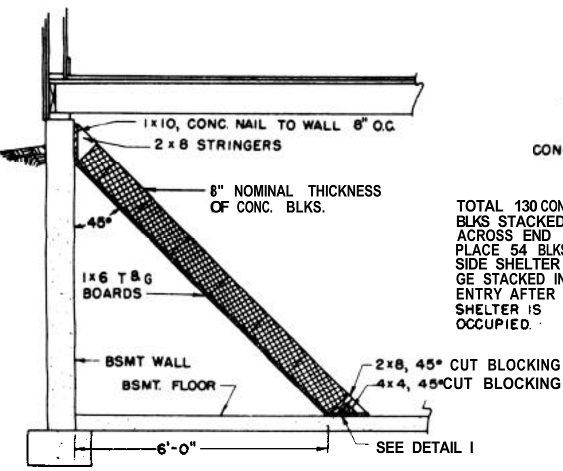
FEDERAL EMERGENCY MANAGEMENT AGENCY



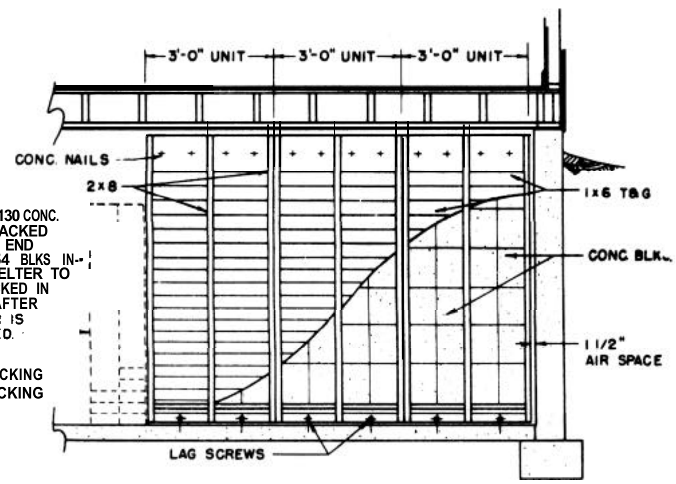
ISOMETRIC OF LEAN-TO UNIT



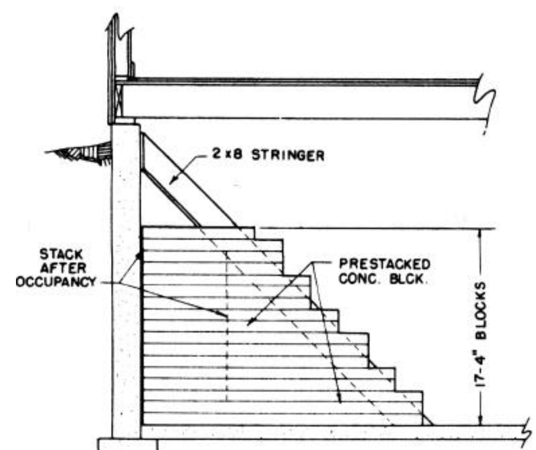
DETAIL
(RECOMMENDED)



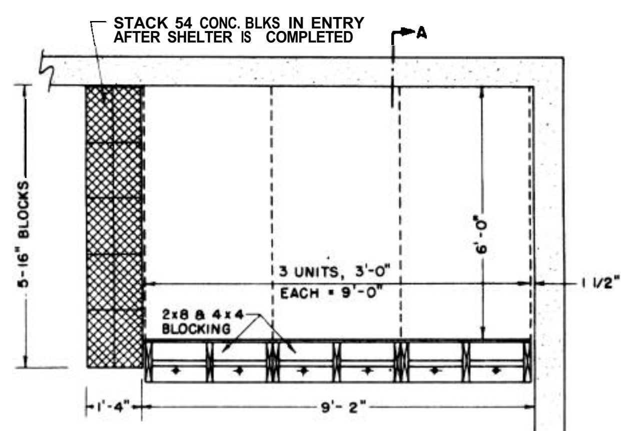
SECTION A



FRONT ELEVATION



END ELEVATION.



PLAN

FEDERAL EMERGENCY
MANAGEMENT AGENCY

GENERAL INFORMATION

This shelter is designed to provide protection from the effects of radioactive fallout in the below grade basement of an existing house. Its advantages are low cost, simplicity of construction, general availability of materials, and the fact that it may be easily disassembled.

