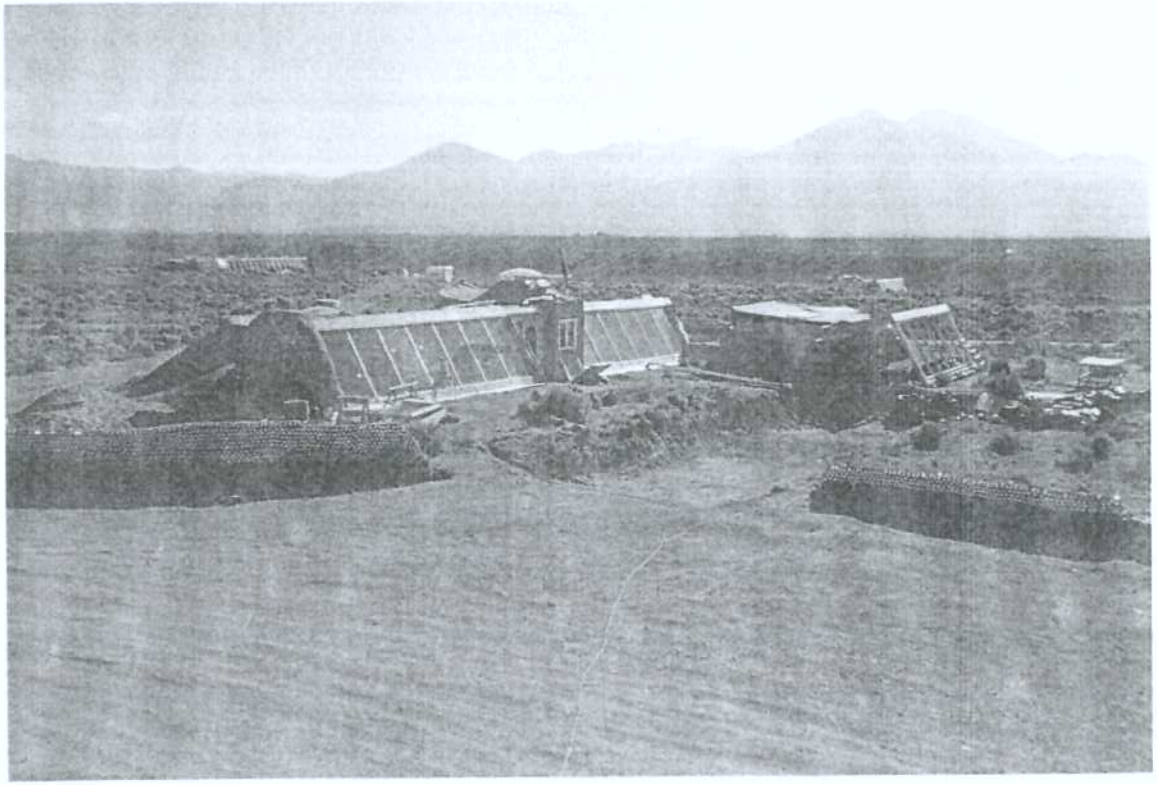
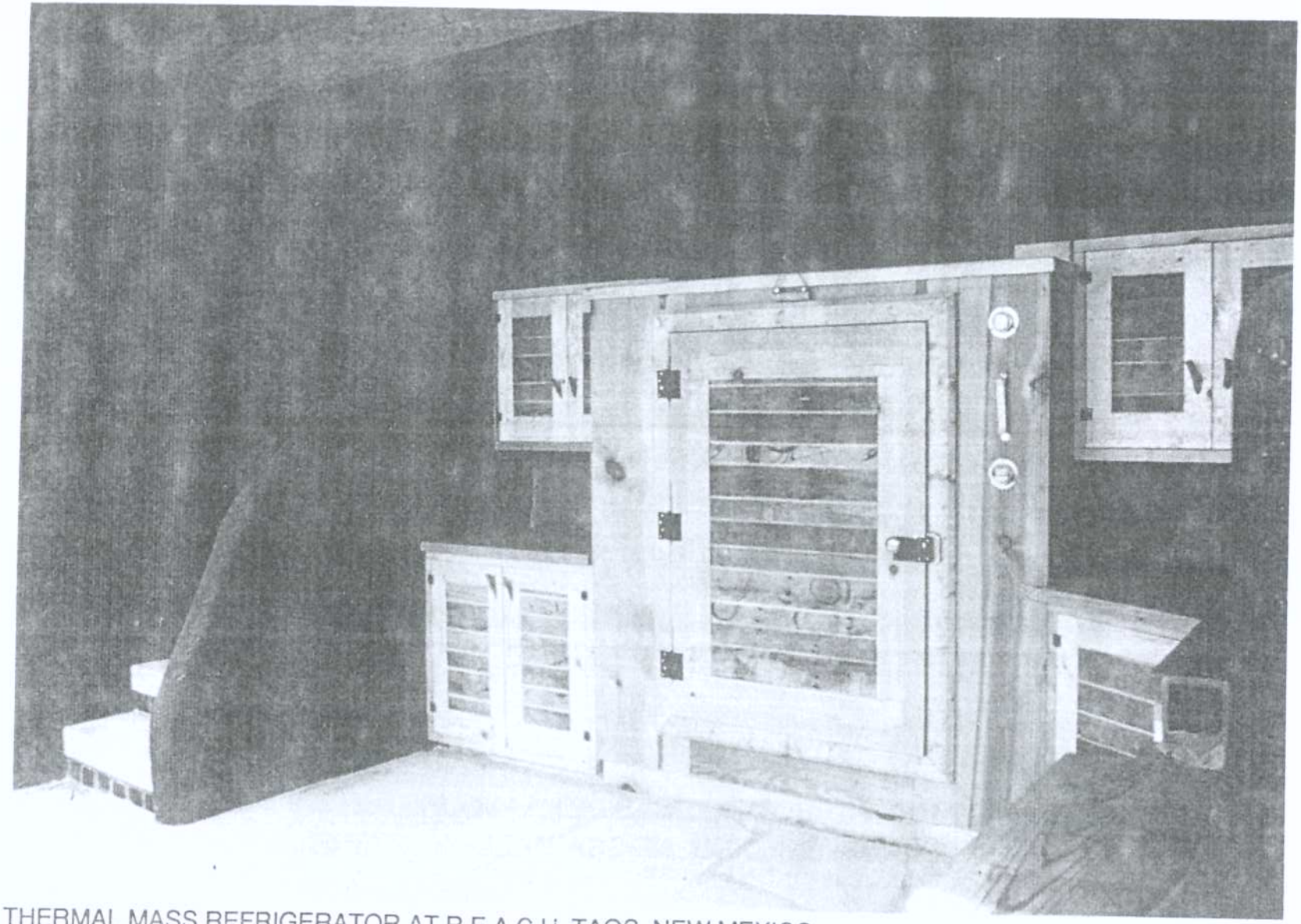
PART TWO
NEW COMPONENT CONCEPTS



RESEARCH BUILDING AT SSA HEADQUARTERS



THERMAL MASS REFRIGERATOR AT R.E.A.C.H, TAOS, NEW MEXICO.

3. THERMAL MASS REFRIGERATOR

THE EARTHSHIP IS DESIGNED FOR MINIMAL ELECTRIC USE SO THAT THE SOLAR ELECTRIC SYSTEM CAN BE AS INEXPENSIVE AND LOW TECH AS POSSIBLE. A "DESIGNED DOWN" ELECTRIC SYSTEM IS DISCUSSED IN EARTHSHIP VOLUME II PP. 9-22. PURSUANT TO THAT DISCUSSION WE HAVE OBSERVED THAT THE SINGLE MAJOR DRAW OF ELECTRICITY IN EARTHSHIPS HAS BEEN THE D.C. REFRIGERATORS. THEY WORK GREAT BUT MONOPOLIZE 2 TO 4 PHOTO-VOLTAIC PANELS YEAR ROUND DEPENDING ON THE SIZE OF THE REFRIGERATOR. WE OBSERVED THAT THE MOST CRITICAL TIME FOR THIS CONSTANT DRAW OF ELECTRICITY IS THE WINTER WHEN DAYS ARE SHORT AND SUN LIGHT IS AT A MINIMUM. THIS IS ALSO THE TIME WHEN LIGHTS ARE USED MORE OFTEN DUE TO EARLIER DARKNESS. HERE IN THE WINTER WE SEE THE LEAST AMOUNT OF SOLAR POWER COMING IN AND THE MOST DAILY DEMAND. DURING THIS "WEAK" OR VULNERABLE TIME (FOR A P.V. SYSTEM) WE HAVE TWO CHOICES:

1. BEEF UP THE SYSTEM JUST TO MAKE IT THROUGH THIS TIME

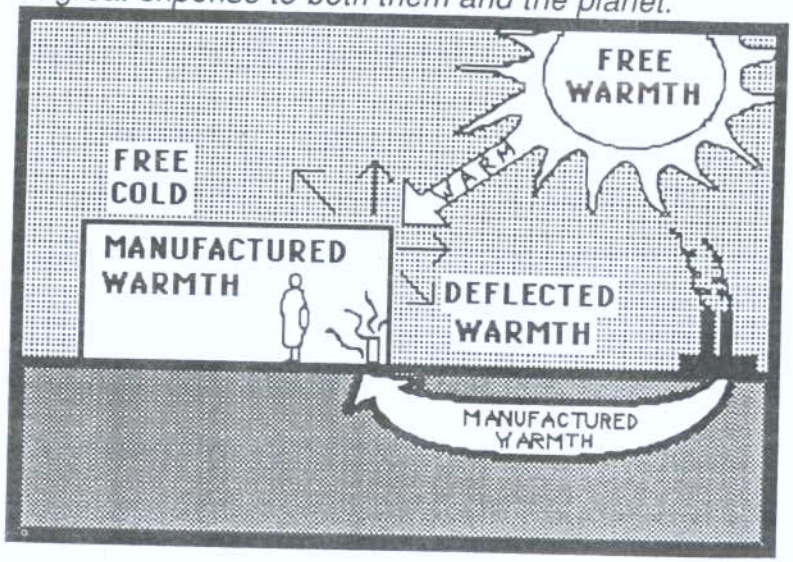
2. REDUCE THE USAGE DURING THIS TIME SOMEHOW.

CAN THE NATURE OF THE EARTHSHIP AND THE PHILOSOPHY OF ALIGNING WITH NATURAL PHENOMENON AGAIN COME TO OUR RESCUE? YES, WE PRESENT THE "THERMAL MASS REFRIGERATOR".

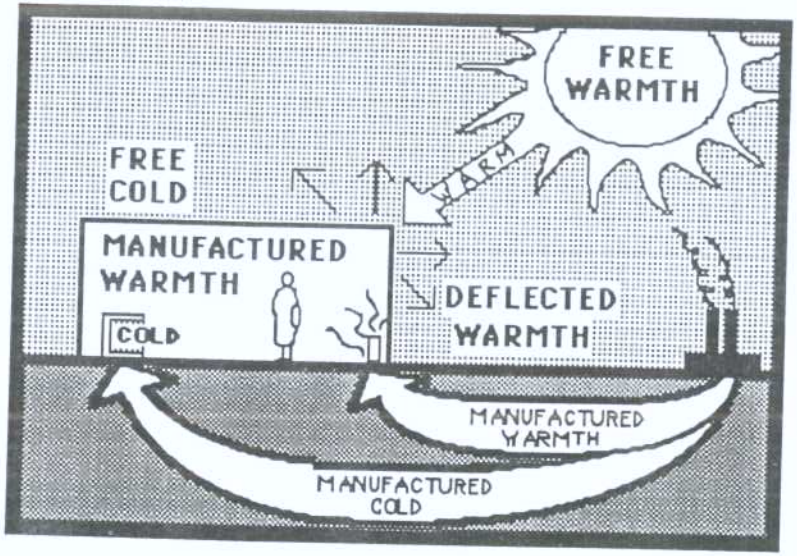
Graphics by Tom Drugan, Claire Blanchard
Photos by Chris Simpson

Imagine you are from another galaxy and you are observing habits and activities of the human beings on Earth. Observation would reveal that these creatures build "boxes" to live in that shield them from the natural elements of the planet.

One such natural element is the sun around which the planet orbits. This sun is a natural source of heat and energy. The boxes shield and separate the humans from this heat. Then the humans manufacture their own heat inside the box using fuels extracted from the planet itself. *They turn their back on natural, "free" heat and make their own heat at great expense to both them and the planet.*



This in itself seems ridiculous, however closer observation reveals an even greater blindness in these humans. They heat the big box with manufactured warmth when natural warmth is available. Then inside the big heated box they build another little box and they use the same manufactured energy to make that box cold *when cold is often naturally available just outside the heated box.*



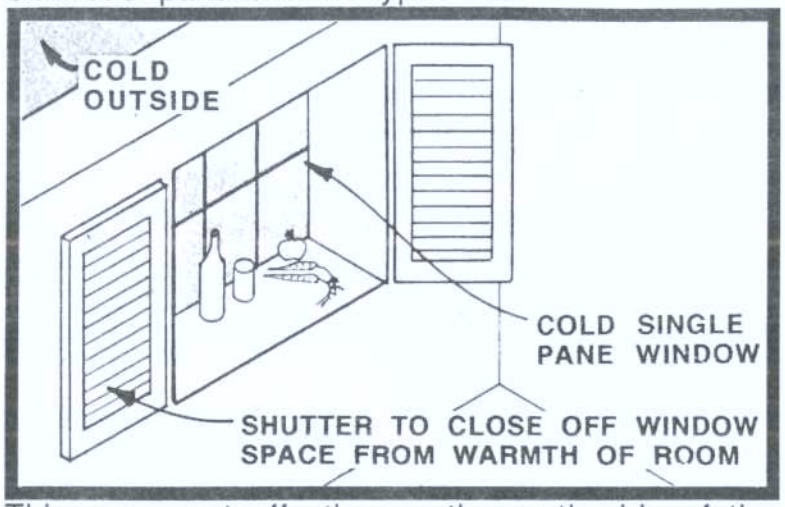
The way this looks from a distant view is quite absurd. The existing environment is COLD but with a source of HEAT "in the sky". The initial box wants HEAT but ignores this source of HEAT from the sky and uses a manufactured and transported form of the same type of energy. Then inside the initial box they do the same thing again. The little box wants to be COLD but ignores the COLD just a few feet away and uses the same manufactured energy to make COLD.

Maybe the problem is that humans can't get far enough away from themselves to see the obvious.

This chapter will pursue the obvious.

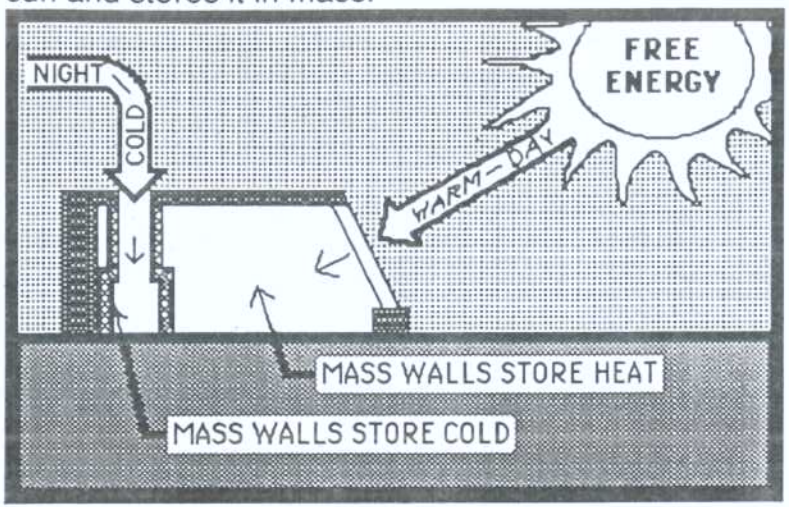
THE NIGHT COOLER CONCEPT

A simple example of the night cooler existed (and exists) in old buildings where single pane glass and thick walls created a deep window seat where food could be cooled simply by placing it on the window sill and closing off the warmth of the room with a blanket or panel of some type.



This was most effective on the north side of the building (in the northern hemisphere) where there is no solar gain on the window. If we take this concept which has been used out of necessity by many (who could not afford refrigeration) and attach it to the already explored concept of thermal mass and the temperature retention qualities thereof, we can have a modern refrigerator that in many areas requires half the energy from outside sources that conventional concept refrigerators do.

We are admitting the cold from the roof (as cold air is heavier and falls down) and storing it in mass much the same as the Earthship itself admits the heat of the sun and stores it in mass.

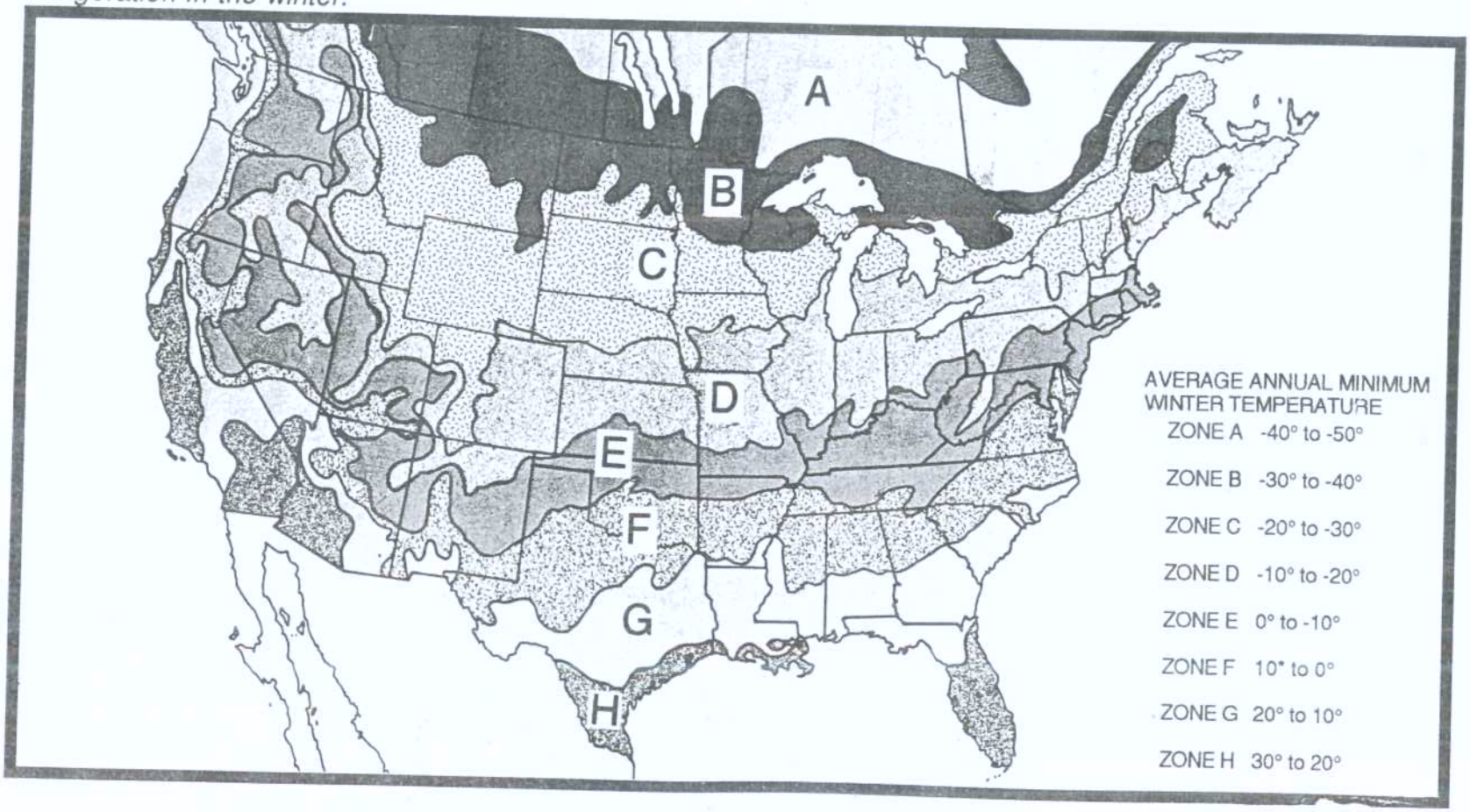


We have a little box inside a big box; both of which get what they need in terms of temperature from the "phenomenon at hand" rather than a power plant.

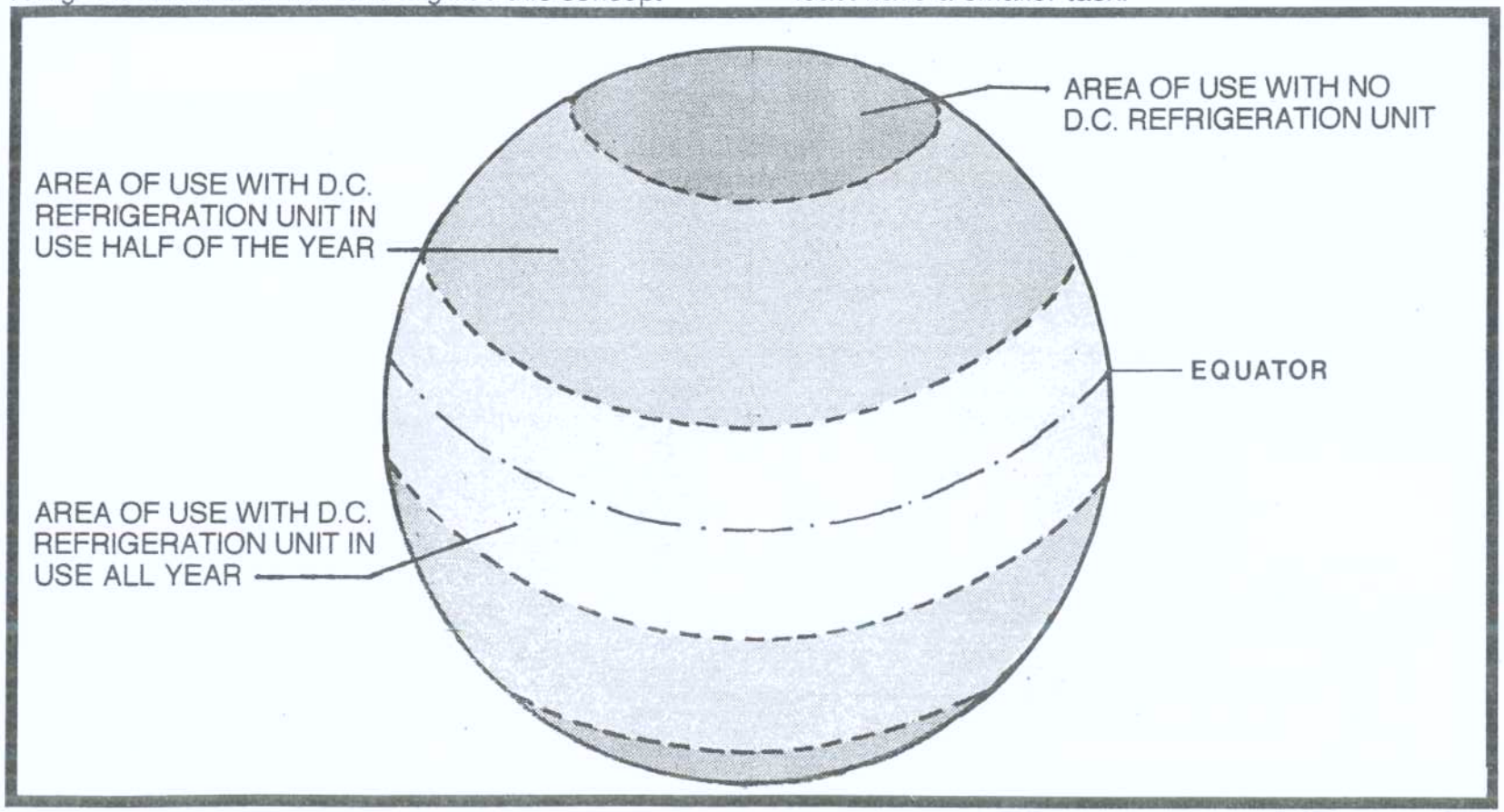
In many areas this concept would work as shown by opening to the night temperatures and closing to the day temperatures. The night temperature is allowed into the mass lined and insulated refrigerator space. This space is closed off during the day time and the mass enables it to retain the cold night temperature through the day. The process starts all over again by admitting the cold air again in the evening.