TECHNICAL SUMMARY

This shelter design will provide 54 square feet of area and approximately 216 cubic feet of space. It will house three persons. The shelter length can be increased by increments of 3 foot panels. The height may be increased by the use of more materials. This increase will be limited by basement height and handling of the panels.

The materials necessary to construct this shelter should be available from retail lumber yards.

Natural ventilation is obtained by omitting 3 blocks from the top of the entranceway closure and by leaving a 1-1/2 in. gap between the end of the shelter and the basement wall.

Construction time should not exceed 20 man-hours when all the materials are on hand at the shelter location. It is desirable to preassemble the lean-to units and store them in a corner. They can then be installed in the best corner of the basement and stacked with blocks in 1 hour.

MATERIALS LIST

Item	Actual Number Required
Masonry :	
4" x 8" x 16" solid concrete masonry units or	290 blocks or
2-1/4" x 4" x 8" solid bricks	1740 bricks
Lumber: ("construction" or "No. 1" grades or better)	
stringers 2 x 8 x 9'-7" (45" diag. cut at both ends)	9 pieces
boards 1 x 6 x 3'-0" T & G (square edge may be used)	69 pieces
1 x 10 x 3'-0"	1 piece
2 x 10 x 3'-0"	1 piece
blocking 2 x 8 x 1'-3-1/2 stress-grade lumber	6 pieces
4 x 4 x 1'-3-1/2"	3 pieces*

*Rip lengthwise at 45" to provide the 6 pieces required

FEDERAL EMERGENCY MANAGEMENT AGENCY

Hardware:

3/8" diam. x 2-1/4" lag screws and washers	12
3/8" bolt size lead expansion shield, 9/16" x 2" hole	12
#10 ga. x 2" barbed shank, large head roofing nails	3 pounds
16D common nails	1 pound
glue, protein emulsion (must develop 450 lbs. /sq. in.)	1-1/2 pints
#5 x 3" concrete nails	36

Special tools :

9/16" star drill to install anchor bolts into concrete basement floor and walls

CONSTRUCTION SEQUENCE

1. Prepare shelter units.
   a. Cut 45° bevels on 2 x 8 stringers. Arrange in 3 foot panels. Using 16d common nails, attach bottom boards and blocking on the beveled ends first,
   b. Fit in, glue and nail remaining bottom boards with large head roofing nails.
   c. Units can be stored assembled, if desired, to save time. It is desirable to locate lag screw holes and install lead shields in floor and basement wall.

2. Assemble shelter (emergency actions)
   a. Turn this panel right side up and place it in its permanent position. Fasten the panel to the floor with lag screws in lead shields leaving a 1-1/2" gap between the end of the shelter and the basement wall. If lead shields have not been installed ahead of time, use concrete nails as shown in the detail.
   b. Fasten in sequence as many panels as are to be used. Nail to wall with concrete nails.
   c. Fill panels with 2 layers of solid concrete block or brick starting at bottom.
   d. Build end wall of 76 stacked blocks 456 bricks.
   e. Place 50 blocks or 300 bricks in the shelter for emergency closure of entranceway.

BASEMENT SHELTERS

Thermal:	Blast:	Residual Radiation:	Initial Radiation:	Chemical/ Biological:
Excellent	Poor	Good	Poor	Poor

Basement shelters serve well as fallout shelters, but do not make good blast shelters (if there is more than a 1 psi blast, the house may fall and burn).

All shelters must have an outside entrance. Consider cutting a hole in the basement wall and inserting a 36" diameter pipe leading to the outside. The horizontal length of the escape tunnel must run at least half the distance of the height of the home.

Germ warfare poses a problem, as it is difficult to make a basement shelter air tight. Retrofit a ventilation/ gas filter system to a 6 in. diameter steel pipe coming through the outside wall. Put a pipe on the opposite wall for exhaust.

The shelter can be made fairly airtight by stapling heavy plastic to walls, ceiling and floor. Tape the entrance shut after entering the shelter.

Design a 12-volt power system. Gel cell batteries produce very little "out gassing", and 6-volt gel cell batteries configure nicely to a 12-volt system.

Consider adding an inverter as well as plugs for water or solar power to the system. Two, 75-watt solar panels should complete the package. Use 12-volt, 240 mamp lights to conserve battery power.