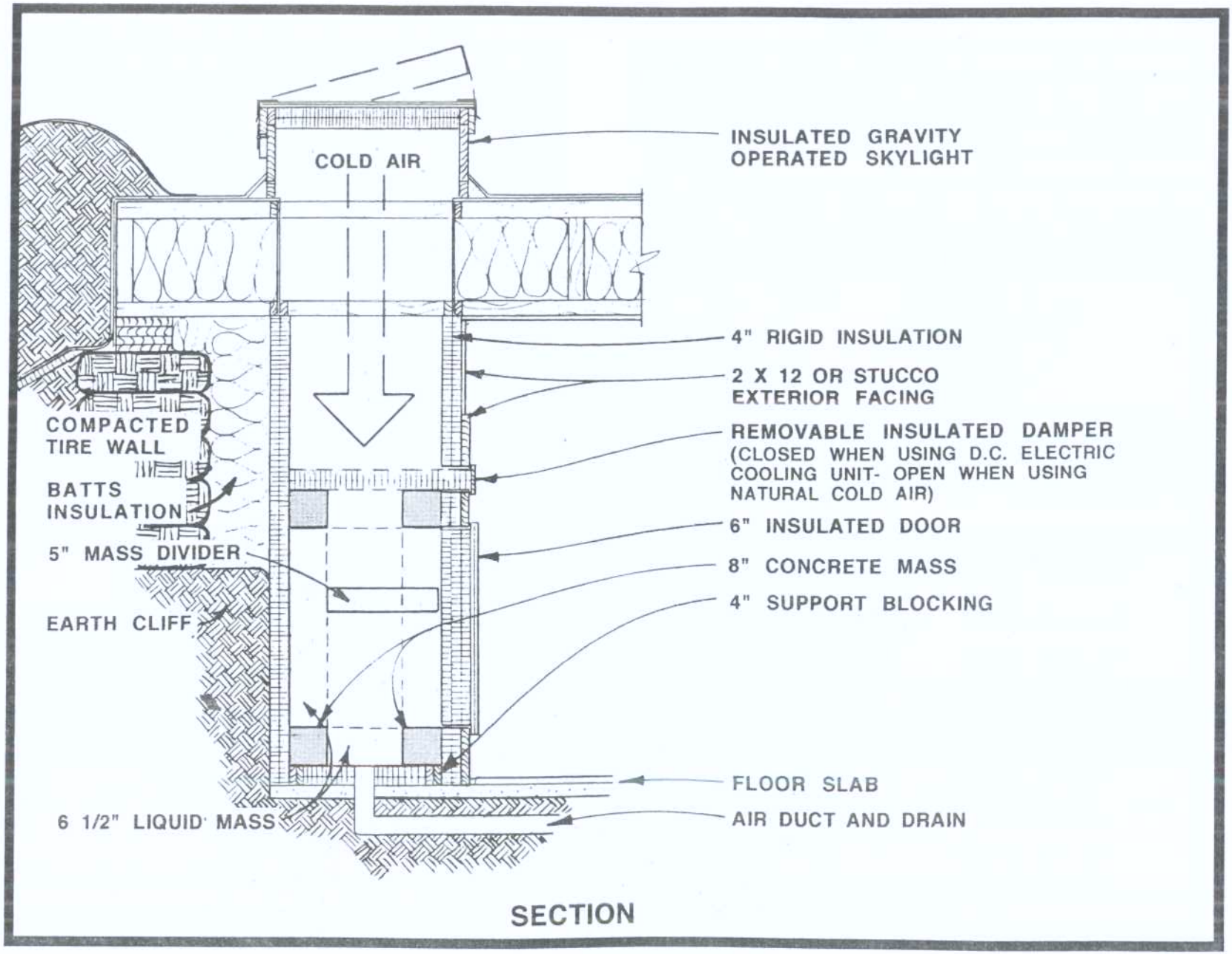
The range of use of this concept can be expanded by attaching a small DC cooling unit, run by P.V. panels. This cooling unit is similar to the one the Sun frost D.C. refrigerator (discussed in Volume II, p. 8 and 25) uses. The cooling unit runs quite often in the summer when there is plenty of sun to power it, but not at all in the winter when there is limited sun. Thus we have *eliminated the use of electricity for refrigeration in the winter.*

The refrigerated space which is in the center of the mass, surrounded by intense insulation, will render the summer use as efficient as possible by *storing* the cold air produced by solar electricity. When you open your refrigerator door and the cold air escapes, the mass quickly cools the space back down after the door is closed. The mass helps the D.C. cooling unit to work less often.



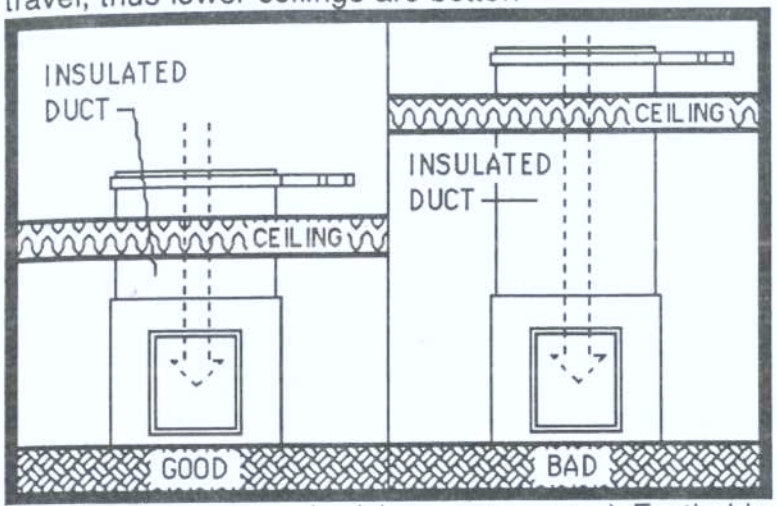
Even in areas where there is no winter freezing, the thermal mass of the night cooler helps *hold the cold* thus reducing the energy required for maintaining refrigeration. Standard refrigerators have only insulation. The night cooler has mass and insulation. In some areas this unit could be used without any auxiliary cooling unit. Any place that has freezing temperatures at night 90% of the time can have free refrigeration. In over half of the globe this concept could suffice without auxiliary power 50% of the time. This reduces the usage of power (solar or other), takes the winter strain off of P.V. power systems and in general puts us a step closer to non freon refrigeration. By *reducing the energy demand* on refrigeration systems on over 50% of the globe we have made the job of refrigeration easier. Now as we struggle toward non freon refrigeration, we at least have a smaller task.



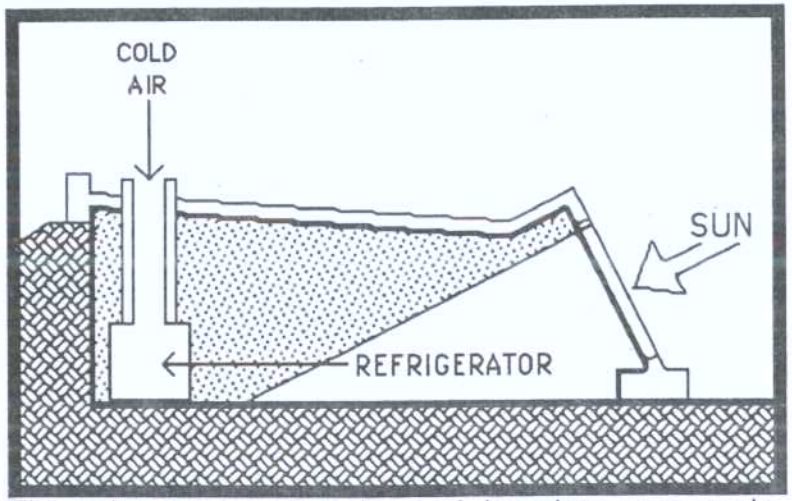

COLD AIR
INSULATED GRAVITY OPERATED SKYLIGHT
4" RIGID INSULATION
2 X 12 OR STUCCO EXTERIOR FACING
REMOVABLE INSULATED DAMPER (CLOSED WHEN USING D.C. ELECTRIC COOLING UNIT- OPEN WHEN USING NATURAL COLD AIR)
6" INSULATED DOOR
8" CONCRETE MASS
4" SUPPORT BLOCKING
COMPACTED TIRE WALL
BATTS INSULATION
5" MASS DIVIDER
EARTH CLIFF
FLOOR SLAB
AIR DUCT AND DRAIN
6 1/2" LIQUID MASS

SECTION

The entire unit is surrounded by mass and insulation. The door is weatherstripped and is filled with 4" rigid urethane insulation. The duct to the roof is also insulated with 4" rigid urethane. The duct must be as wide as the space to be cooled plus the width of the mass. The higher the ceiling the farther the air has to travel, thus lower ceilings are better.



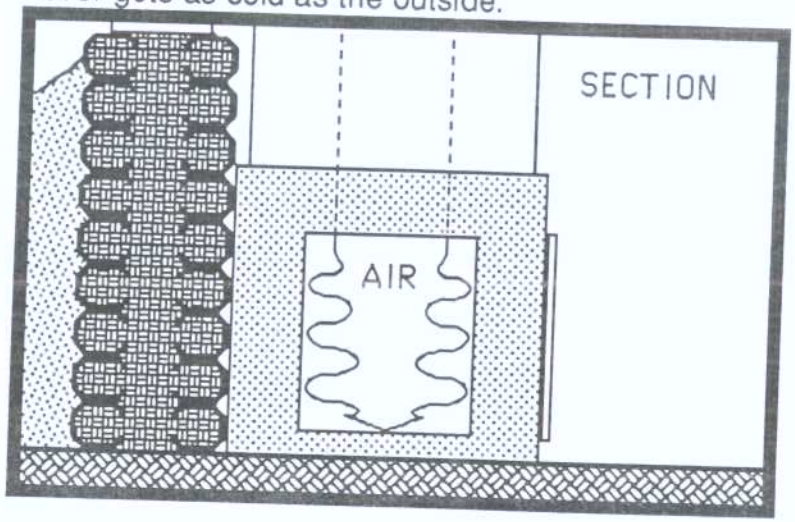
The duct has a standard (but solid insulated) Earthship gravity skylight (as detailed in Volume II) above. An insulated slide out damper is used to close the duct off from the cooled space during times when cool air is not coming in and you are trying to contain what you already have. This damper is also used when the D.C. refrigeration unit is the source of cool air as you are also trying to contain this cool air. In section the unit is a freezer space on top with a cooling space on the bottom. The cooling space can be about 2'-0" tall while the freezer space is about 12" tall. This 12" is important as this dimension is necessary to accommodate the cooling coils of the D.C. cooling unit. A 5" mass divider between the refrigerator and freezer is made of sheet metal and filled with aluminum cans of cheap beer.



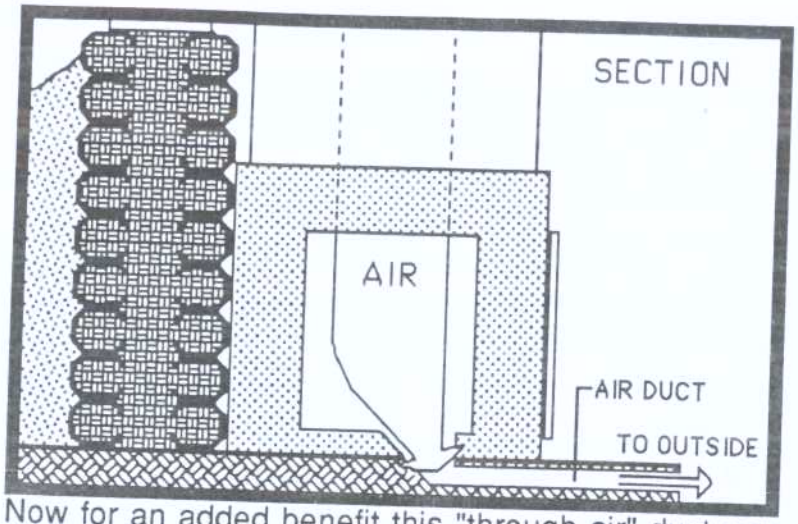
The unit must be placed out of the winter sun angle.

This means deeper into the "U" module. It is very massive, so to place it against or slightly recessed in a mass or cliff wall is a good idea.

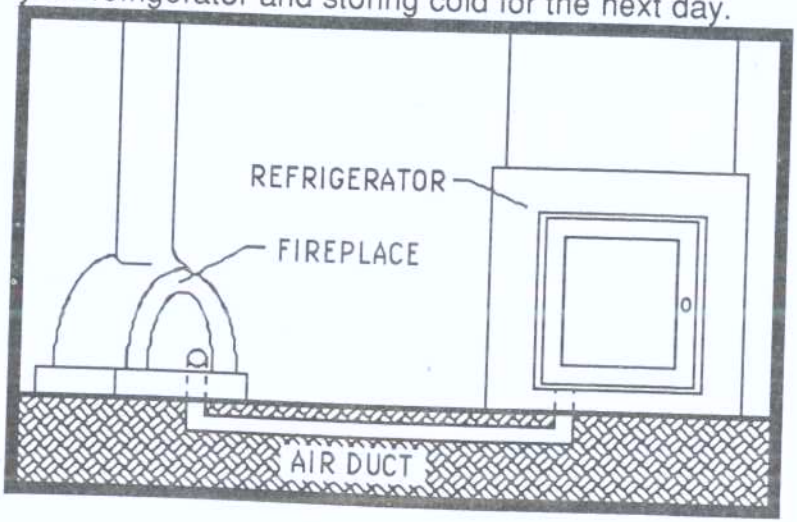
We have observed that the incoming cold night air fills up the space and won't come in as much when there is no place for it to go. This allows cooling but never gets as cold as the outside.

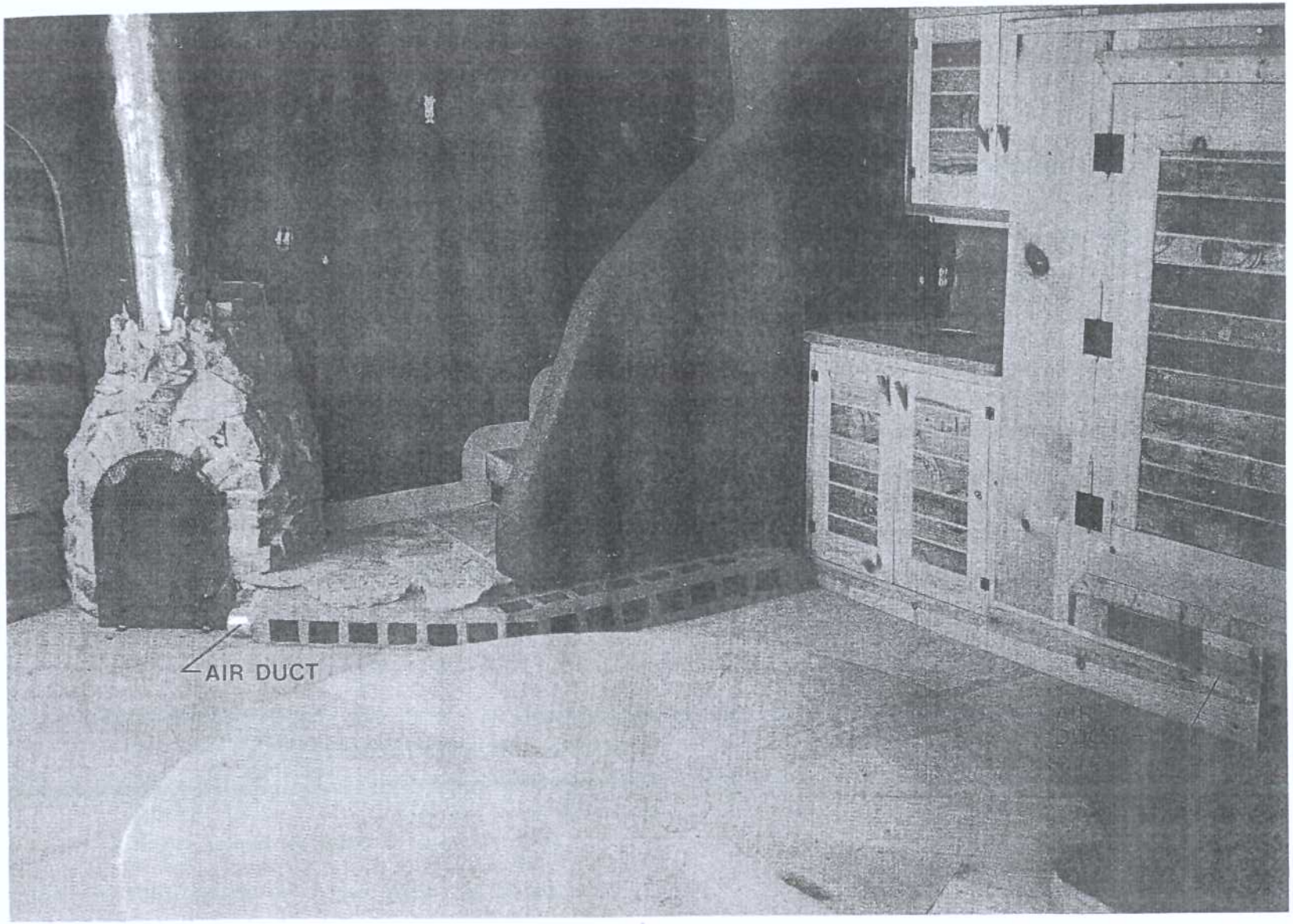


When there is a duct coming out the bottom to the outside, the cold air is pulled all the way through the unit and creates a constant flow of fresh cold air. This achieves temperatures as cold as the outside.



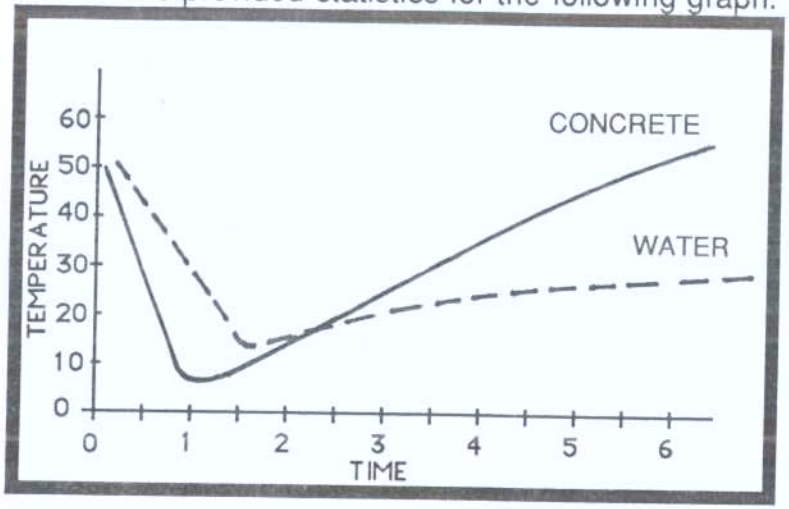
Now for an added benefit this "through air" duct can double as a fresh air duct for a nearby fireplace. It is sucked out through the fireplace chimney providing combustion air for the fireplace which stops it from sucking air through cracks around doors and windows. Whenever you burn a fire, you are cooling your refrigerator and storing cold for the next day.



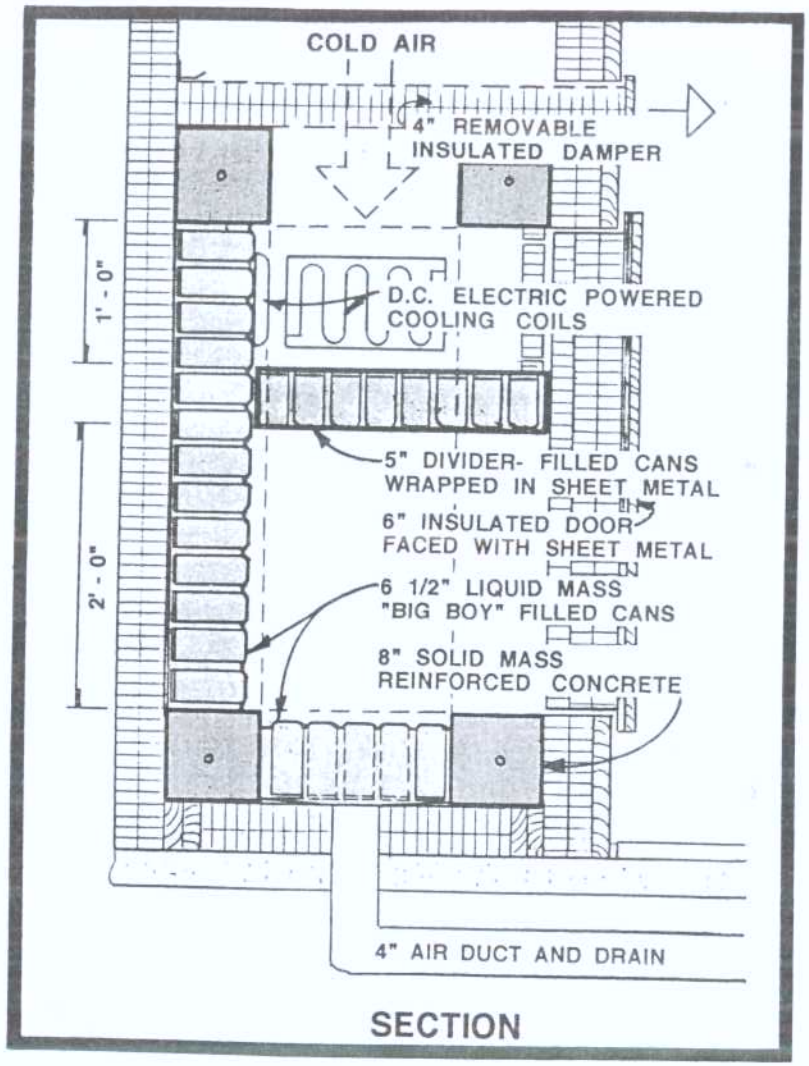

AIR DUCT

SPECIFICS

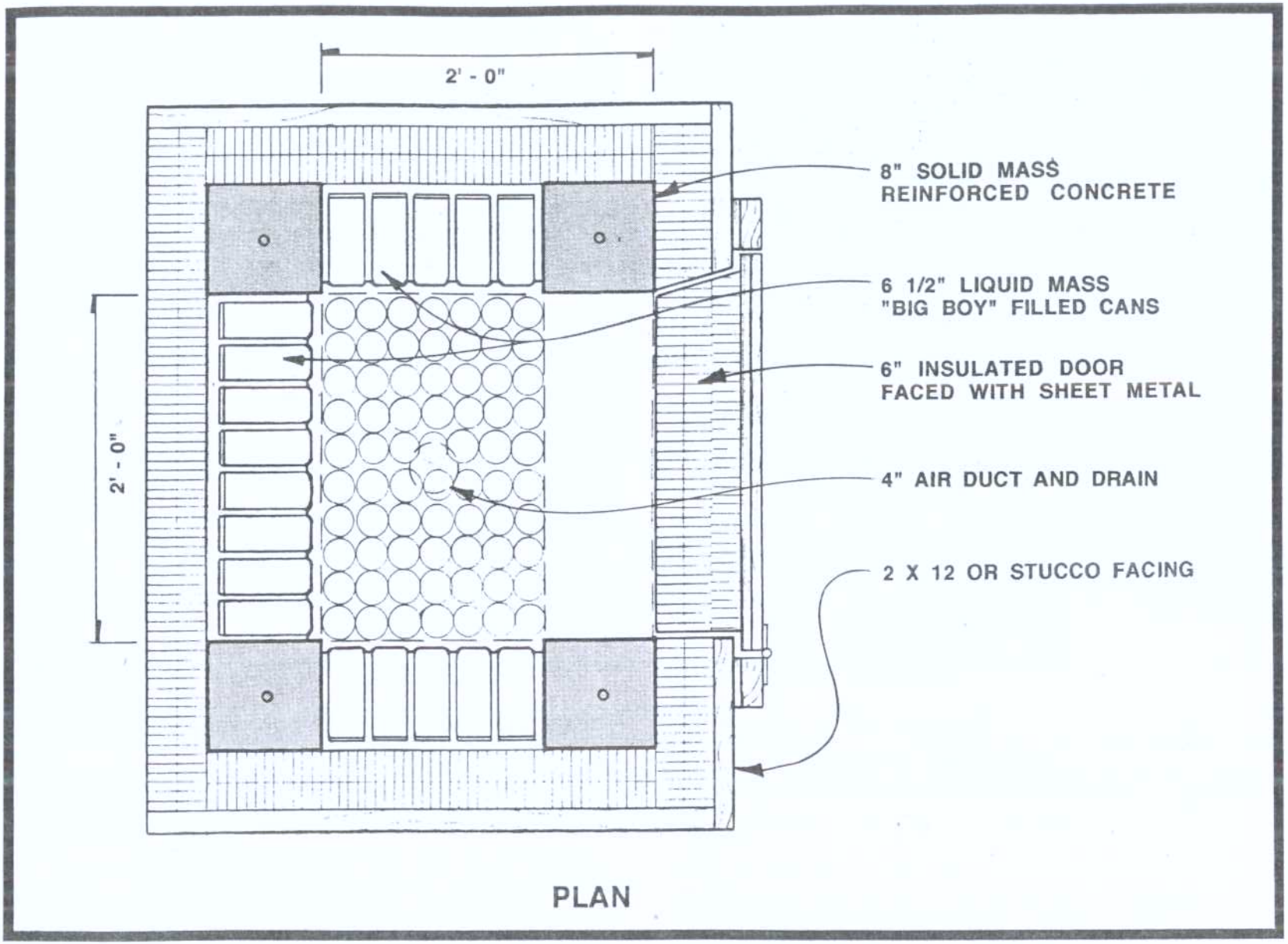
Various experiments with concrete and water thermal mass have provided statistics for the following graph.



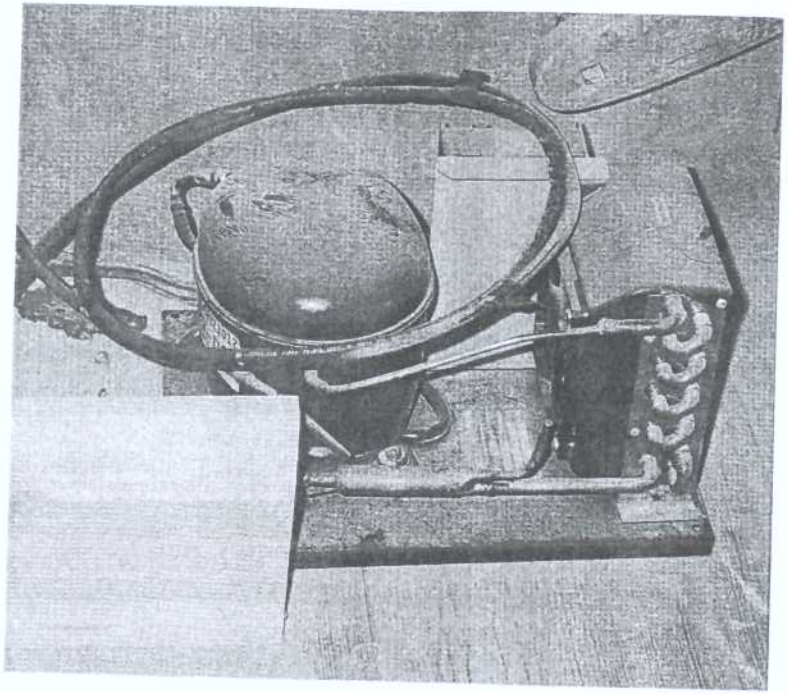
The results show that concrete gets colder faster but water holds the cold for a longer time. This means that a combination of concrete mass to get cold quickly and water mass to see you through a longer period of time is the best approach to building the mass for your "night cooler". We leave "pockets" in the 8" thick concrete mass walls to accommodate water (or cheap beer in aluminum cans) for the liquid mass. You want at least 70% of the mass to be liquid.



The unit in plan is roughly a 2'-0" x 2'-0" space surrounded by 8" of thermal mass. The mass (at least 70% water) is surrounded by 4" of rigid urethane insulation.


2' - 0"
2' - 0"
8" SOLID MASS
REINFORCED CONCRETE
6 1/2" LIQUID MASS
"BIG BOY" FILLED CANS
6" INSULATED DOOR
FACED WITH SHEET METAL
4" AIR DUCT AND DRAIN
2 X 12 OR STUCCO FACING

PLAN



The DC refrigeration unit, shown opposite, or the night air has the capacity to freeze the upper (freezer) part of the unit. The freezer mass is connected to the refrigerator mass and consequently conducts the cold temperature into the lower compartment, thus cooling (not freezing) that area. The mass buffer between the two compartments also aids in containing the *freezing* temperatures while conducting *cold* temperatures. Thus we have a mass refrigerator with a freezer powered both by night temperatures and by the sun. We have taken another appliance and cut its power demand down thus allowing the home power system to be smaller, simpler, and less expensive.

Detailed construction drawings of the thermal mass night cooler are available from SSA. The D.C. refrigeration unit can also be purchased through SSA. These together are cheaper than the Sunfrost D.C. refrigerator and result in a significantly lower household electrical requirement.

Construction drawings for the thermal mass night cooler $100.00

D.C. refrigeration unit. $600.00

Prices subject to change after the printing of this book.

4. THE SOLAR TOILET

THE CONTINUED PRACTICE OF MIXING WATER WITH HUMAN EXCREMENT IS A WASTE OF WATER, A HAZARD TO THE ENVIRONMENT IN WHICH IT IS DUMPED, AND GENERALLY AN ENLARGEMENT OF THE PROBLEM. THE BEAUTIFUL TOWN OF TAOS, NEW MEXICO HAS A SEWAGE TREATMENT PLANT THAT CAN'T HANDLE ITS "LOAD" SO THEY ARE HAULING SLUDGE TO THE DESERT IN TANK TRUCKS AND PLOWING IT UNDER. FECAL MATTER WAS FOUND IN THE DRINKING WATER OF A PUBLIC SCHOOL IN THE CITY OF ALBUQUERQUE, NEW MEXICO. NEEDED GROWTH IN MANY URBAN AREAS IS LIMITED BECAUSE OF LACK OF ADEQUATE SEWAGE FACILITIES. WITH RESPECT TO ENERGY, HEALTH AND THE ENVIRONMENT, WE NEED TO QUIT MIXING OUR SHIT WITH WATER AND ALCHEMIZE IT INTO ANOTHER FORM. *WE NEED TO DO THIS ON A LARGE SCALE NOW.* IN AN EFFORT TO EVOLVE A VIABLE END TO BLACK WATER IN BOTH URBAN AND RURAL AREAS, WE HAVE USED AND LIVED WITH VARIOUS COMPOST TOILETS FOR ALMOST TWENTY YEARS. IN THE FIRST PART OF THIS CHAPTER, WE WOULD LIKE TO PROVIDE AN UPDATE ON THE RECOMMENDATIONS WE PRESENTED IN EARTHSHIP VOLUME II ABOUT THESE COMPOST TOILETS. THEN WE WOULD LIKE TO INTRODUCE A RADICAL NEW CONTRIBUTION TOWARD SOLVING THE PROBLEMS OF BLACK WATER. AS WE LISTEN TO THE EARTH, OUR OWN NEEDS AND THE VARIOUS ENVIRONMENTAL AUTHORITIES, AND TRY TO SATISFY ALL, WE INTRODUCE - THE SOLAR TOILET.

Graphics by Tom Drugan
Photographs by Peter Kolshorn / Tom Woosly

UPDATE ON COMPOST TOILETS

The REACH project has given us the opportunity to live with both non-electric compost toilets made by SunMar - the Centrex-NE (formerly WCM-NE) composter used in conjunction with Sealand 910 Traveler low flush toilet and the toilet/composter in one unit, the Excel- NE (formerly Sunmar-NE). Of the two, the most sensible and least expensive in terms of cost and installation is the SunMar Excel-NE.

The SunMar Excel-NE uses no water or electricity for composting. There is a small DC fan ($50) that is a must or it will stink. The fan uses a small amount of electricity (less than an efficient light bulb) and must be on *all* the time. It would be good to have a spare fan on hand as they are quite delicate and an imperative part of the unit. We once had a chipmunk crawl down the vent stack and get caught in the fan. Both chipmunk and fan were damaged beyond repair. Another time a fan just burned out. The unit begins to smell immediately after the fan quits working.

The unit must be used properly. We have found that almost any kind of composting "enhancers" will work such as sawdust, peatmoss, vegetable scraps, or leaves. Some form of composting aid must be added daily (like feeding a rabbit) and the unit must be tumbled after every use. The worst misuse of this unit we have seen is that some people do not understand the "back tumbling" process which is really how and why it works.

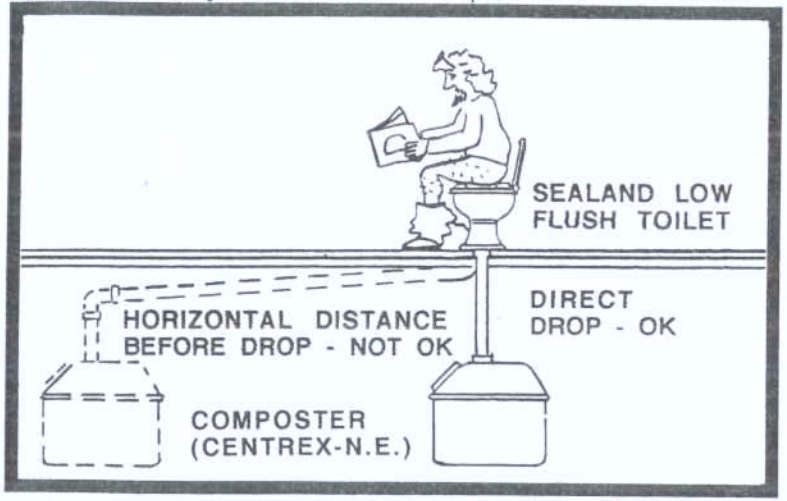
Every three weeks (assuming regular use) the tumbler must be turned backwards for about two revolutions. This unloads some of the contents from the tumbler into a tray in the bottom of the unit. This tray is a very important part of the process of getting the material dried out and harmless enough to put on the ground. The tumbler simply holds the contents separate from this tray and mixes it up as new contents are added. The material begins to break down here but never gets a chance to really dry out. The contents that have been back-tumbled into the tray are left undisturbed for about three weeks.

After three weeks (assuming no new contents are allowed to fall into the tray) the material in the tray is very dry compost that can be put right on top of the ground outside. The only real problem with this unit is that if the above tasks of adding composting additives, tumbling and back tumbling are not executed properly; the material that is dumped onto the ground outside is "rich" and unacceptable for surface use. This means it would have to be buried and authorities can't count on people dealing with this problem adequately on a regular basis. Since there is this potential, these units are not being accepted in any area that is, or has the chance of being, highly developed. The bottom line is the Excel-NE works very well if you know how to use it, but chances are you won't get it approved in a reasonably populated area. It is great for remote home sites and responsible people.

For those who can't be that close to "fecal matter", the low flush toilet with the Centrex-NE model can work well under certain conditions. It also must have a DC fan going all the time. If horizontal runs are used from the low flush toilet to the composter, an occasional flush out of the lines with scalding hot water is

necessary. We advise short or no horizontal runs if possible.

This SunMar remote composting unit (Centrex-NE) used in conjunction with the Sealand low flush toilet (discussed in Volume II) has some drawbacks. If the composting unit is placed directly below the toilet so there is a direct drop into the composting unit, it works well with the same procedures as the Excel-NE. Obviously, it has the same potential for misuse.



It does take very little water to flush in this circumstance. However, the addition of any water seems to retard the composting process. Furthermore, if too much water is used (and there is a tendency to do this) the overflow is forced into action. It clogs very easily and simply does not work well. If there is any horizontal distance required to get to the composting unit, too much water is required to carry the solids to the unit. This results in more use of the easily clogging overflow. This can cause overflow into the tray which is supposed to remain undisturbed and dry. When you empty the tray it can be filled with some pretty foul stuff. What you end up with is wet, soggy, partially composted stuff that should be buried into the ground rather than dumped on the surface. *The mixing of water with human excrement is simply a mistake.* The plumbing and remote space required to use the composter with the Sealand low-flush toilet results in an expensive situation. In that the remote unit requires a two story building, it is automatically not feasible in many Earthship situations. *We absolutely do not recommend this set up if you have any substantial horizontal distance to "travel" between toilet and composting unit.*

In a direct drop situation it can work if you treat it like a rabbit and feed it kitchen compost, peat moss, leaves or straw daily. Also, it is imperative to keep water to a minimum. The more water you use, the more additives (compost, peat moss etc.) you need. Most Earthships are one story and this unit is not worth the expense of trying to create a direct drop situation. However, a knowlegable, responsible person with the right architectural circumstances can successfully use this unit.

The problem that environmental authorities and codes have with compost toilets is that if used in large numbers in dense urban areas and if not used properly we could have a big problem. (There have also been some complaints of flies and gnats with both units.) We recommend intelligent use of the SunMar compost toilets in rural areas but we respect the fears of the authorities in urban areas. The fact that compost toilets aren't allowed in urban areas means that we still have a problem.

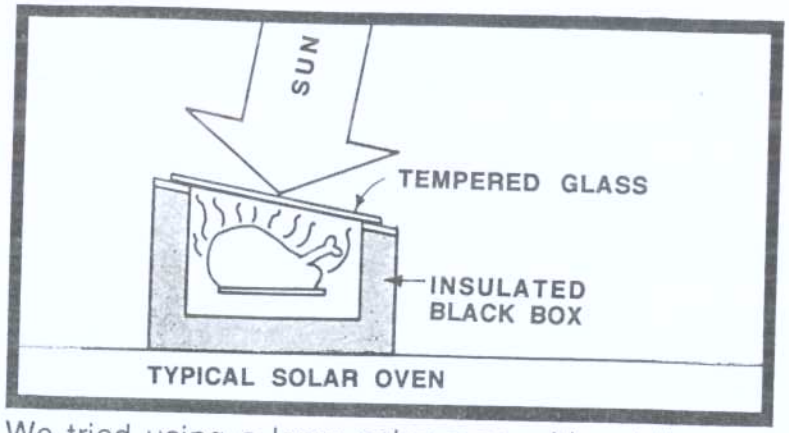
We need a solution that will work for both rural and urban areas, and something that is impossible to misuse.

SOLUTION

We found ourselves looking for a dry toilet situation that required less effort and that produced a more acceptable "product" to put back on the land. We were also looking for a fool proof process that was not as tedious as taking care of a rabbit. The bottom line is, at best, the SunMar units require too much care for the average busy twentieth century human to want to deal with.

The ultimate unit must do everything itself and leave you with a truly transformed product that no building inspector or environmental authority would have a problem with. The reason compost toilets are not acceptable in many areas is that the final product is often too rich and the widespread production of this product could create an undesirable situation. The final product must be something so benign that you could hold it in your hand and would want to put it in your yard or hallway planters.

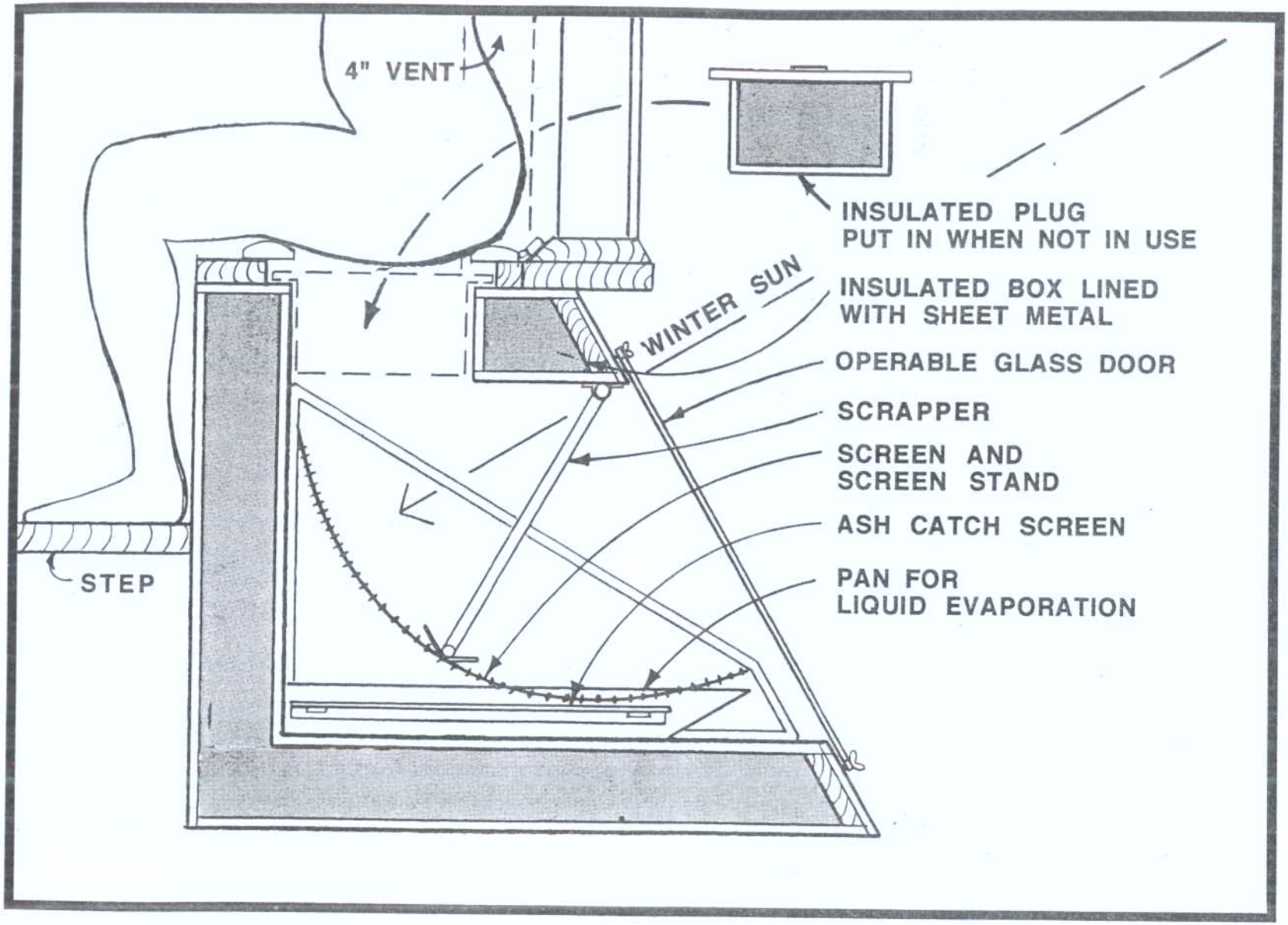
Many people have seen and/or heard about solar ovens. They are a well insulated black box with tempered glass on the front. They really work. You can boil water and cook turkeys in them.



We tried using a large solar oven with a toilet seat built into the top side. The results blew us away. Have you ever left a casserole in the oven on "warm" over night. What you end up with is ash - crackling ash.

THE SOLAR TOILET CONCEPT

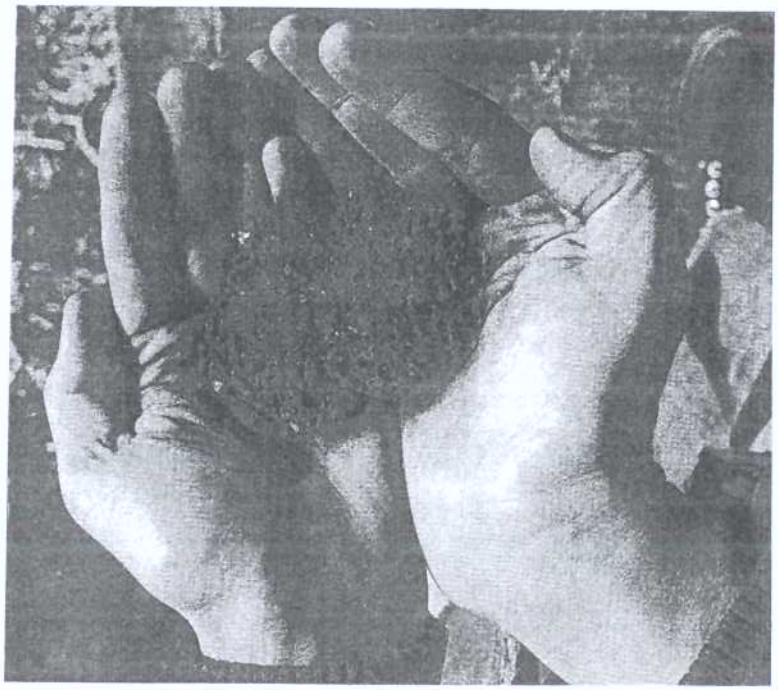
The concept of this toilet is a cross between a solar oven and a compost toilet. It uses no water and no electricity. It uses sun. The excrement goes into a basket that holds the solids and lets the liquids drip through. This basket is placed against the solar front face of the Earthship (or south side of any house) in a black insulated space similar to a solar oven. Extreme temperatures (200 to 400 degrees) and direct sun simply fry the solids and evaporate the liquids. The fried solids turn to black ash and fall through the basket into a pull-out tray where it almost turns to dust. This tray is emptied once a month. This black ash is not going to scare anyone. It can even be put on an interior planter. We have put this black ash/powder into water and had the water tested. *The test showed no bacteria in the water.*



SECTION OF SCRAPER MODEL SOLAR TOILET

The volume of fried ash that is emptied out once a month is remarkably small. The ashes from two people using a solar toilet for one month will half fill a quart container.