CONCRETE SHELTERS

Thermal:	Blast:	Residual Radiation:	Initial Radiation:	Chemical/ Biological:
Excellent	Good	Excellent	Poor	Excellent

All specifications for concrete shelter construction in this article are made according to the directives of the Swiss Federal Office Of Civil Defense. The Swiss use concrete, exclusively, for their public shelters. Public concrete shelters in Switzerland are built to two overpressure standards: 15 pounds per square inch (psi) and 45 psi. However, the government encourages the 45-psi standard wherever possible.

Shelters should be built to withstand as many threats as practically possible. People living well away from blast targets should still build to the minimum 15-psi standard in order to properly shield against fallout radiation. **Eight inches of concrete on the roof of a shelter will NOT provide adequate shielding from the radiation levels resulting from a full-scale nuclear attack in the United States—regardless of location. There are no safe areas!** Nuclear attack is not the only reason to build a shelter. Areas of large earthquake or tsunami potential require shelters built to the 45-psi standard.

Space Requirements:

- Each individual must have a min. of 11 sq. ft. of floor space and 88 cu. ft. of free air space.
- Each shelter must have a min. of 60 sq. ft. with min. headroom of 6 ft. 6 in.
- Each air lock must have between 25 and 54 sq. ft. of floor space.

Do not use brittle material (tile or plaster) on interior floors or walls.

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Airlocks:

Airlocks are interim rooms designed to allow access from the shelter living area to the outside, without contaminating the air for those remaining inside the shelter. All public shelters in Switzerland incorporate airlocks into their shelters.

Airlocks should have two gas-tight doors, which are never to be opened at the same time. One door is the main entrance door from the outside, and the other door leads from the air lock to the shelter. This assures protection of the interior shelter room from radiation, blast pressure and war gasses. People entering the air lock from the outside, must close the outside door and stay in a closed down condition until the air of the air lock has been purged. It is easier and faster to purge a small air lock than a large one, and the area of the airlock should be kept between 27 and 54 sq. ft. Filtered air from the shelter room should be exhausted through a blast valve into the air lock. The air from the airlock should be exhausted through another blast valve to the outside.

The air lock, in small shelters, can also act as the decontamination room. The decontamination room serves as a cleaning and dressing room for people contaminated by poison gas or radioactive dust. The decontamination room should be used to store protective clothing and gas masks, which must be worn at all times by persons leaving the shelter. In larger shelters, the decontamination room should have a shower and toilet area built into the room. For shelters housing more than 100 persons, the decontamination room should be a separate room, having direct access to the airlock.

The airlock and decontamination rooms should be constructed of the same thicknesses of concrete, and same protection levels as are prescribed for the shelter room.

Entranceways

The outside entranceway for concrete shelters is a protected, open area leading to the shelter entrance. It is usually a partially covered ramp or staircase leading down to the door of the shelter. One purpose of the entranceway is to keep debris away from the door.

Ideally, the entrance way should lead to the air lock door and access to the shelter should come from inside the air lock.

Entranceways (no airlock):

When the exterior shelter wall is less than 16-inches thick, and there is no airlock, the protection against radiation must be improved by a reinforced concrete passageway leading to the shelter entrance door. The wall and roof elements of the passageway must be at least 8 inches thick and the length of the passageway must be at least four times the width (a 4-ft wide entranceway must be 24 feet long). The door to the shelter must be perpendicular to the direction of the entranceway.

Entranceways (with airlock):

The entranceway to an airlock should be at least 6 feet long and the door to the shelter should be perpendicular to the direction of the entranceway. If there is no entranceway, an 8-inch thick, 4 x 6 ft. reinforced concrete debris guard must cantilever over the shelter door.

Doors:

The entrance door must act as an adequate radiation barrier since even a closed door represents a weak spot in the shelter. Vertical 'walk in' type entrance doors should be constructed of 8-inch thick frames filled with concrete. Entrance doors to the shelter and/or airlock must open outward. The positive phase blast protection comes from the door resting against the massive frame that has been poured into the shelter wall. As the positive pressure phase passes over the shelter, a negative phase pulls at the door. The locking mechanism

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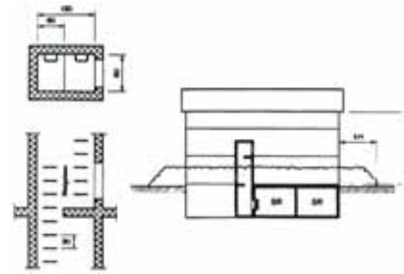
must be able to withstand the 5-psi negative phase pressure. Never use in-ward opening doors on the exterior of the shelter. Inward opening doors cannot withstand the positive pressure phase and will experience failure. Small (24” x 32” max) emergency exit doors, if placed at the bottom of an escape shaft for blast protection, should open inward. Interior doors may open either direction.