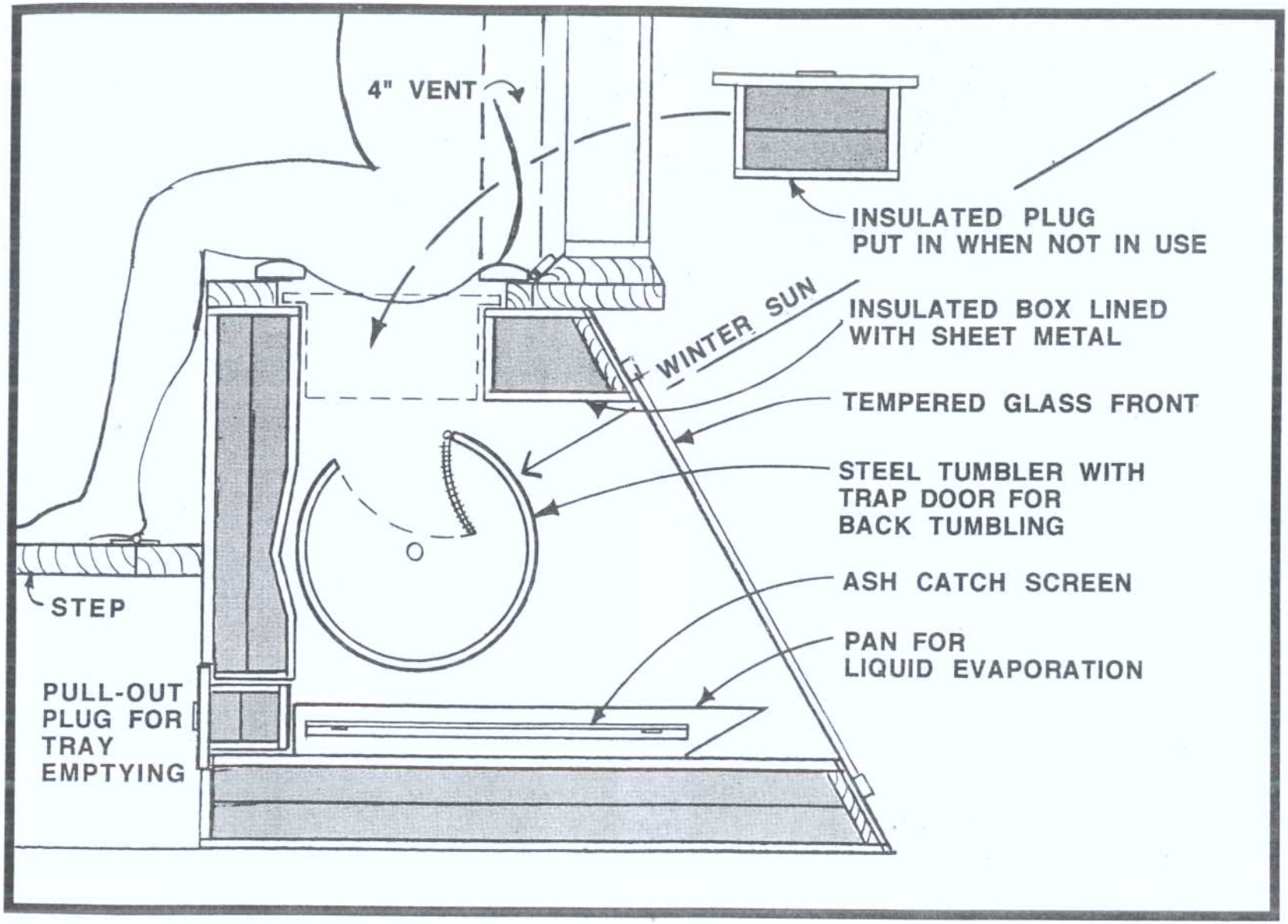
Regular toilet paper can be used. It simply dries up and turns to flakes, then dust. You can drop a match in and burn it for instant disappearance in the scraper model. This unit can be totally built in with the architecture with no plumbing. It essentially costs no more then the Excel-NE. It vents like a wood stove and requires a scraper to be moved back and forth once a day. The following picture illustrates the final product - fried ash.



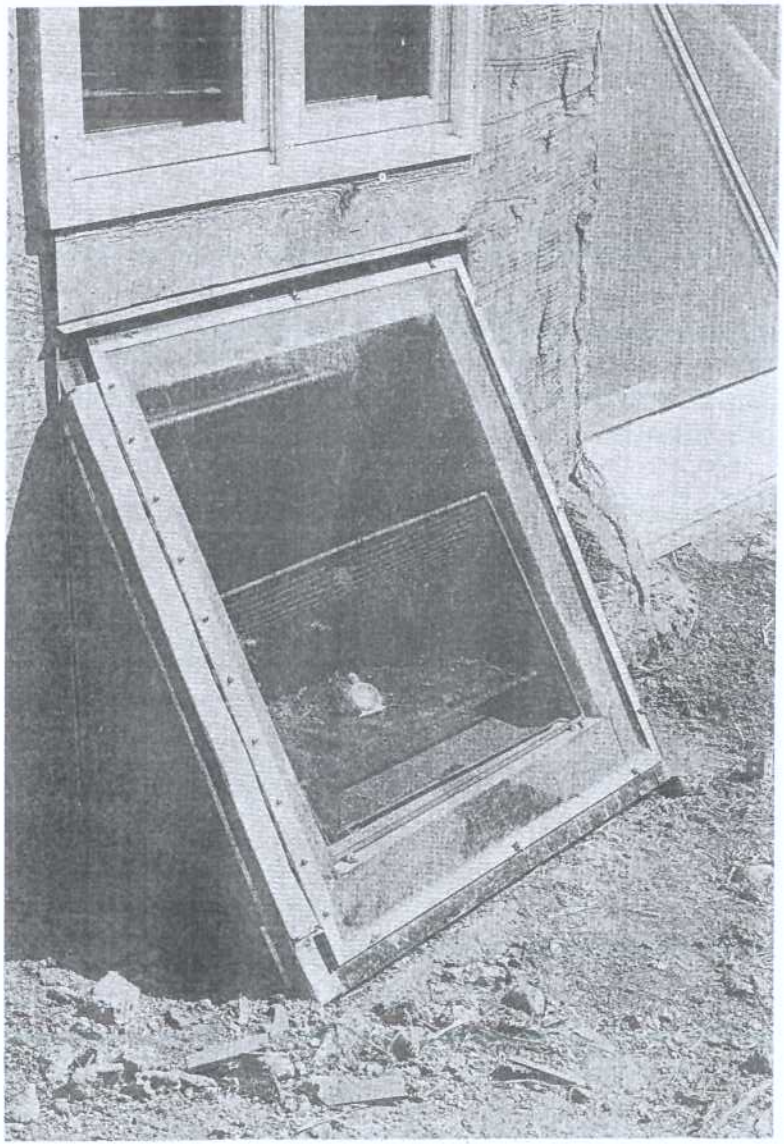
Our first working prototype, (the scraper model) worked great but had one drawback - you could see the fecal matter through the glass. Obviously, many people couldn't handle this. We have since evolved a tumbler model which is more expensive, but contains the contents in a steel tumbler drum. In this circumstance, you can see nothing through the glass nor through the seat. Yes, tampons can be put in. On this tumbler model we have moved the door opening that allows the tray to be removed to the inside. This pull out plug is easier to operate (inside the building) and cheaper to build than the "glass door" on the front.

Both units require a D.C. fan similar to the SunMar units. An important factor here is that the electric fan is *only turned on during use* and kept off the rest of the time in order to maintain high temperatures in the "oven". It is not on all the time like the fans in the Sun Mar units. We have a set of construction drawings available for the scraper model. The tumbler model is more involved and we simply manufacture it. Both units are designed to fit into the front face of an EARTHSHIP.

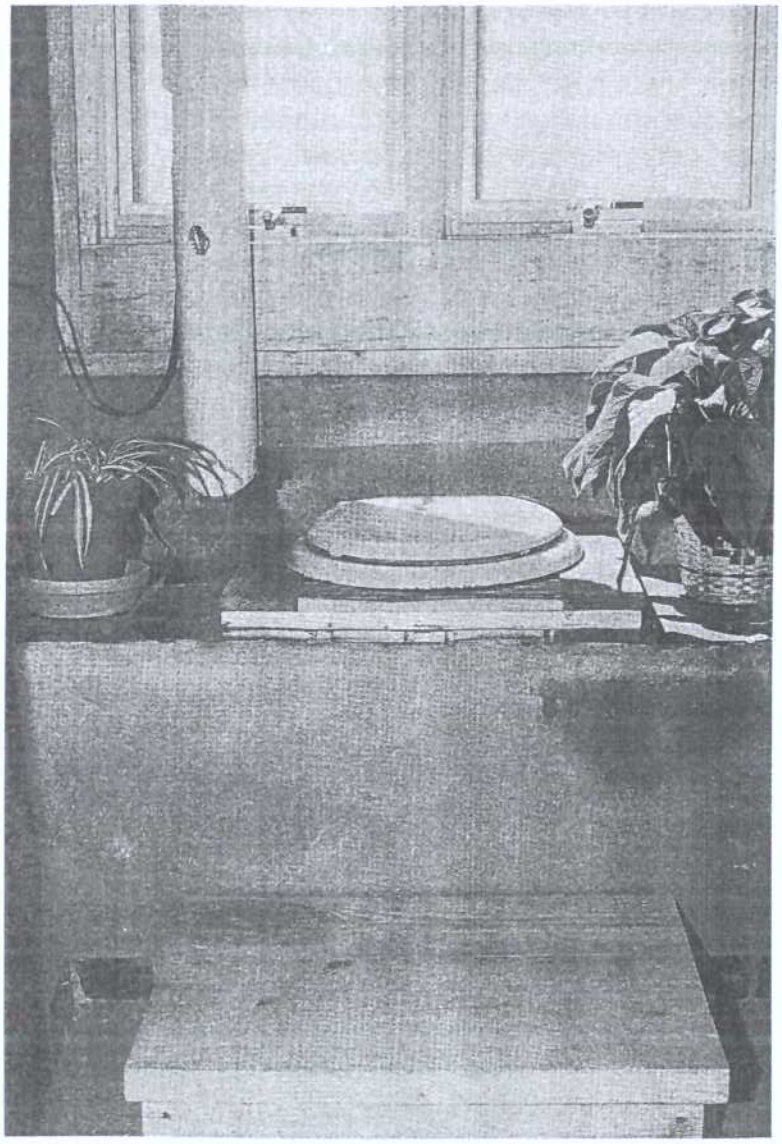
The tumbler model works much the same as the SunMar composter when the sun is not out. Then when the sun comes out it fries the back tumbled compost. Thus the tumbler model extends the use of the concept to cloudier areas and minimizes the visual contact with the compost.



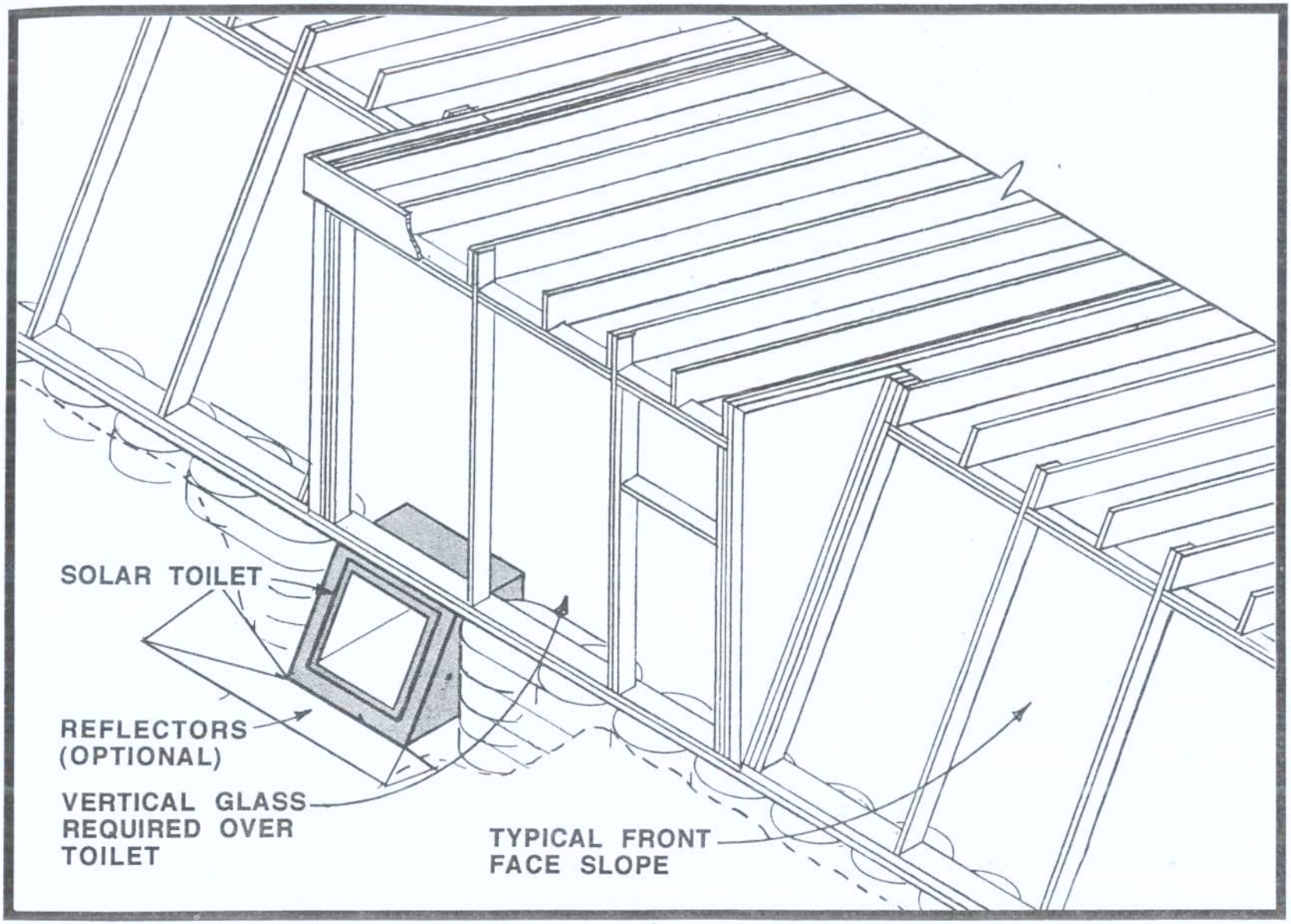
SECTION OF TUMBLER MODEL SOLAR TOILET



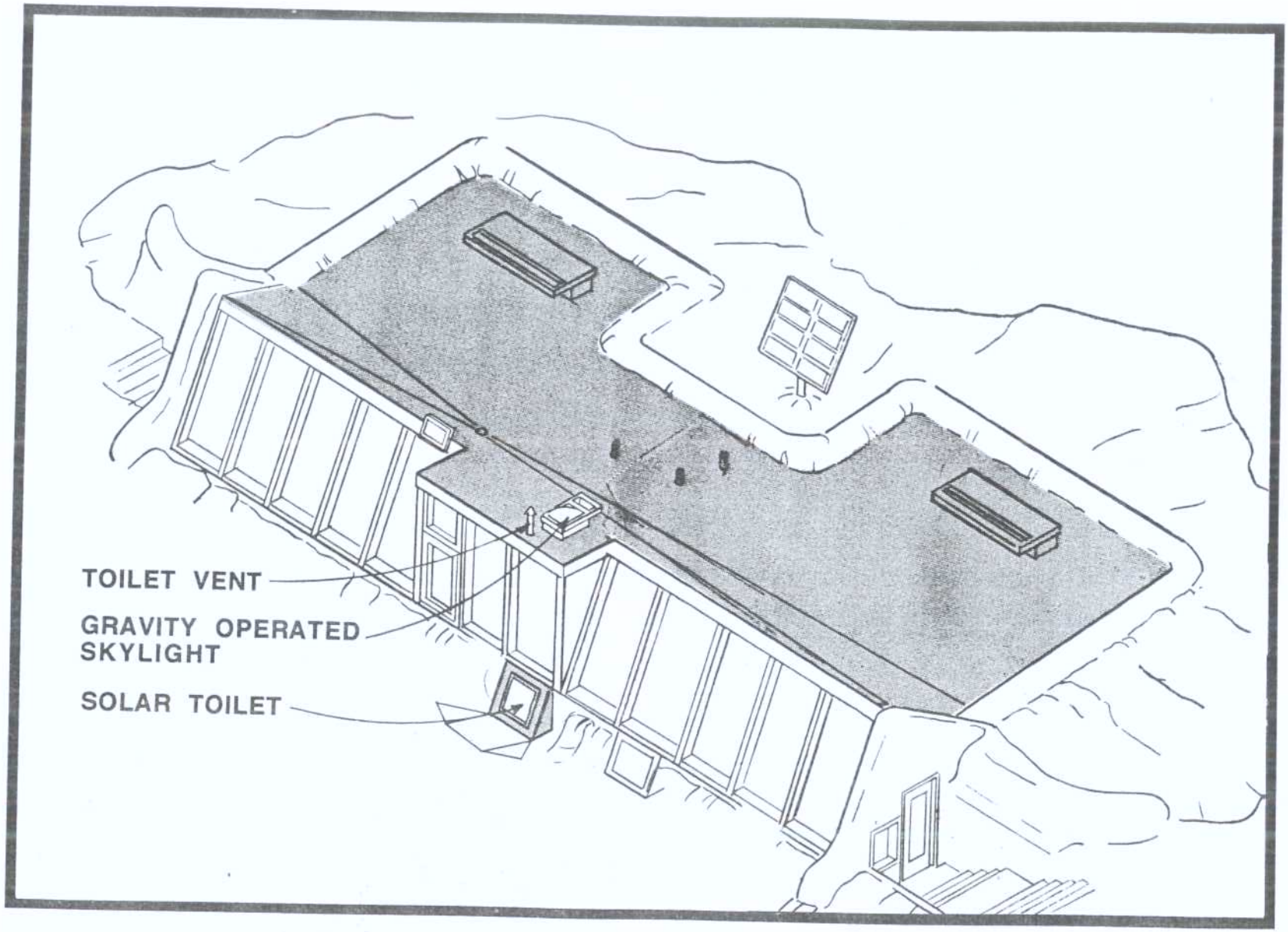
OUTSIDE OF SOLAR TOILET PROTOTYPE



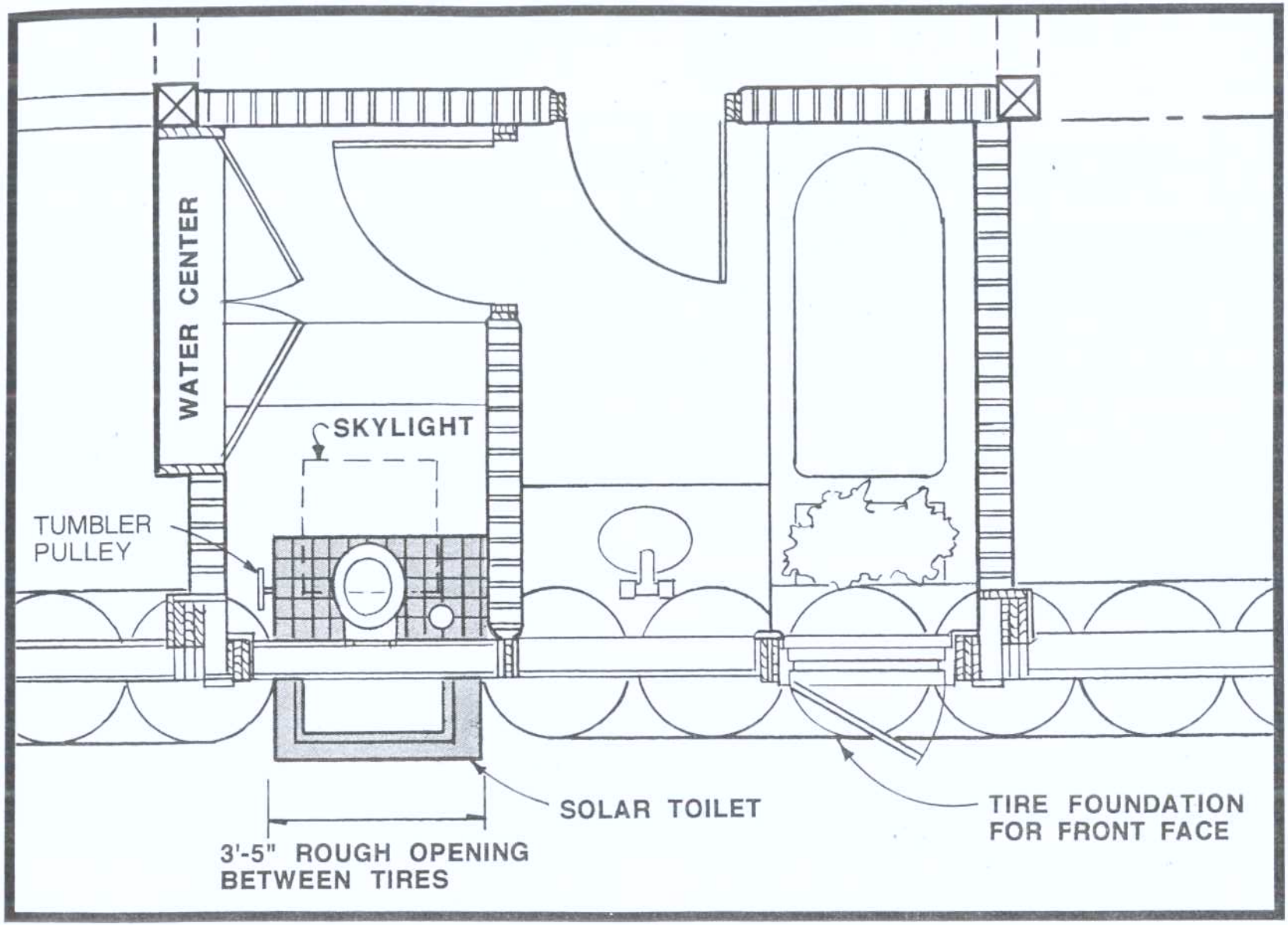
INSIDE OF SOLAR TOILET PROTOTYPE



FRAMING FOR GENERIC SOLAR TOILET INSTALLATION



OVERVIEW OF GENERIC EARTHSHIP SHOWING SOLAR TOILET



FLOOR PLAN OF GENERIC SOLAR TOILET INSTALLATION

These units can be installed in any building whether it is an Earthship or not. They must however, be placed on the south side of the structure (in the northern hemisphere), as the sun is what makes them work.

We still recommend a little closed off room for the toilet (see previous page) with a small gravity operated skylight (see Chapter 8, Vol. II). Different geographic locations would require different glass angles similar to the EARTHSHIP itself. Either model will work as a composter during cloudy weather. For extremely cloudy weather the tumbler model is the only choice. At this point the scraper model is great for areas with 200 or more sun days per year and the tumbler model will extend the use to areas with only 150 sun days per year. You need one for every 4 people in sunny areas and one for every 2 people in areas down around 200 sun days per year. Optional reflectors will enhance the performance of either model.

Both units are available through SSA. The DC fans and construction drawings for the scraper model are also available through SSA.