Emergency Exits:

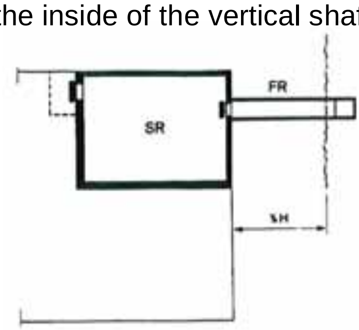
All shelters must be designed with an emergency escape exit. There are several acceptable designs for emergency exits but escape tunnels are the most effective means for escape without outside help.

Corrugated steel is significantly less expensive than concrete and in some situations can be used in place of concrete for the construction of the escape tunnels.

Option 1: The horizontal length of the escape tunnel must be a minimum of one-half the height of the building (measured from ground level to height of eaves). The tunnel should have a minimum diameter of 36 inches (or a minimum rectangular area of 7 sq. ft.). The tunnel should slope away from the shelter with a min. grade of 1% and a max. grade of 15%. The tunnel must have an 8-inch thick concrete door on the wall opening at the shelter end. The small emergency escape door must open to the inside of the shelter. The vertical shaft must have a pressure resistant cover at the top. The vertical shaft must be open at the bottom to allow for drainage. Embedded rungs or a fixed metal ladder must be placed at one-foot intervals for all shafts over 5 feet high. If the shaft rises more than 15 ft., intermediate landings should be built and the cross section must be increased to 2 ft. 8 in. by 4 ft.



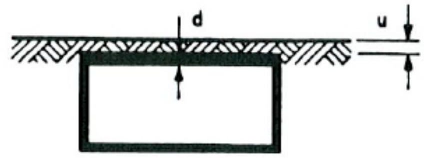
Option 2: The concrete door at the shelter end of the tunnel may be eliminated if the tunnel diameter is no more than 48 in., and the length of the tunnel plus the length of the vertical shaft is a minimum of 22 feet (in order to clear the debris field, the length of the horizontal run of the tunnel must still be at least one-half the height of the building). A steel, blast proof door must be placed at the top of the vertical shaft. The blast door at the top of the shaft must open to the outside and be equipped with an emergency jack in the event that debris covers the door. This alternate design must also include an exhaust pipe under the door, near the top of the shaft, with a blast valve attached to the inside of the vertical shaft.



Thickness of concrete for roof slabs:

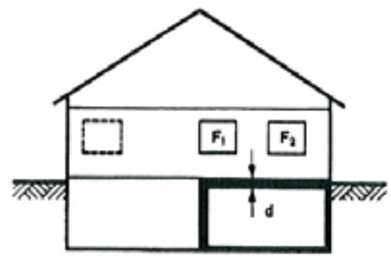
Roof Slabs (not under building).

Earth cover	Concrete (15 psi)	Concrete (45 psi)
0 in.	22”	34”
12”	14”	26”
20”	12”	20”



Roof slabs under building.

	Concrete (15 psi)	Concrete (45 psi)
One story	14 “	22 “
Multi-story	12”	18”

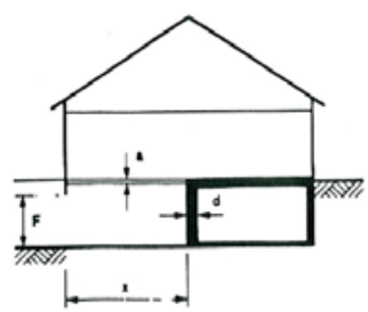


When the room above the shelter has windows & doors involving more than 50% of the wall area, the above roof slab thicknesses should be increased by 2”.

Thickness of concrete for wall slabs:

Thickness of interior shelter walls adjacent to an open basement room.

Concrete (15 psi)	Concrete (45 psi)
20”	26”



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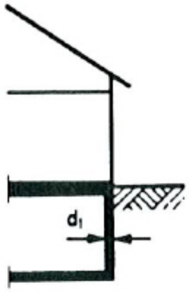
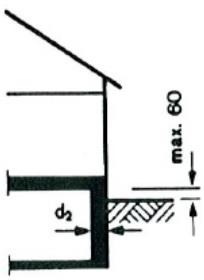
Thickness of outside shelter walls completely underground.