INSTRUCTIONS FOR USE ARE AS FOLLOWS:

1. Turn on fan
2. Open damper
3. Lift toilet seat and pull plug then reposition toilet seat
4. Use toilet (optional - drop match in and burn paper-scraper model only)
5. Install plug and close toilet seat
6. Turn off fan
7. Close damper

8T. Tumble 2 turns (on tumbler model only)
8S. Move scraper back and forth a few times at the end of each day (scraper model only)
9. The back tumbling operation (described on page 100) must happen once a month on the tumbler model

PRODUCT LIST:

DC Fan	$50.00
Solar Toilet Scraper Model	$1500.00 plus freight
Solar Toilet Tumbler Model	$1700.00 plus freight
Construction Drawings and Procedures For Scraper Model	$100.00
Sunmar Excel-NE	$999.00 plus freight
Sunmar Centrex-NE	$999.00 plus freight
Sealand 910 Traveler	$161.00 plus freight

Prices subject to change after the printing of this book

ORDER FROM:

Solar Survival Sales
P.O. Box 1041
Taos, New Mexico 87571
(505) 751-0462

5. SOLAR OVEN / DISTILLER AND ELECTRIC COOK TOP

MOST EARTHSHIPS, UP UNTIL NOW, HAVE BEEN USING GAS FOR COOKING. THIS IS BECAUSE ELECTRIC OVENS USE TOO MUCH POWER TO RUN OFF OF A SOLAR ELECTRIC SYSTEM. WE ARE CONSTANTLY TRYING TO ELIMINATE USES OF FOSSIL FUEL IN EARTHSHIPS FOR MANY ENVIRONMENTAL, ECONOMIC, AND PHILOSOPHICAL REASONS. WE HAVE, THEREFORE, DEVELOPED A SOLAR OVEN THAT IS THE SAME BASIC CONFIGURATION AS THE SOLAR TOILET. THIS LEAVES US WITH ONLY THE COOK TOP TO POWER WITH SOLAR ELECTRICITY AND THAT CAN BE DONE. SINCE (BEING SOLAR) THE SOLAR OVEN IS "ON" ALL DAY LONG AND ONE DOES NOT COOK ALL DAY LONG, WE HAVE DETAILED IT TO DOUBLE AS A SOLAR DISTILLER. DISTILLED WATER IS NEEDED FOR THE BATTERIES IN THE SOLAR POWER SYSTEMS IN ADDITION TO ITS USE AS FOOL PROOF, SAFE DRINKING WATER. OUR SOLAR OVEN/DISTILLER IS A WELCOME ADDITION TO THE VARIOUS EARTHSHIP APPLIANCES THAT FREE US FROM THE BONDAGE OF TWENTIETH CENTURY DOGMA.

Graphics by Tom Drugan
Photographs by Chris Simpson

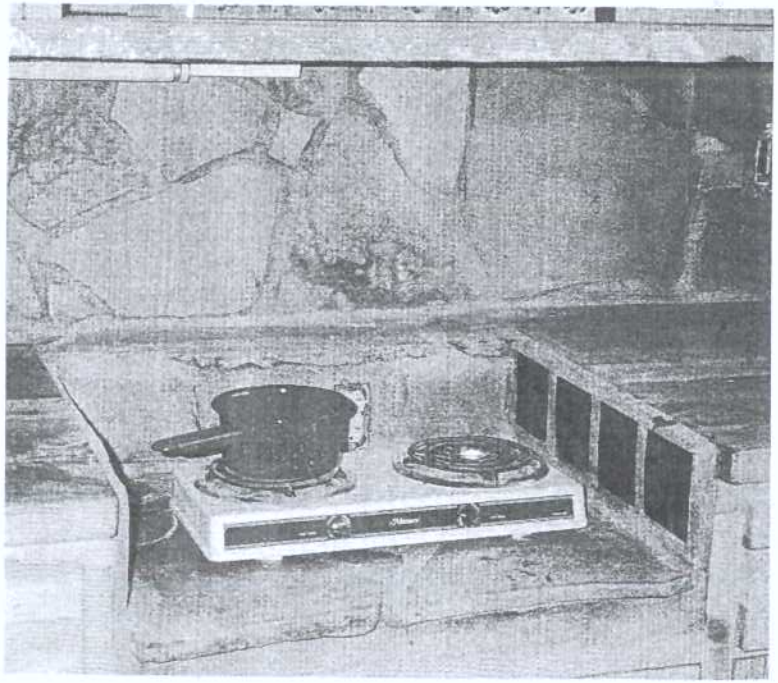
THE OVEN

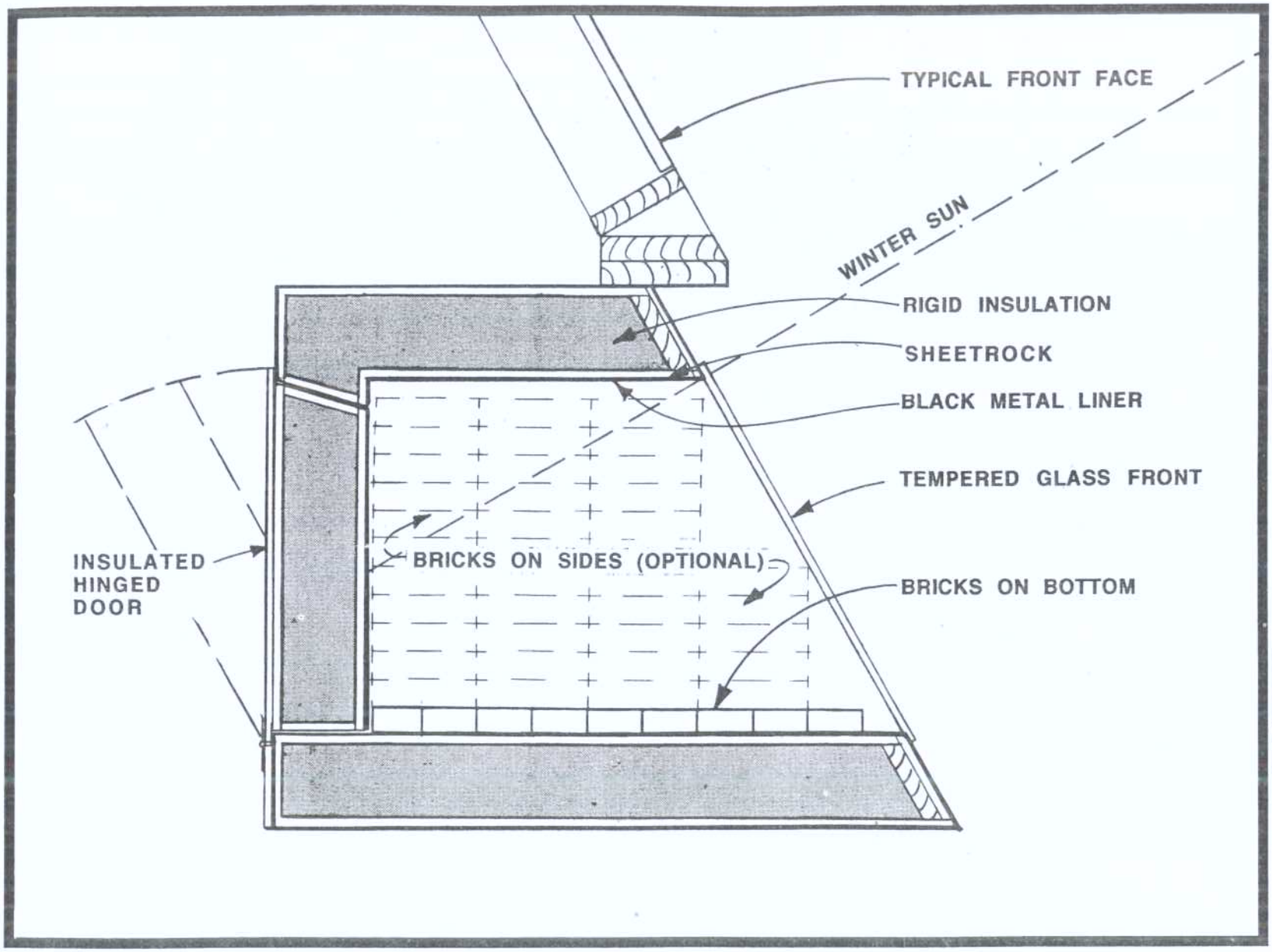
Since the solar toilet is basically a solar oven that can reach temperatures of up to 400 degrees Fahrenheit, we have used the same basic unit as a point of departure for manufacturing the solar oven/distiller. We have simply replaced the toilet seat with an oven door.

There is no vent pipe necessary in the oven and it is always light on the inside during use because of the sun. The unit is somewhat larger than a regular gas or electric oven but this better facilitates the distilling aspect. The unit must be installed on the solar front face of the Earthship. It can also be used in a regular house as long as it is built in to the south face (in the northern hemisphere).

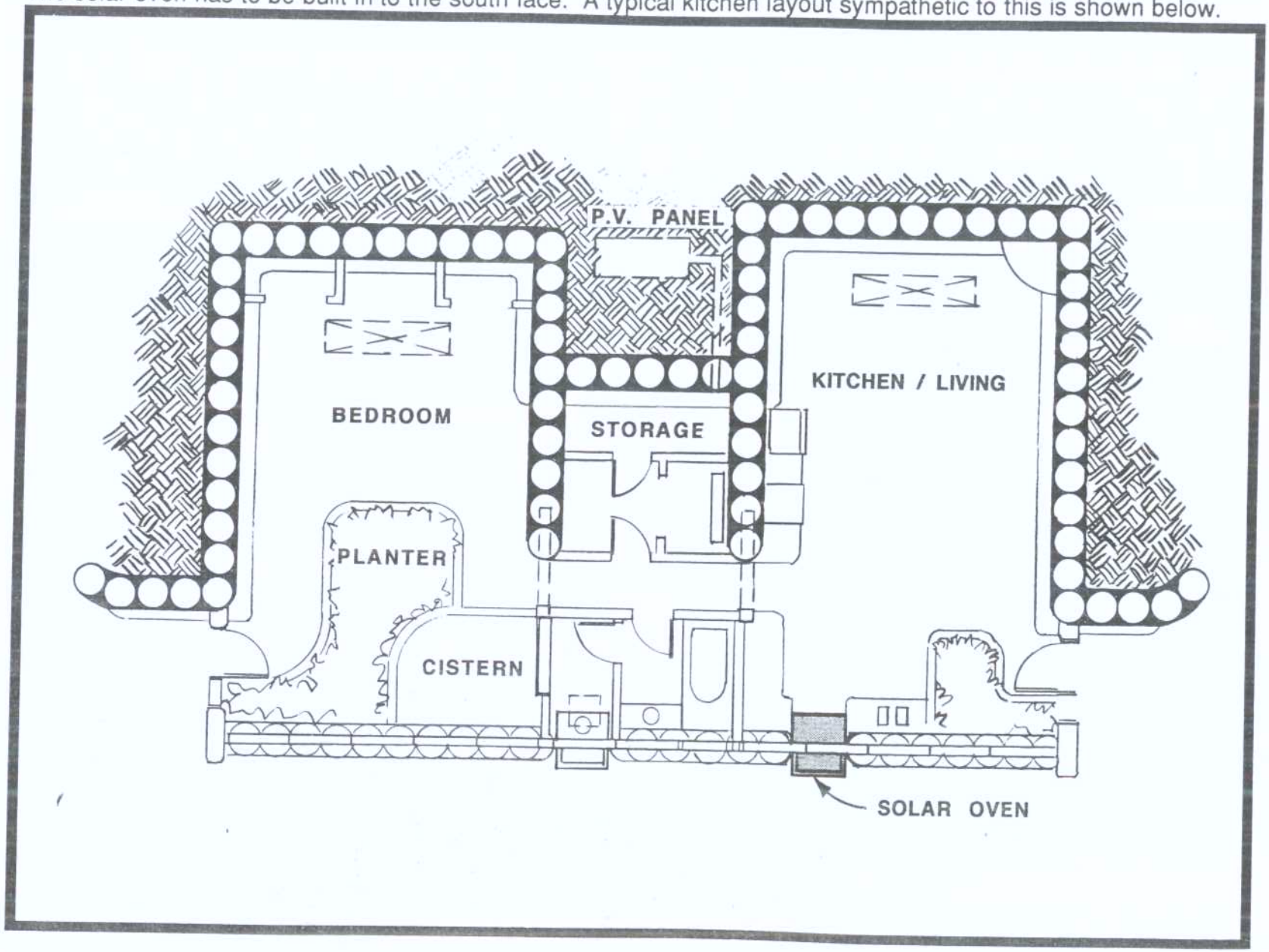
The solar toilet has a 5/8" sheetrock liner under the metal liner. This sheet rock liner acts as thermal mass and helps the toilet hold its heat when the sun goes behind a cloud. In the solar oven we are allowing for a brick liner that will hold heat thus creating a very slow cool down situation. This allows a dinner dish to be cooked in the late afternoon and remain "on warm" until dinner time. Standard fire brick (painted black) would be used and they would be placed in the oven by the home owner after the oven is installed into the home. The opposite page illustrates a detailed section of this unit with the fire brick in place.

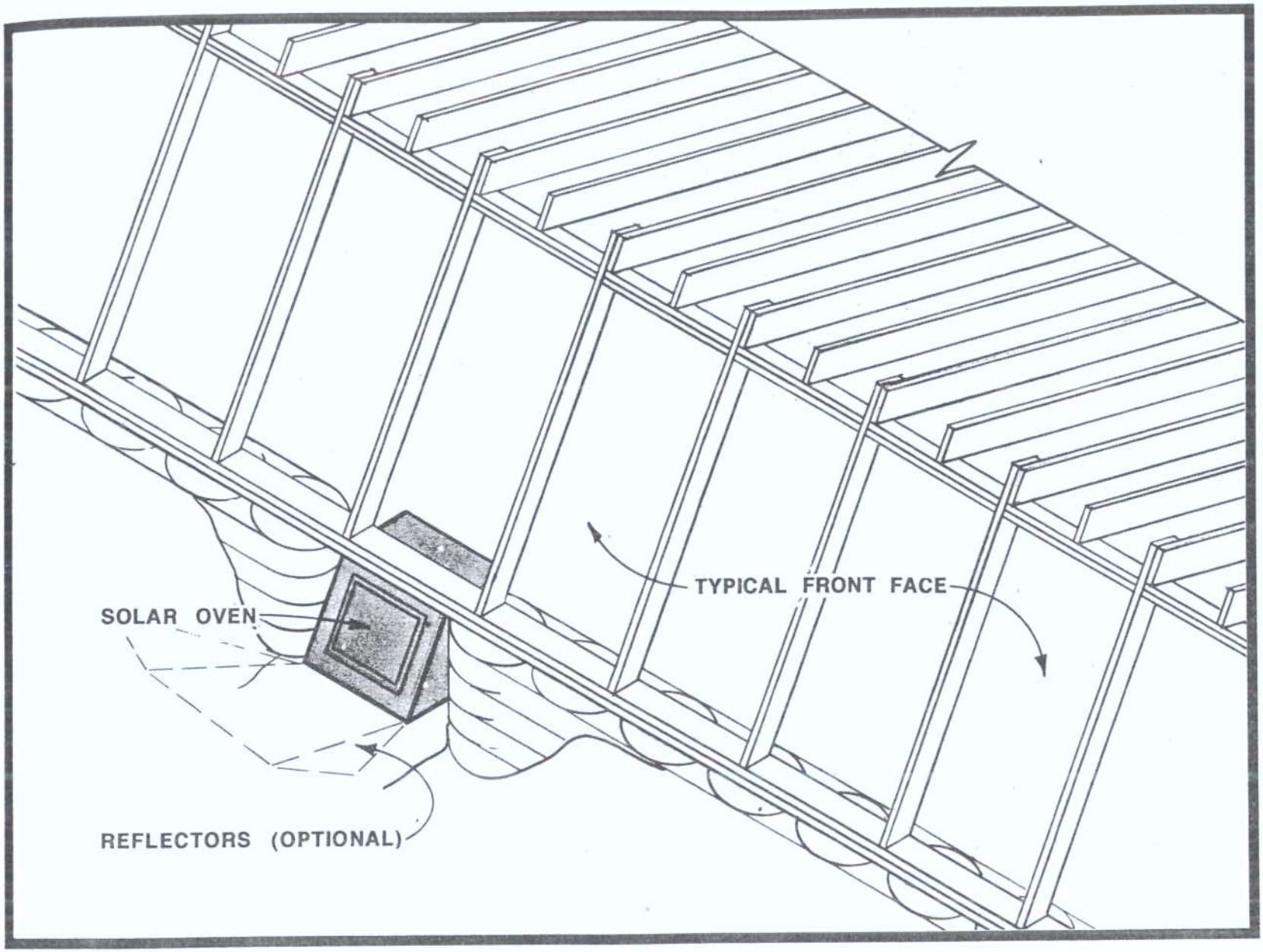
This oven used in conjunction with a standard AC electric cook top will provide a total cooking system that uses no gas. Most two burner electric cook tops work perfectly on the inverter that comes with the Power Organizer Module discussed on page 51. The wattage of any appliance is usually given in the accompanying literature or on the device. Electric cook tops usually have one 1000 watt burner and one 700 watt burner. The maximum on the small POM inverter is 1700 watts. The maximum on the large POM inverter is 2500 watts. Look for these wattages when purchasing an AC two burner cook top. If you can find a DC electric cook top, you can use four burners as there is no inverter to relate to for DC. This will require that you have the appliance on a circuit by itself with wire to the POM sized correctly for the distance involved.

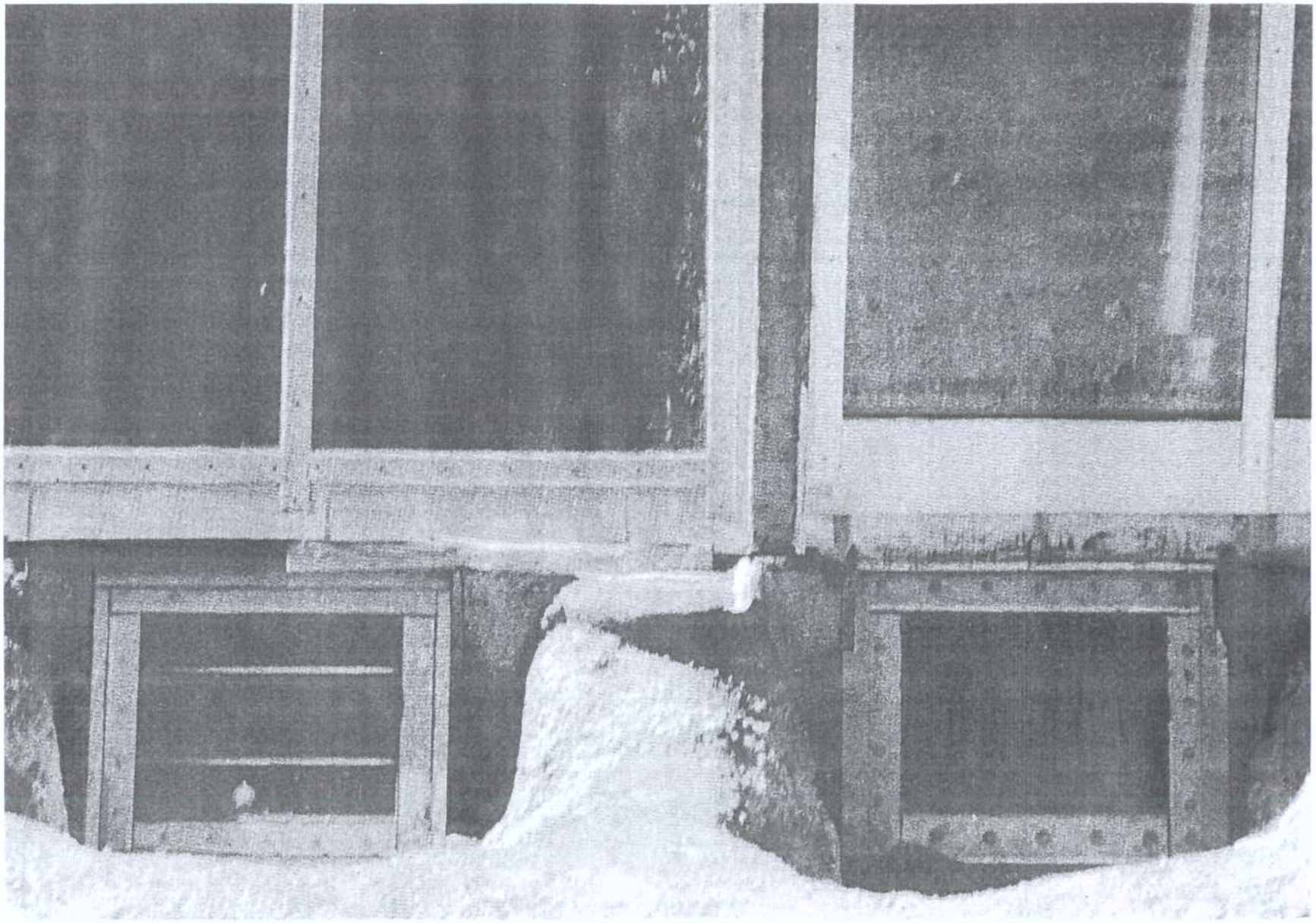



TYPICAL FRONT FACE
WINTER SUN
RIGID INSULATION
SHEETROCK
BLACK METAL LINER
TEMPERED GLASS FRONT
INSULATED
HINGED
DOOR
BRICKS ON SIDES (OPTIONAL)
BRICKS ON BOTTOM

The solar oven has to be built in to the south face. A typical kitchen layout sympathetic to this is shown below.