Concrete (15 psi)	10”
Concrete (45 psi)	10”



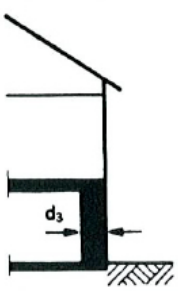
Thickness of outside shelter walls partially underground (ground surface not more than 2 ft. below the underside of the shelter roof slab).

Concrete (15 psi)	20 “
Concrete (45 psi)	28 “



Thickness of above ground shelters and uncovered walls (ground surface more than 2 ft. below the shelter roof slab.

Concrete (15 psi)	32 “
Concrete (45 psi)	48 “



Steel reinforcement:

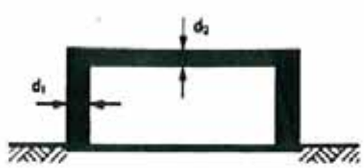
All walls and roof slabs must have a minimum of two curtains of reinforcement steel rebar. This minimum reinforcement should be at least 0.2% of the concrete cross section, with the exception of the undersurface of the floor. All rebar must overlap on the earth side of the wall by one-inch and on the building interior side by ½ inch. For further details, see ***“Technical Directives for the Construction of Private Air Raid Shelters,”*** *p 37,* for sale in the TACDA Store.

Above Ground Concrete Shelters:

High water tables, permafrost, rock and other such conditions may dictate the construction of an above ground concrete shelter (AGCS). The walls and ceilings of above ground shelters must be thicker to compensate for the radiation attenuating factors of the soil cover in below ground shelters.

Rain occurring shortly after fallout begins will wash early fallout from the troposphere and cause higher levels of radiation to be deposited in the direct vicinity. Choose a location for your shelter that will allow rainwater to drain away from the outside walls. It is advantageous to add a sloped concrete apron near the bottom of all outside walls. If possible, slope the roof of the shelter to allow for drainage of the rainwater.

The shelter shell should be constructed of reinforced concrete. Do not use light density materials such as cinder block, isolating concrete forms (ICF) or blown shock-crete in an AGCS. The shielding capability of the shelter is dependent upon the weight of the material used.



Exposed roof slabs and walls, above ground

Thickness of shelter shell for 1 atmos.	3 atmos.
d_1 = 80 cm (31")	120 cm (48")
d_2 = 56 cm (22")	85 cm (34")

15-psi shelter: All walls must have a minimum thickness of 31 inches. The ceiling must have a minimum thickness of 22 inches.

45-psi shelter: All walls must have a minimum thickness of 48 inches. The ceiling must have a minimum thickness of 34 inches.

One obvious disadvantage to an AGCS is its high visibility profile. You can easily disguise its intended function. Frame in fake windows, and put a false cover on the outside such as logs, paint or siding materials. Fake shelves or furniture can disguise the entrance door to the shelter. Your AGCS can easily be turned to multi-function use. Depending on the size and placement, it could be used as a child’s play house, garden or tool shed, doghouse, safe, home theatre, game room, gym, etc.

You may want to build your AGCS inside a barn or even in an interior location of your home. Heating, cooling and accessibility become less of a problem.

The shelter must be built in such a manner that it is independent of the outside structure (structural element). These other structural elements may be attached monolithically or fixed rigidly to the shelter shell; however, they must be fashioned in such a manner that their collapse does not destroy the shelter shell. The weight of the outside structural element must be considered when designing the interior shelter.

References for this article: Nuclear Weapons Effects; Technical Swiss Civil Defense Directives for the Construction of Private Air Raid Shelters **(sold in the TACDA Store).**

NORAD

By Paul Seyfried

Many people erroneously believe that NORAD is a concrete shelter. When Sharon and I visited NORAD in 2003, the only concrete we saw was at the door emplacements. The inside of the rooms are nothing but indigenous rock held in place with heavy gauge wire fencing well fastened with dinner-plate sized washers and stakes. NORAD was built (dug out) in the very early 1960's.

The crew is further protected inside by steel plate (1/2") box-type offices about three stories high. These interior structures are suspended on VERY large coil springs for shock attenuation.

There are two enormous concrete filled blast doors, about 10 feet x 10 feet square, and 3 feet thick, one about 20 feet behind the other, each weighing 25 tons. We were shown the entire facility, the tour lasted about 6 hours.