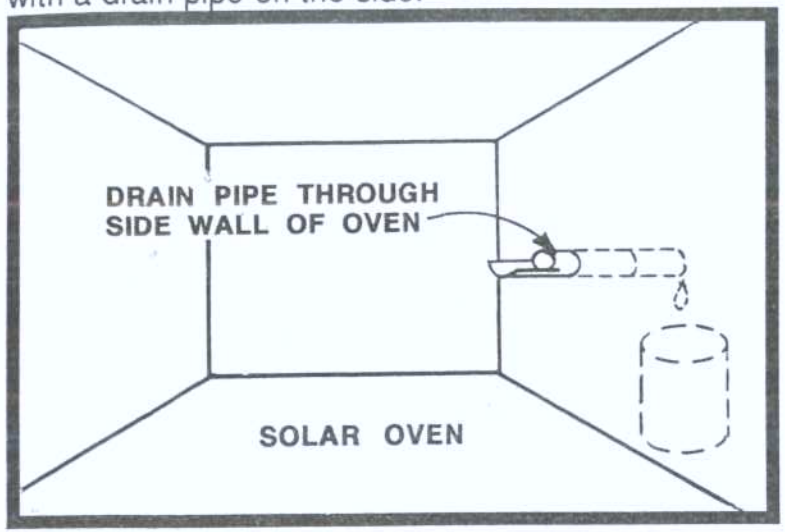

SOLAR OVEN
TYPICAL FRONT FACE
REFLECTORS (OPTIONAL)



SOLAR OVEN AND TOILET INSTALLATION UNDER CONSTRUCTION

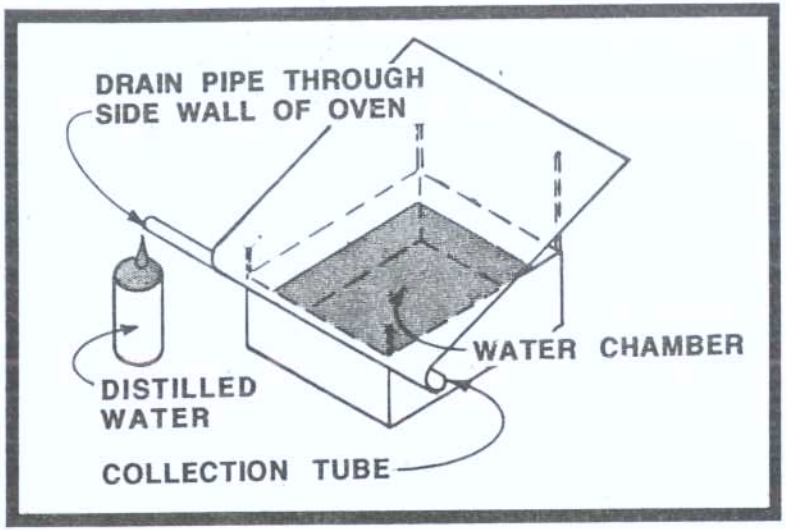
THE DISTILLER

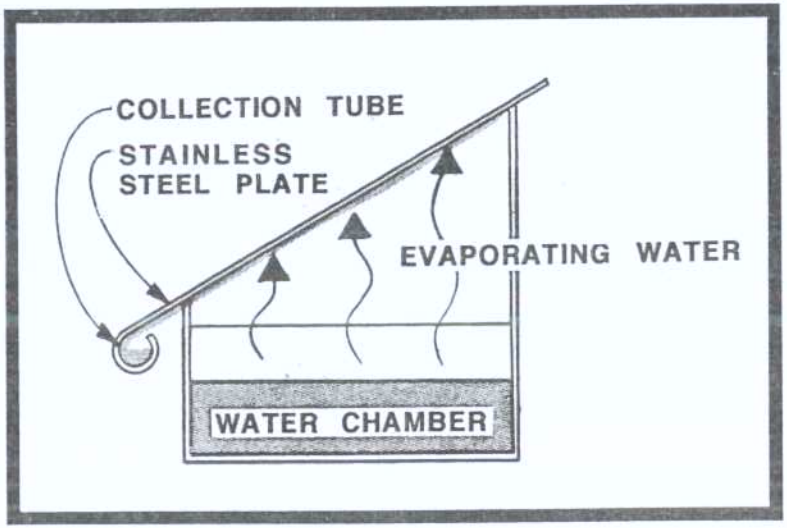
The water distilling aspect of this unit is simply a device that is placed in the oven when it is not used for cooking. Since the oven will be well over 200 degrees Fahrenheit for most of all the sunny days, there will be plenty of time for distilling water when cooking is not going on. The distiller/oven comes with a drain pipe on the side.

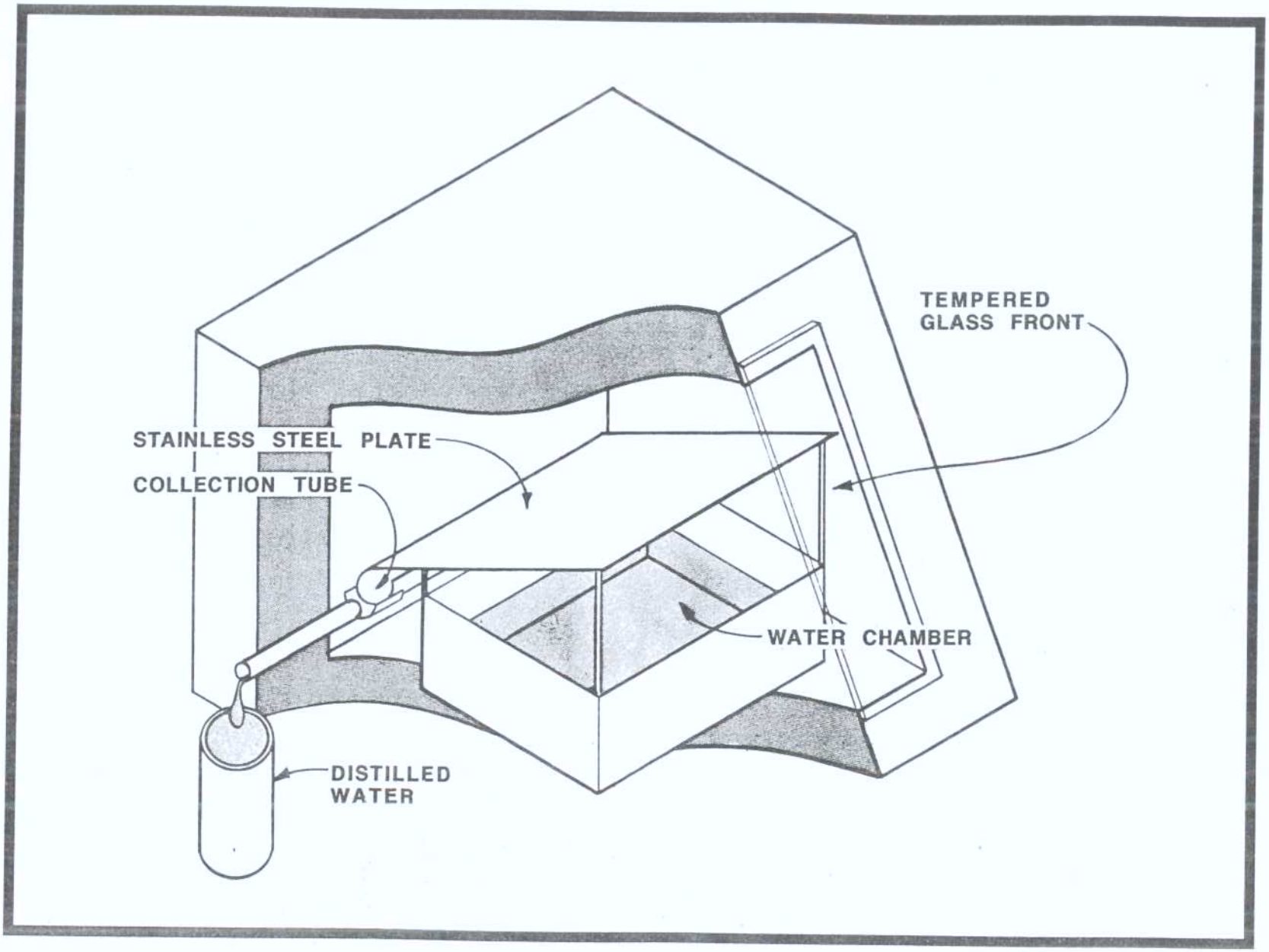


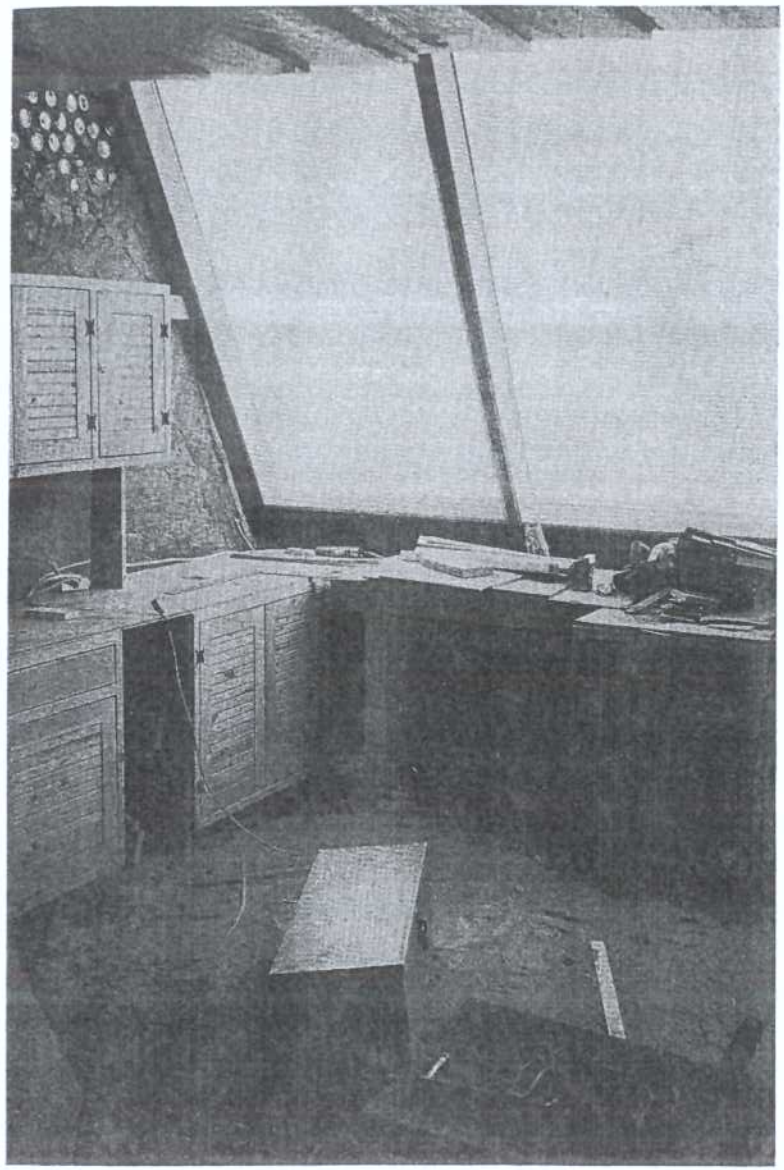
The distilling unit fits on to the opening to this pipe. Water evaporates up from the water chamber, hits the stainless steel plate and runs into the collection tube. This tube directs the distilled water to the drain pipe. You set your own container under this pipe outlet and watch the distilled water fill your container on a sunny day.

This unit is obviously only effective in or near the sunbelt. Two hundred or more sun days a year would make this unit a feasible appliance for your Earthship. Research is going on right now for a gas backup aspect of this unit. This would increase its range of use and allow free cooking and distilling whenever there is sun.






TEMPERED
GLASS FRONT
STAINLESS STEEL PLATE
COLLECTION TUBE
WATER CHAMBER
DISTILLED
WATER



SOLAR OVEN UNDER CONSTRUCTION

Drawings for solar oven	$150.00
Solar oven	$ plus freight
Distiller unit	$ plus freight

Prices subject to change after the printing of this book.

ORDER FROM: Solar Survival Sales
Box 1041
Taos, NM 87571
(505) 751-0462

6. STRAW BALE - TEMPORARY STRUCTURE

ONE MAJOR BURDEN PEOPLE HAVE WHEN TRYING TO BUILD THEIR HOME IS PAYING RENT OR A MORTGAGE WHILE THEY ARE BUILDING. THIS CONDITION USUALLY PUSHES THEM FARTHER FROM THE POSSIBILITY OF BUILDING OUT OF POCKET AND INTO THE BANK LOAN NIGHTMARE. SOME PEOPLE HAVE ATTEMPTED TO SOLVE THIS PROBLEM BY LIVING IN TENTS, TEEPEES, SCHOOL BUSES, OR MOBILE HOMES WHILE BUILDING THEIR EARTHSHIP. A GOOD TEEPEE COSTS $800 OR MORE TO GET SET UP. SCHOOL BUSES GO FROM $1000 AND UP AND MOBILE HOMES OR CAMPERS ARE EVEN MORE EXPENSIVE. NONE OF THESE CAN REALLY BE INCORPORATED IN TO THE ULTIMATE PLAN OF THE HOME, I.E. THEY ARE TEMPORARY SITUATIONS. SCHOOL BUSES AND MOBILE HOMES ARE NOT ALLOWED ON SOME PARCELS OF LAND AND TENTS AND TEEPEES ARE REALLY LIKE CAMPING OUT AND PROVE TO BE DIFFICULT FOR LONG TERM LIVING THROUGH COLD, WIND AND RAIN. **THERE IS THEREFORE A NEED FOR A CHEAP, DURABLE, COMFORTABLE, QUICKLY ERECTED, LOW VISUAL IMPACT, TEMPORARY STRUCTURE FOR HUMANS TO USE WHILE BUILDING A MORE SUBSTANTIAL AND CODE APPROVED EARTHSHIP.** IF THIS STRUCTURE WERE SUBSTANTIAL AND VISUALLY PLEASING ENOUGH THAT IT COULD LATER BE USED AS A PERMANENT PART OF THE EVENTUAL BUILDING (TOOL SHED, UTILITY ROOM ETC.) IT WOULD BE EVEN MORE JUSTIFIED. AS WE BEGAN THE **STAR** COMMUNITY, WE FOUND OURSELVES IN THE IMMEDIATE, TEMPORARY STRUCTURE DILEMMA. PEOPLE WANTED TO USE MOBILE HOMES, SHEDS, AND OTHER QUICK, RELATIVELY CHEAP TEMPORARY STRUCTURES TO AVOID PAYING RENT AND HAVE AN IMMEDIATE, TEMPORARY SHELTER. IN A COMMUNITY PROJECT THIS COULD RESULT IN A VERY "JUNKED OUT" LOOK ON THE LAND. POTENTIAL PROBLEMS WITH ENFORCING TIME LIMITS FOR TEMPORARY STRUCTURES AND KEEPING A LESS OFFENSIVE COMMUNITY "LOOK" ON THE LAND WOULD ALWAYS BE LOOMING IF UNCONTROLLED TEMPORARY STRUCTURES WERE ALLOWED. YET THE CONCEPT OF TEMPORARY STRUCTURES IS NECESSARY AND *NECESSITY IS THE MOTHER OF INVENTION.*

Graphics by Claire Blanchard
Photographs by Pam Freund

"Life is what happens to you while you are making other plans", John Lennon.

Many people in the real world opt to use mobile homes just while they get their lives together. This always turns out to be forever because we all know that *no one gets their life together.* There is, however, something to learn from the **temporary** approach to life. Alas, **life is temporary**. So why have a permanent home? The price of **temporary** *anything* is much less than the price of permanent *anything*. Many of us spend our entire lives building and paying for a permanent home - *then we die.*

With the Earthship concept we have plucked the conventional house off the various grids, built it out of materials indigenous to the twentieth century, and made it possible for anyone to do it. *We have changed the concept of housing into a vessel which independently takes us on a voyage the rest of our lives.* We have seen that the traditional concept of housing can be budged from its place in our reality. Let's go little further, "if you can move it an inch, you can move it a mile."

This chapter will explore some thinking from the **temporary** concept and blend that with the Earthship concept in an effort to:

1. Come up with something more aligned with the environment both in terms of aesthetics and independent performance than any of the existing temporary types of shelter.

2. Match or beat the square footage price paid for existing temporary type shelters.

3. Provide (in a temporary shelter) most of the amenities that any permanent home would have.

There is a great advantage to this **temporary** concept. It allows us to escape our permanent *dream home* dogma and get in position emotionally to accept the alternative because *we know it is temporary.*

THE FIVE DAY HOME EXPERIMENT

Five people work for free for five days to build a 300 square foot space for one of the five to live in. The design of this space (available from SSA) will be identical for everyone involved. The nature of the design will be such that more identical space and a solar greenhouse, hallway, heating duct (see Earthship Volume I., p.) could be added. Functional shelter, comfortable winter and summer, will exist after five days. This five day program will provide 300 S.F. of warm/cool space finished on the exterior with south facing glazed doors. The owner of each space will provide approximately $1,200 worth of materials delivered to the site and staged in an organized position for the five day event. This materials list can be compiled from drawings provided by SSA and will include straw bales, plastic sheeting, concrete and some lumber. The staging for each project and acquisition of materials would be executed by each individual owner. $1,200 and five days work with five people will provide very comfortable temporary shelter that can have interior finishes, details and systems added at the owners leisure. Other than the $1,200 materials price, each of the five persons involved will have to commit to 4 more five day work

events to repay each of the four people for helping him/her. All involved will be considered as equals regardless of race, sex, or personal status.

A model of this straw bale structure was built on office grounds by SSA. The physical net result is that after $1,200 per person and a total of 25 work days five people will be inside their own "homes" in spaces that will take care of them comfortably through all kinds of weather.

The intellectual net result is that possibly, from placing ourselves in this *temporary plateau*, we will see that we don't really need all that we thought we did in a *dream home*. If every member of our family had their own "five day space" (that they helped to build) maybe that would be enough. Imagine having the rest of your life to yourself, helping others and learning more about the earth that supports us.

Cloaking this unit with the title **temporary** gives us freedom. We are simply using this freedom to explore an approach to living not allowed before, by banks, codes and our own preconceived ideas of housing and life. New approaches to living will not be found *within* our own existing dogma. We must trick ourselves and the prevailing enforced dogmas (codes, traditions, etc.) with a "false I.D." to allow us out of existing dogma long enough to look around. We might be amazed at what we find.

DESIGN FACTORS

The structure should be made from an insulative material easy and cheap to acquire anywhere, preferably organic in nature. Straw bales which are already being looked at for cheaper permanent housing have a major advantage - they can be very quickly assembled into a temporary structure. Our objective is to create a quick, cheap temporary structure "engineered" well enough that it could possibly be incorporated into the eventual permanent Earthship.

In order to hold temperature with minimal auxiliary heating or cooling the structure should have some thermal mass. This can be achieved by sinking the structure into the ground with earth cliffs, similar to the Earthship concept.

The temporary structure should require a minimal amount of exterior finishing with a maximum of protection from the elements. Solution - bury it.

For codes or engineers to even consider accepting a straw bale structure, the design should evenly distribute a minimal amount of weight to very short straw bale walls. The weight is simply meant to stabilize these walls, not load them. The majority of the weight should go to post and beam structure as straw bales are inconsistent and can't be safely rated for large loads. Shorter and curved walls increase what little bearing potential the straw walls have. A circular shape will also resist burial around the circumference.

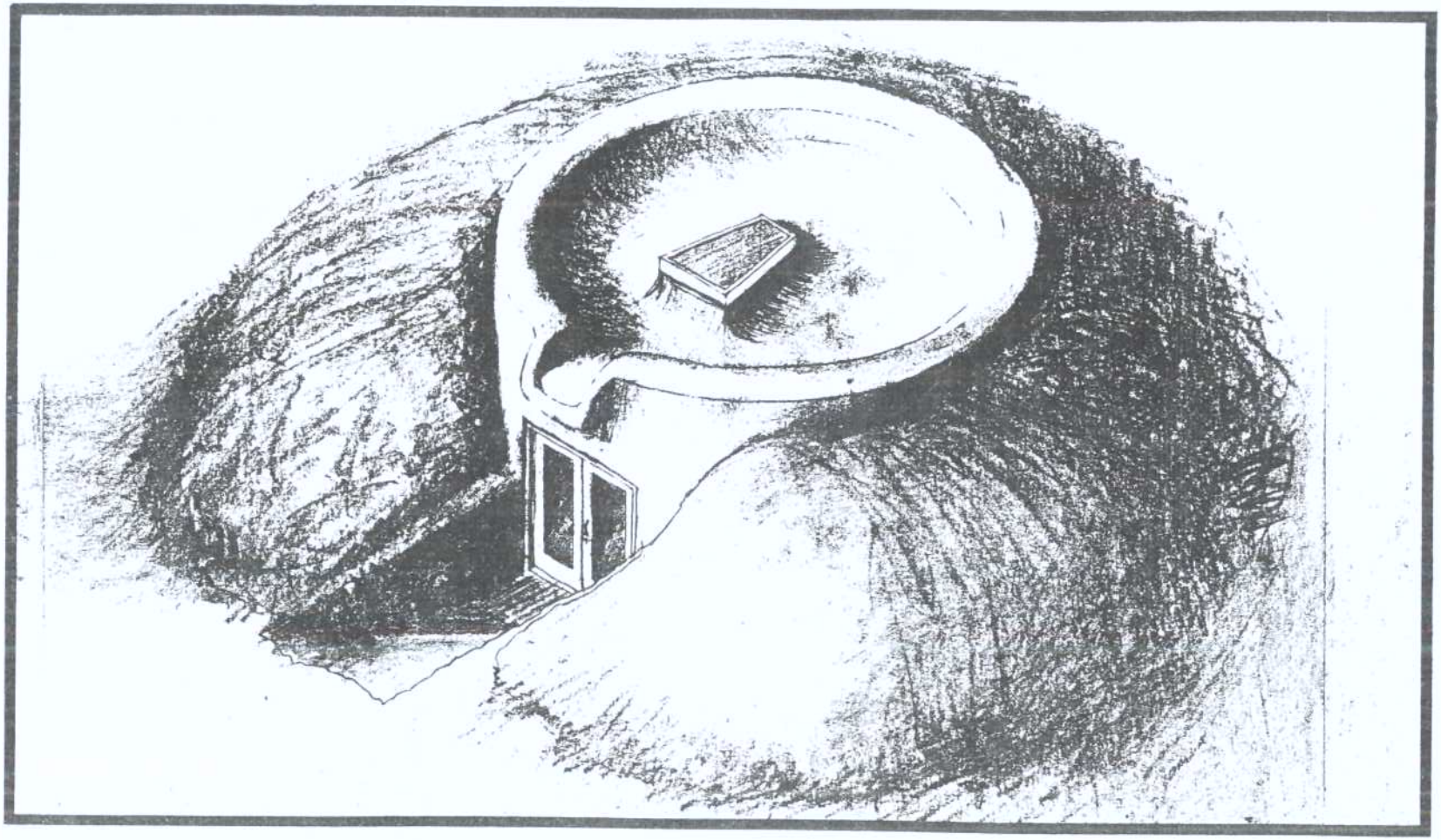
The roof should be of a slope that will allow collection of water and should be south sloped to facilitate collection of water from snow.

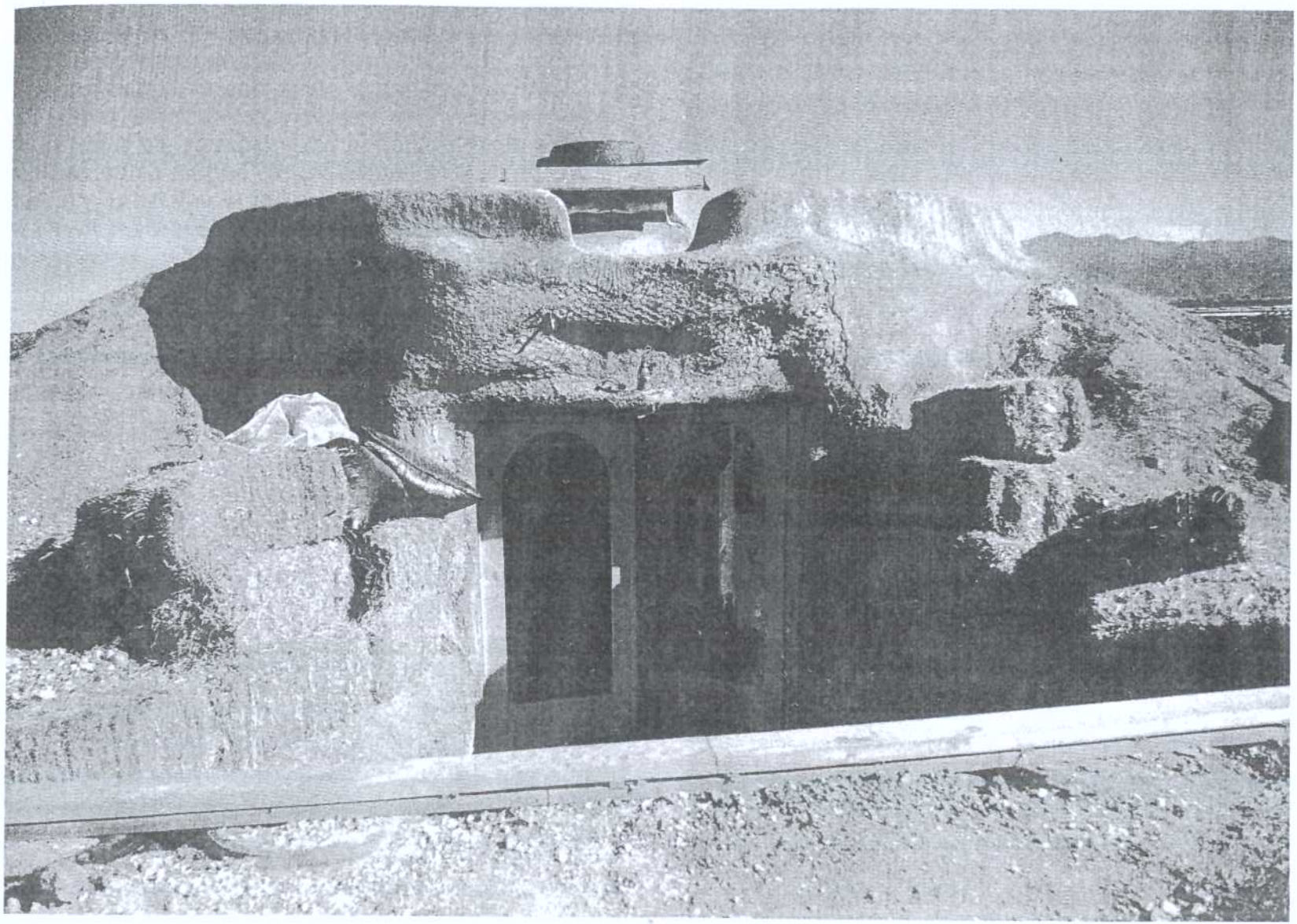
The appearance should be as soft and camouflaged as possible. The structure should have solar gain

and have permanent or temporary green house potential. This achieves the possibility for the temporary structure to be worked in to eventual Earthship design as a tool room, utility room, etc. Accordingly it should have adequate ventilation and egress. Material costs and manifestation time should relate to other temporary structures.

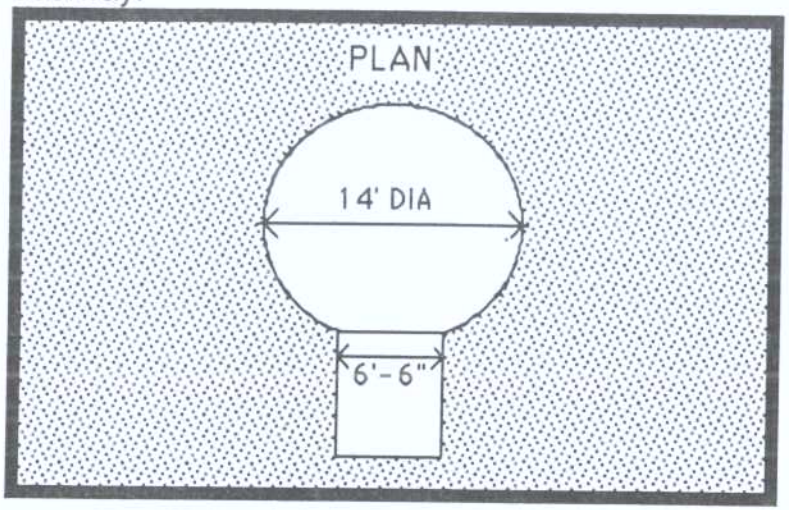
Throughout design, construction, and use the thought must be entertained of long term use of this temporary structure and possible evolution toward code requirements in structure and safety.

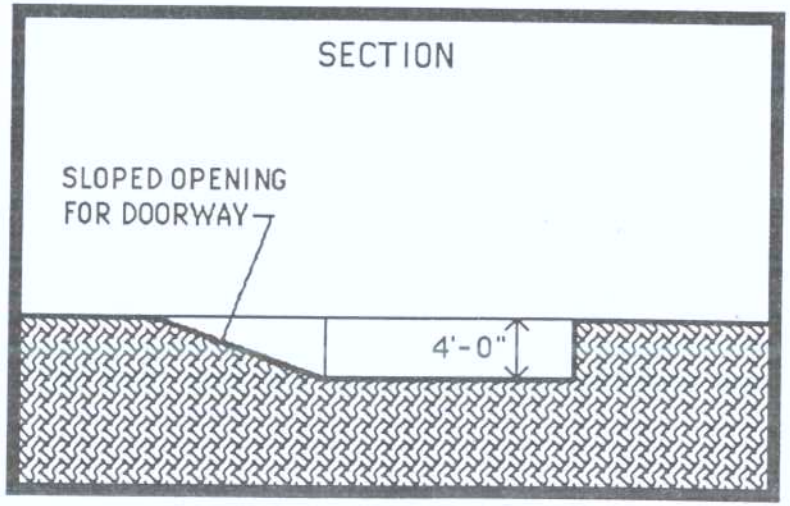
With the above needs and thoughts in mind we offer the following straw bale temporary structure with step by step construction procedures.



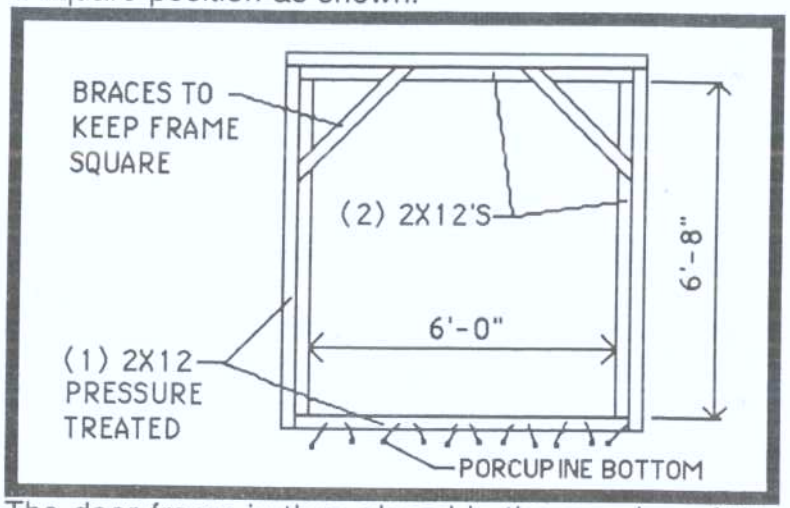


The first step in the construction of the temporary straw bale structure is to dig the "keyhole" shaped excavation into the earth. This hole should be 14' in diameter and 4' deep with a sloped opening for the doorway.

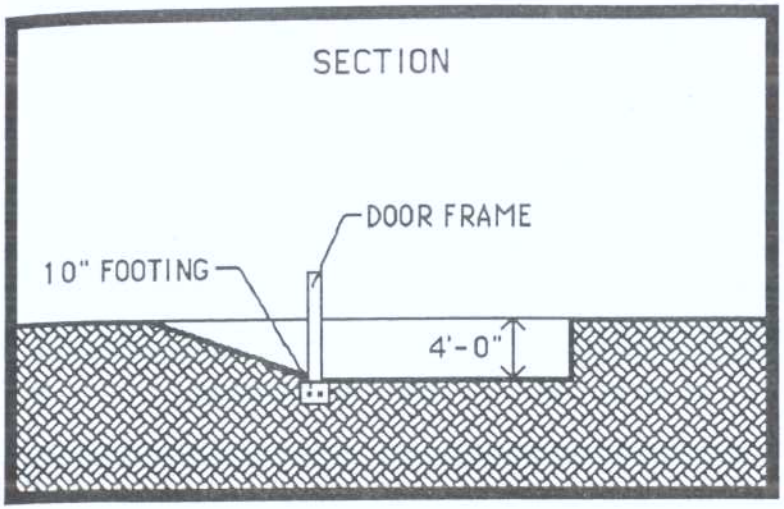


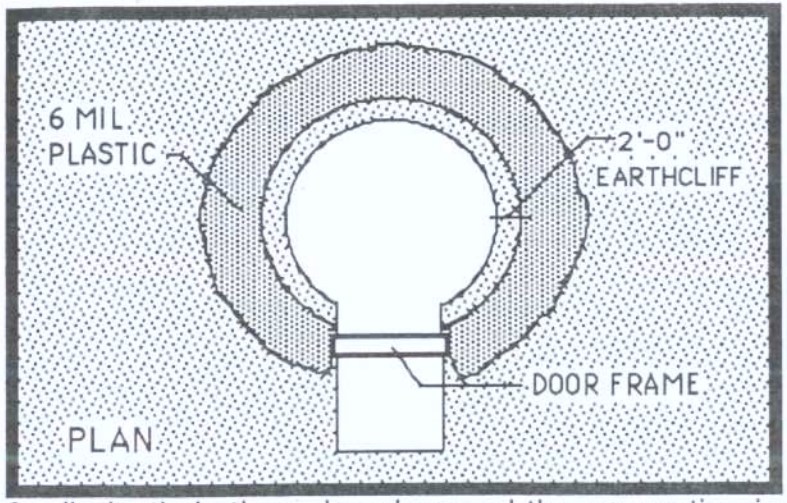


The next step before stacking the straw bales is to install the door frame, which doubles as two columns. The door frame is a 6'-0" by 6'-8" clear opening. This width will allow a reasonable amount of solar gain through glass doors even without a greenhouse. The frame is constructed of 2"x12" lumber as shown in the next diagram. Be sure to use pressure treated lumber for the bottom piece and the two outside pieces as the frame will be in contact with the earth and weather. Brace the door frame in a square position as shown.



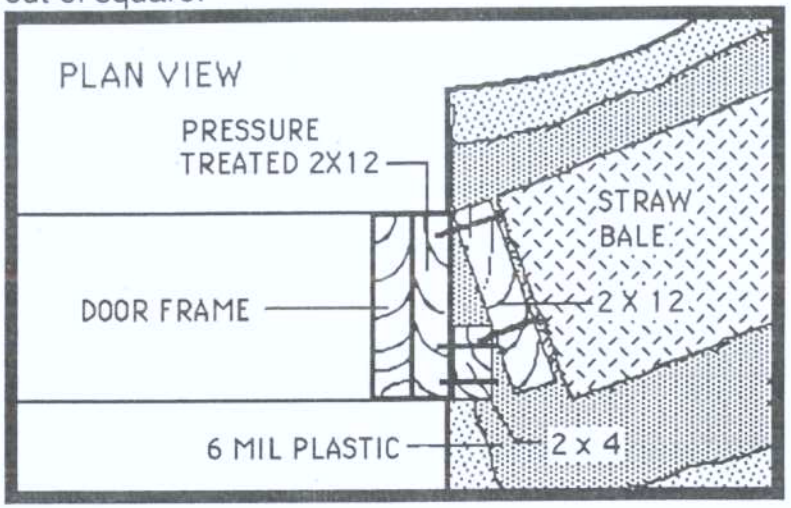
The door frame is then placed in the opening of the circle, trimming the earth around it for a tight fit. It will be placed on a 10" thick concrete footing with (2) 1/2" rebar as shown. The bottom piece of pressure treated lumber will be porcupined (Volume I pp. 157-7) to attach it to the footing. The footing is necessary as the door frame will be acting as a column and to minimize contraction and expansion of materials by going below the frost line..



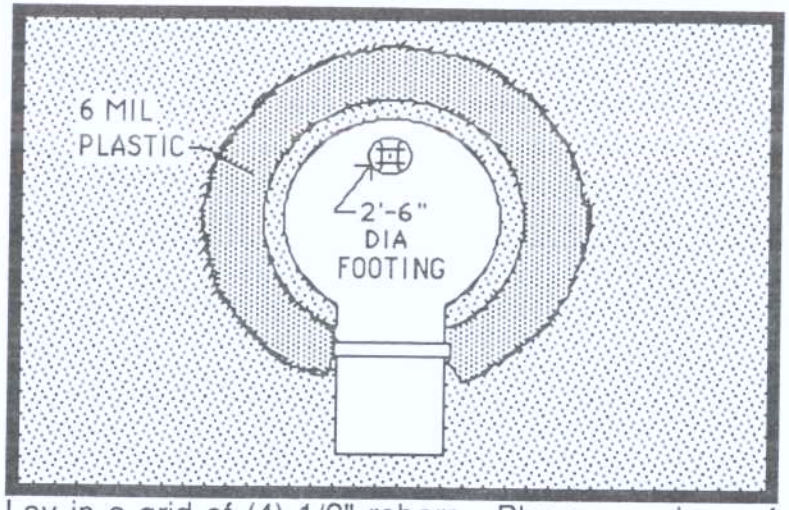


6 mil plastic is then placed around the excavation in the path of the straw bales. Notice the path of the straw bales allows for a 2'-0" earth cliff to be carved later, similar to the Earthship "U". The plastic protects the bottom of the bales from contact with any ground moisture.

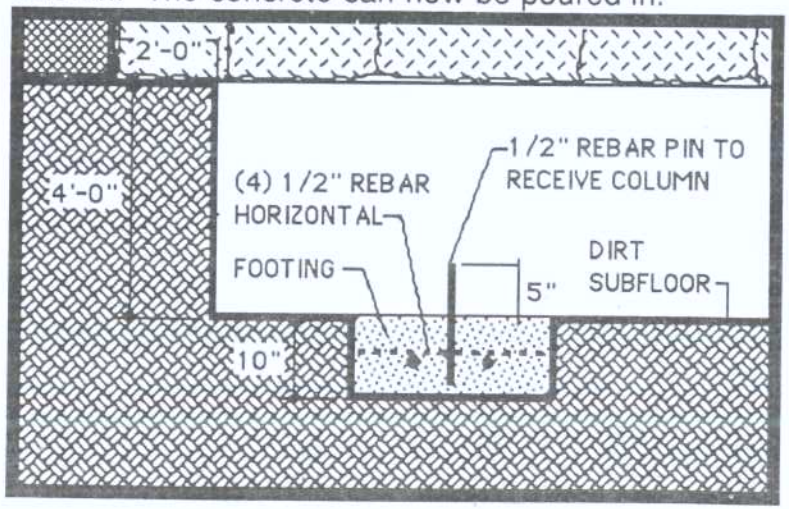
Before the bales are stacked, additional blocking is attached to the part of the door frame that is above grade. This blocking, made of a 2x4 and a 2x12, is angled to receive the straw bales. Screw these members to the door frame as nailing could knock it out of square.



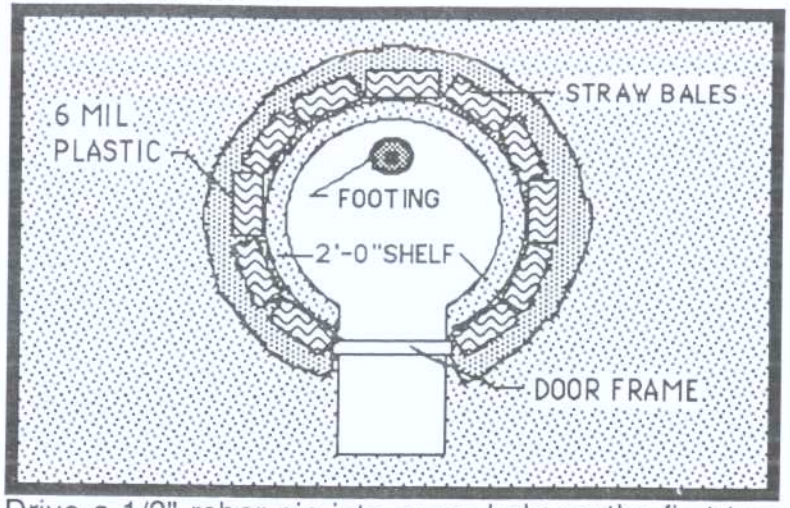
Before continuing with the walls, a footing must be poured in the floor to receive the column which supports the major part of the roof. Because the construction of the building is so quick it is best to pour the footing now to give it time to set up. Dig a hole 10" deep and 2'-6" diameter. The column will be centrally located but near the rear to allow as much uninterrupted open space as possible.



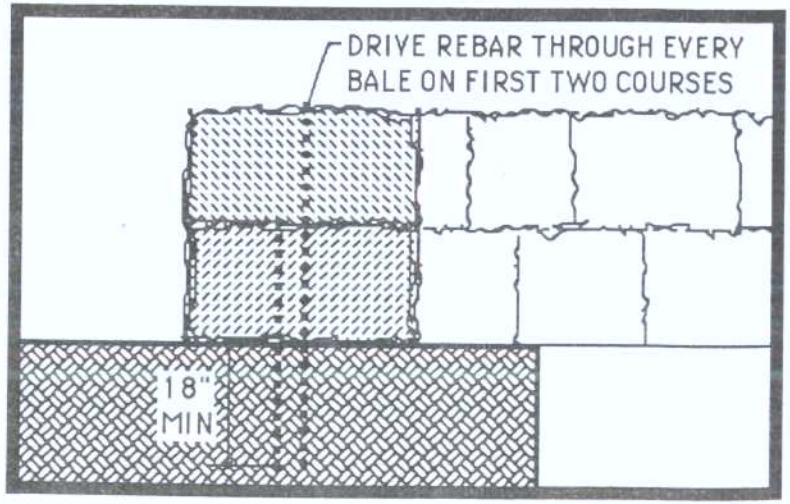
Lay in a grid of (4) 1/2" rebars. Place one piece of 1/2" rebar vertically in the center leaving 5" sticking out above the top of the footing to receive the column. The concrete can now be poured in.



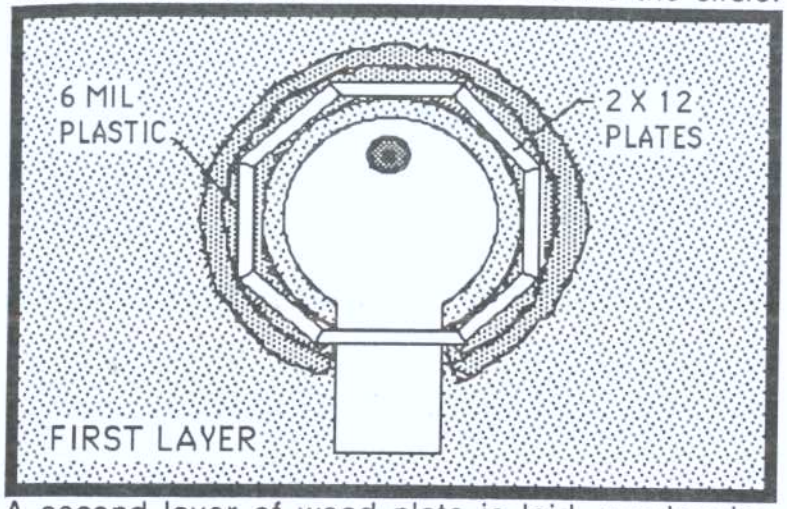
The straw bales are laid in a circle around the hole like bricks leaving a 2'-0" shelf that will later be carved to 12". Each of the three courses is staggered from the one below..



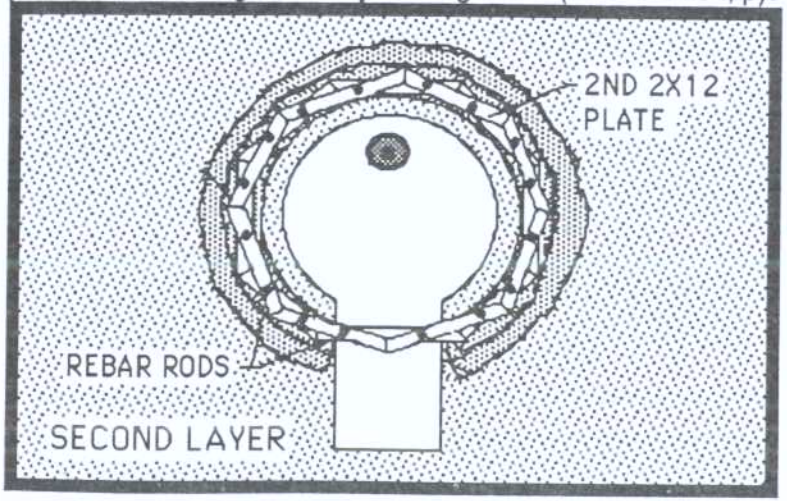
Drive a 1/2" rebar pin into every bale on the first two courses. All pins should go into the ground at least 18".



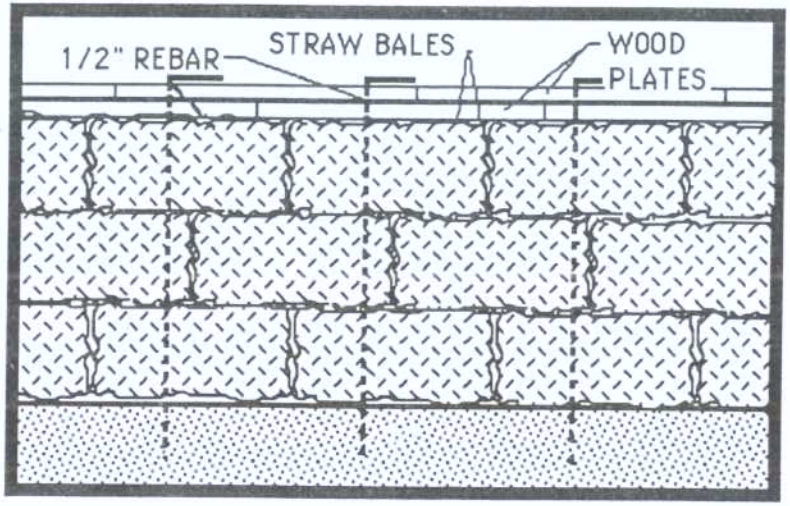
When all three courses are done, plastic is draped over the top and outside of the bale wall and the wood bond beam plates are placed. The first layer of the wood bond beam plate, made of 2x12 pressure treated lumber, is laid in sections around the circle.



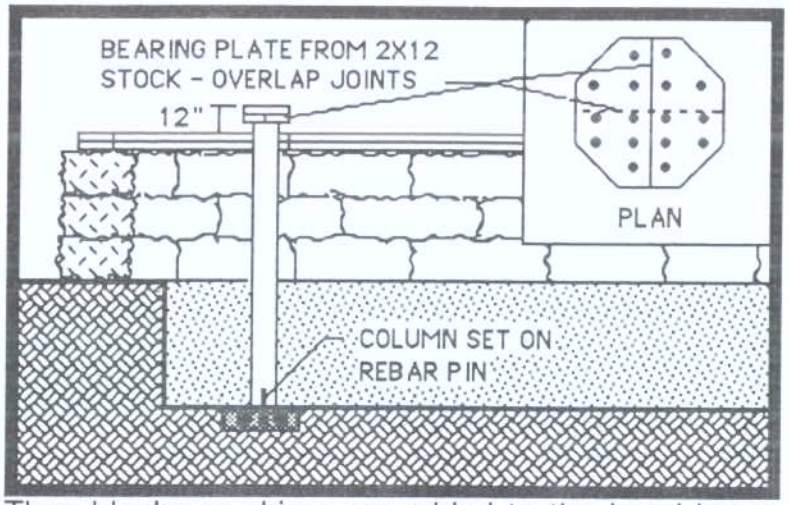
A second layer of wood plate is laid, overlapping joints and nailing both layers together (see Volume I, p).