We sat at the big "U" shaped desk where the heavy hitters sit, each phone having about 100 buttons on it. They asked us not to touch anything... Looked at the big screens with lots of information on the whereabouts of all of the people in the National Command Authority. During 9/11/01, they got most of their info from ...you guessed it- CNN! We saw how their blast valves worked; one was even lying on the floor (as it was being serviced) for us to inspect…closely.

Unlike the Swiss made passive blast valves, which work when the shock wave impinges against the shutter disk, NORAD's active valves are activated when a thermal probe outside detects the thermal signature of a nuclear explosion. This triggers the release of high-pressure (3,000 psi) nitrogen gas that is stored in banks of cylinders, into pneumatic actuators. The valves are closed before the shock wave reaches them. They sound like a high-powered rifle going off in your living room when they fire. They're about 3 feet in diameter, and about 7 feet long (without the nitrogen cylinders).

The public Swiss shelters don't share any technology traits with NORAD. Their shelters are only expected to protect occupants to about 45 psi overpressure, maximum, and many of the home shelters will not meet this criteria because their entrances are terribly vulnerable to prompt radiations, ie neutrons. NORAD, on the other hand, is a 1000-psi facility, and well protected against neutrons. It is old, however, and will likely be closed in the next two years because it is vulnerable to very accurate Russian ICBMs. The U.S. has now built better facilities at Mt. Weather, Ravin Rock and other locations the public doesn't even know about.

If a typical Swiss or American (home) shelter is within 7500 feet of a nuclear explosion, the prompt neutrons will stream RIGHT THROUGH the 8 inch thick concrete blast door, and the 30 inch thick concrete ceiling and kill the occupants in a few days. NORAD has 6 feet of concrete in their sequential blast doors to adequately deal with this problem. Deep underground shelters (steel or concrete) can deal with prompt neutrons by putting ten feet of dirt cover overhead and stuffing shielding into the angled entryways.

Find photos and information at:
http://en.wikipedia.org/wiki/North_American_Aerospace_Defense_Command
Or Google NORAD

Dear TACDA,

I am a TACDA member and enjoy your informative journals. Recently, due to current events, my thoughts have turned once again to the potential of NBC catastrophy. I have a question that I have not seen addressed anywhere-- not from TACDA nor anywhere else. In the event of a nuclear attack, would it make sense to take precious time to seal off the chimney on one's roof? In my case, I have no fireplace, but there is still an open conduit down to my furnace, and then into my utility room (birds have entered my house this way!) My furnace would be fairly close to where I would expect to take shelter in a nuclear emergency.

It seems to me that having an open chimney would invite nuclear fallout a way to get into your house. I was thinking that if the utilities were shut off first, I could get on the roof with a garbage bag and duct tape to cover it up, so no particles could enter my house that way. Does this make sense? Obvously we would need the furnace turned off for the duration of the event. I don't exactly know what happens if you run your gas furnace with a plugged chimney, but it can't be anything good (CO poisoning? fire?) Thanks for any insight you may have. Keep up the good work - looking forward to TACDA Academy when that comes out.

David W.
Lansing, MI

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Dear David,

Normally the chimney vent would not be large enough to allow significant amounts of radiation to enter your home. Entrances to the basement (windows, doors, staircases) are a much greater concern. We are mostly concerned with gamma radiation. A cover will not attenuate that type of radiation. Particles, on the other hand, will be contained in the furnace filter. A dirty filter is actually better than a clean filter for this purpose. But as you said, the furnace will not be running at that time, anyway. If this is a local crises, after it passes just change the furnace filter (put on a mask and use tongs to remove the filter).

If an attack is immanent, go directly to your shelter and take a posture to protect your head. Do not stop to do anything else. Do not lean against an outside wall, as the force generated through the ground could cause lethal injury. I, personally would not risk going outside or onto my roof during an escalating crises or actual event. The radiation is at the highest level during the first 7 hours after the event and the risk from the thermal effect and blast is too great.

If you are well away from the target, however, you may have as much as an hour before the fallout reaches you. I would prefer to use this time to gather last minute supplies and ready my emergency equipment. If you are in a blast zone and there is a GRADUAL escalating crises, quickly turn off your utilities and settle yourself into your shelter.

Please go to the web site, http://www.disastershelters.net. You will find much needed information there about all types of sheltering and sheltering scenarios.

Best Regards,

Sharon Packer

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