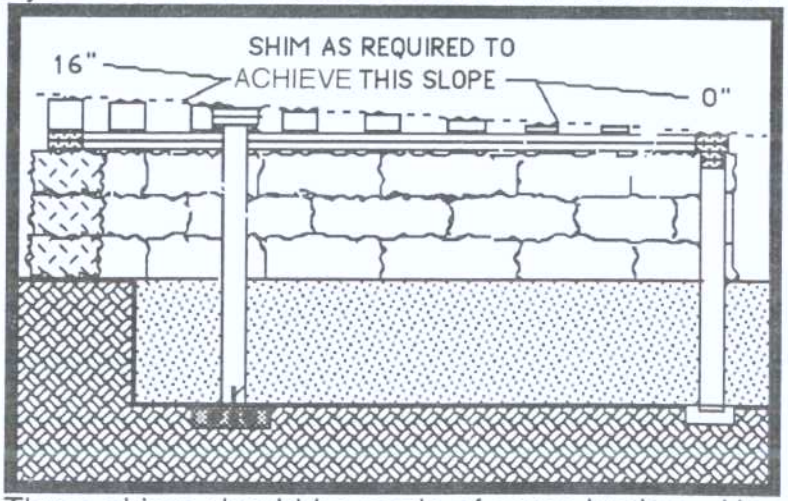
Holes are drilled in the plates and rebar rods are then hammered through all three courses and 18" into the ground to anchor the plates. Leave about 6" of rebar sticking up above the plate so you can bend it over with a steel pipe. This anchors the plates to the straw bales



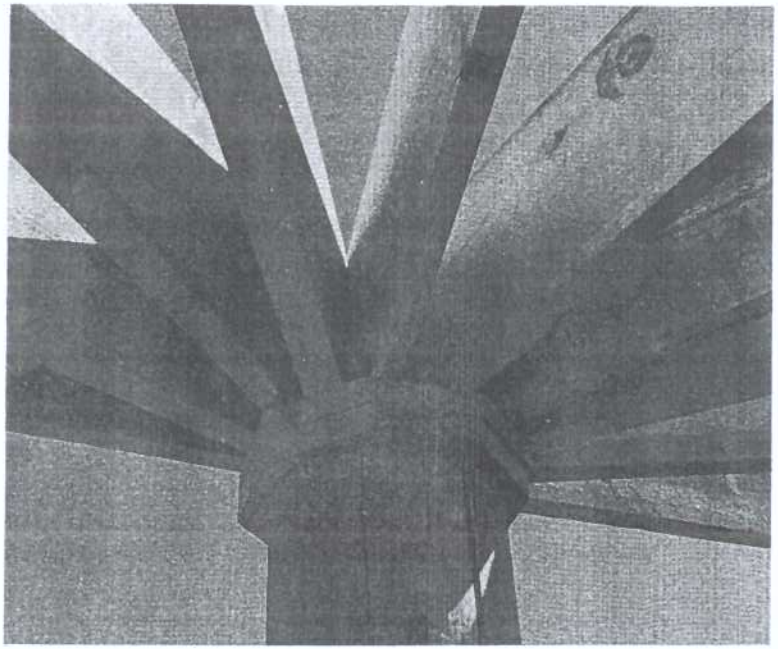
Now the roof structure begins by first placing an 8" round wood column towards the back of the straw bale room on the footing poured earlier. Add a double bearing plate made of 2"x12" lumber. This plate is a 2'-0" octagon and is placed 12" above the bond beam plates.

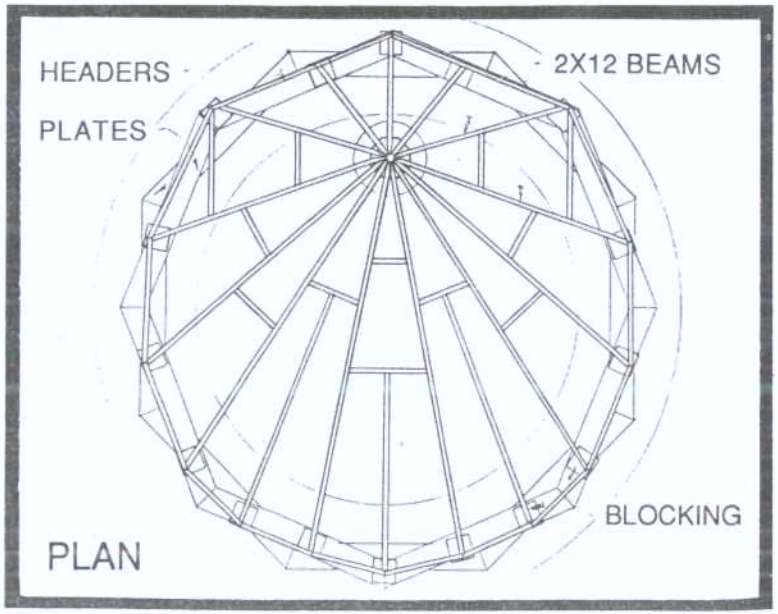


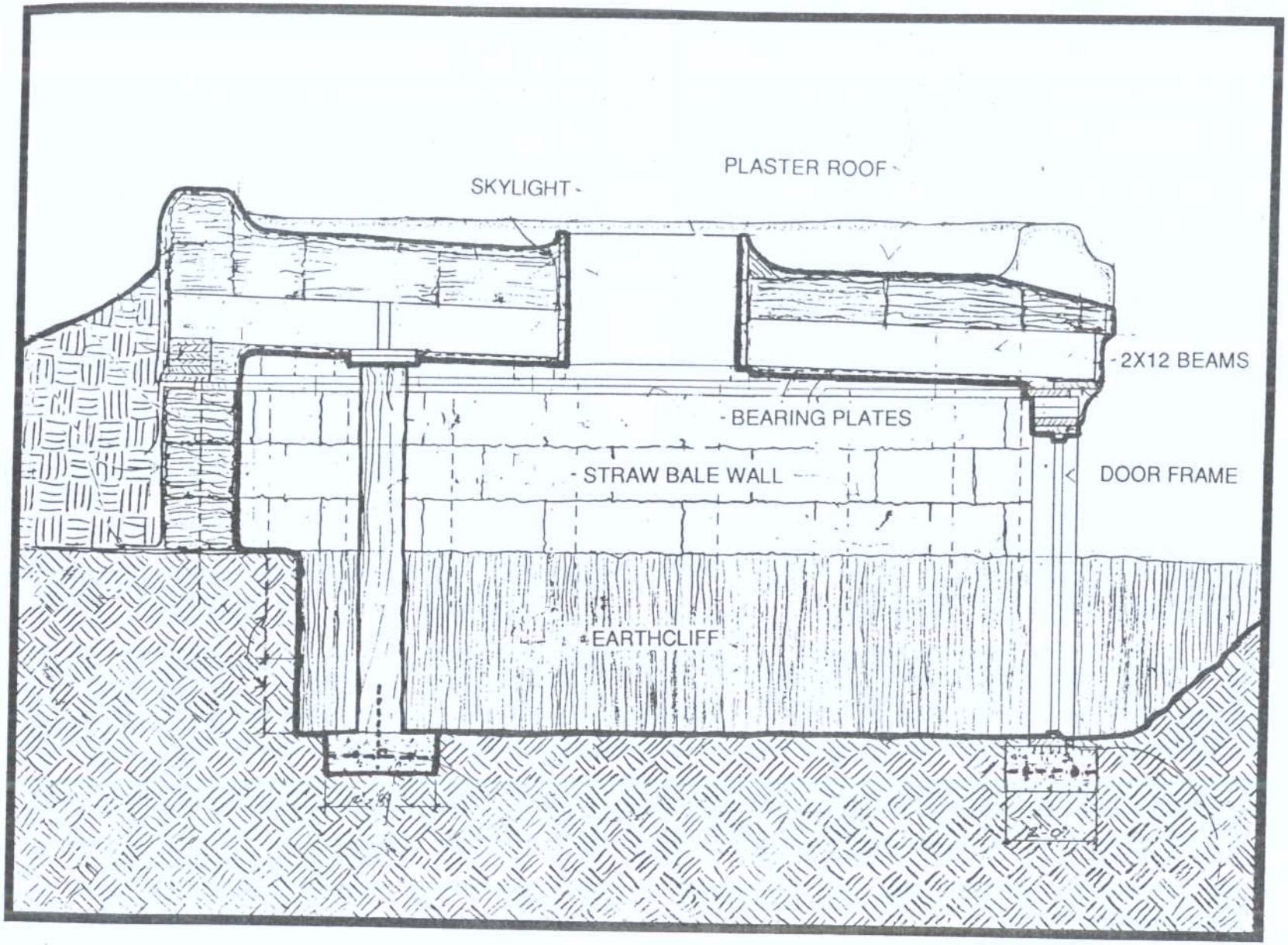
Then blocks or shims are added to the bond beam plates to create a slope from north to south. The front by the door is 0" and the back near the column is 16".



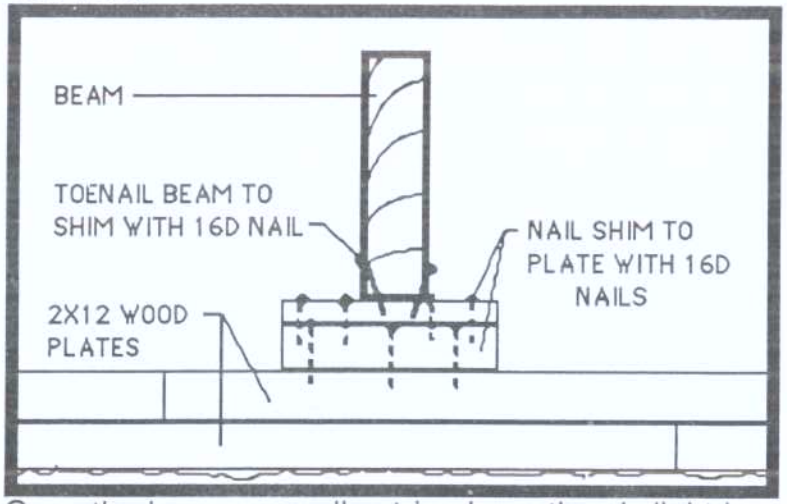
These shims should be made of scrap lumber. Use whatever thickness will achieve the desired height. These pieces should be securely nailed to the plate with 16d nails. Now the beams can be placed as shown opposite.



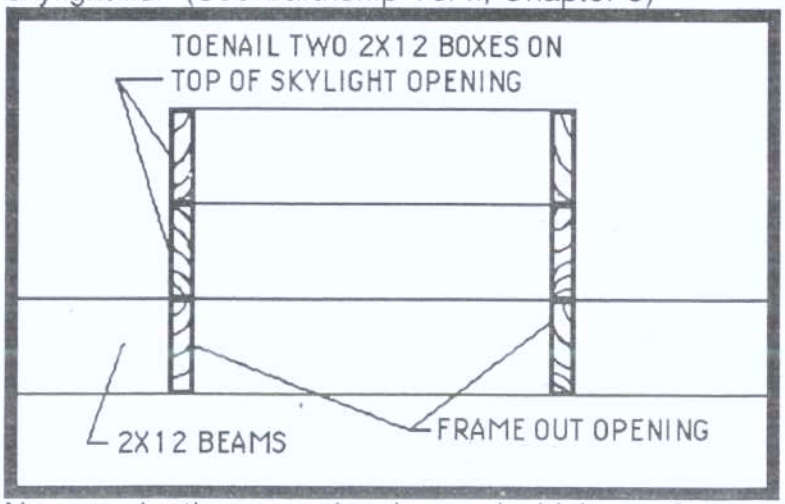



SKYLIGHT
PLASTER ROOF
2X12 BEAMS
BEARING PLATES
STRAW BALE WALL
DOOR FRAME
EARTHCLIFF

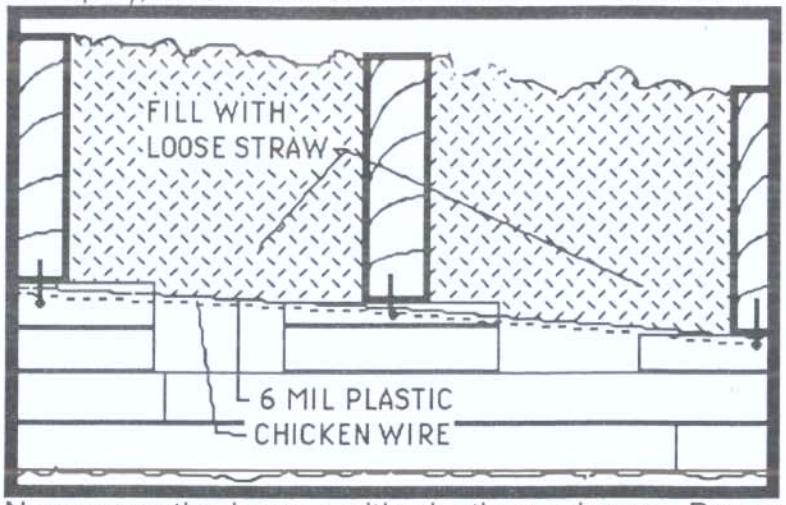
Beams are attached to the plate by toenailing with 16d nails.



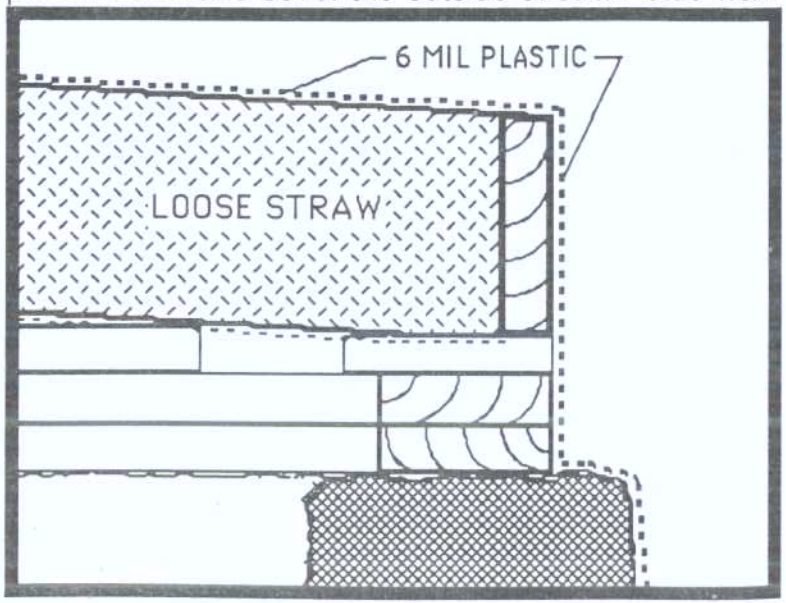
Once the beams are all set in place, the skylight box should be framed out with two more layers of 2x12 stock added vertically. This will later receive the skylight lid. (See Earthship Vol II, Chapter 8)



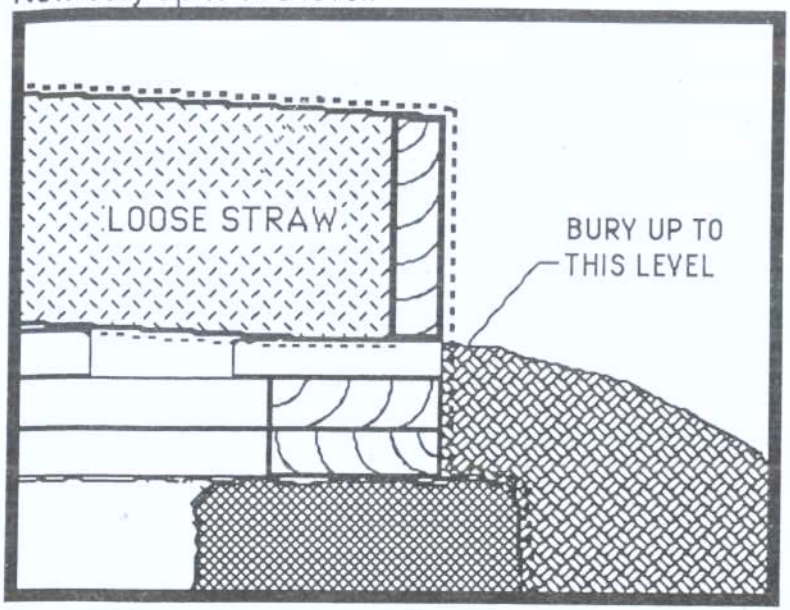
Now a plastic vapor barrier and chicken wire are nailed to the underside of the beams (leave the skylight hole open), which then can be filled with loose straw.



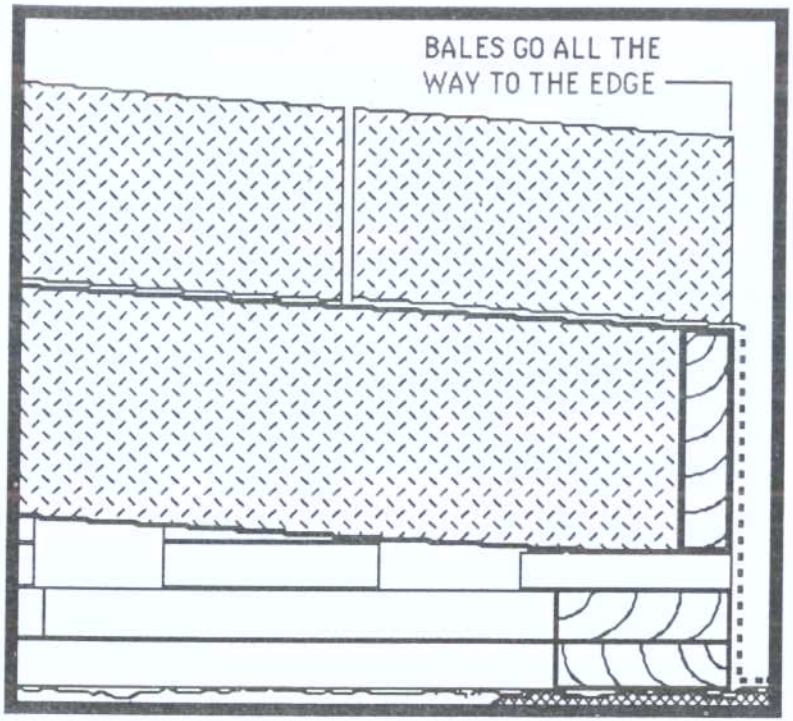
Now cover the beams with plastic as shown. Drape plastic down and cover the outside of straw bale wall.



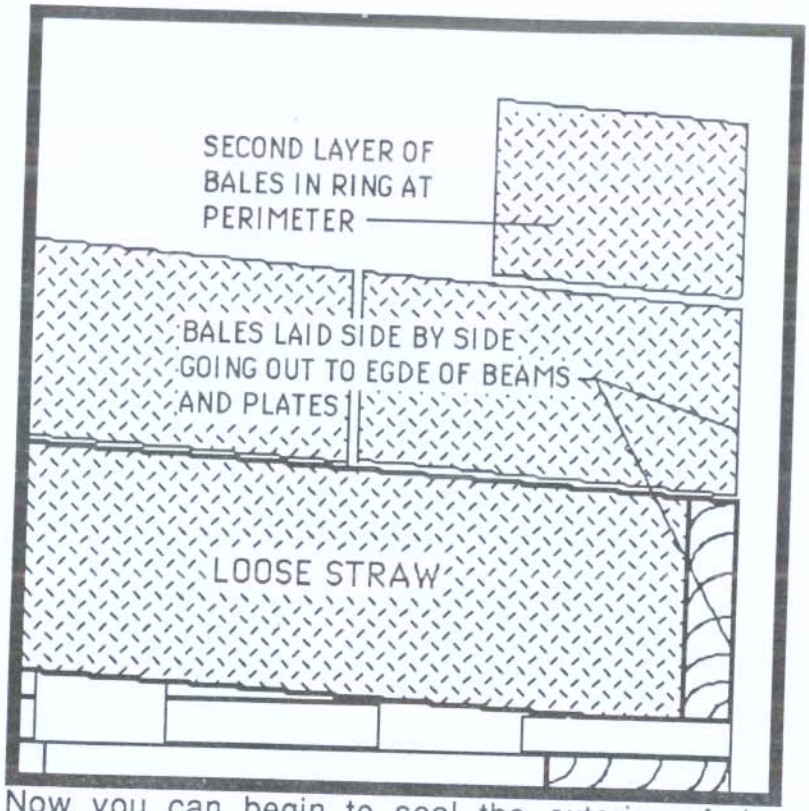
Now bury up to this level.



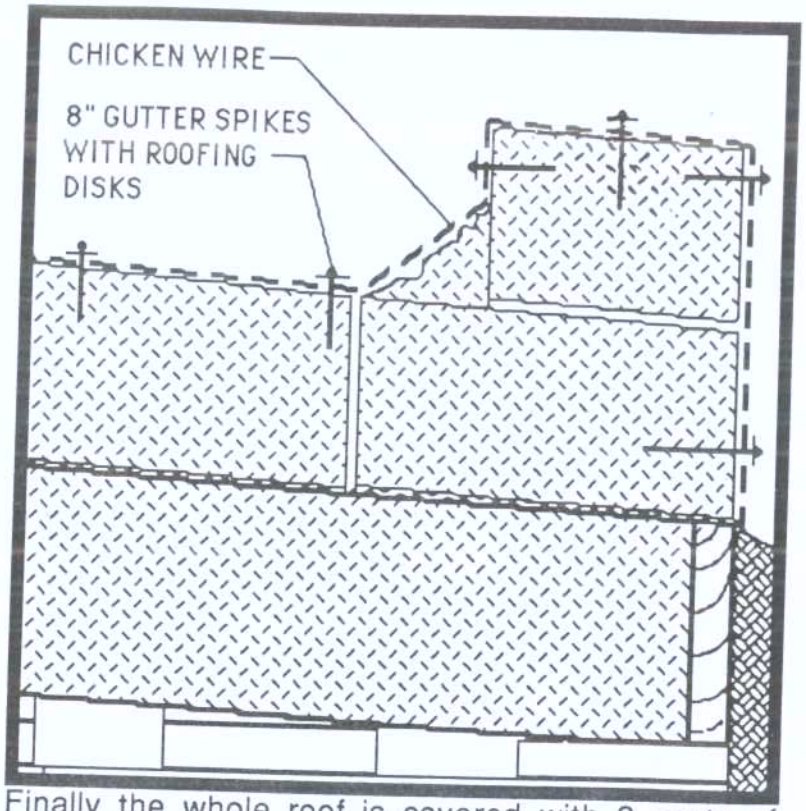
On top of the beams and loose straw, bales of straw are laid side by side (or in a circular pattern) to provide an additional 14" of insulation. These bales cover the entire roof and should go all the way to the outside edge of the plates. This results in about 26" of straw insulation, approximately R50-60. Be sure you use straw - not hay as it can spontaneously combust and result in fire. Also be very sure that your straw bales amd loose straw are dry. Do these insulating operations all in one day to avoid getting caught in a rain and having wet straw. You will end up with compost if you have wet straw.



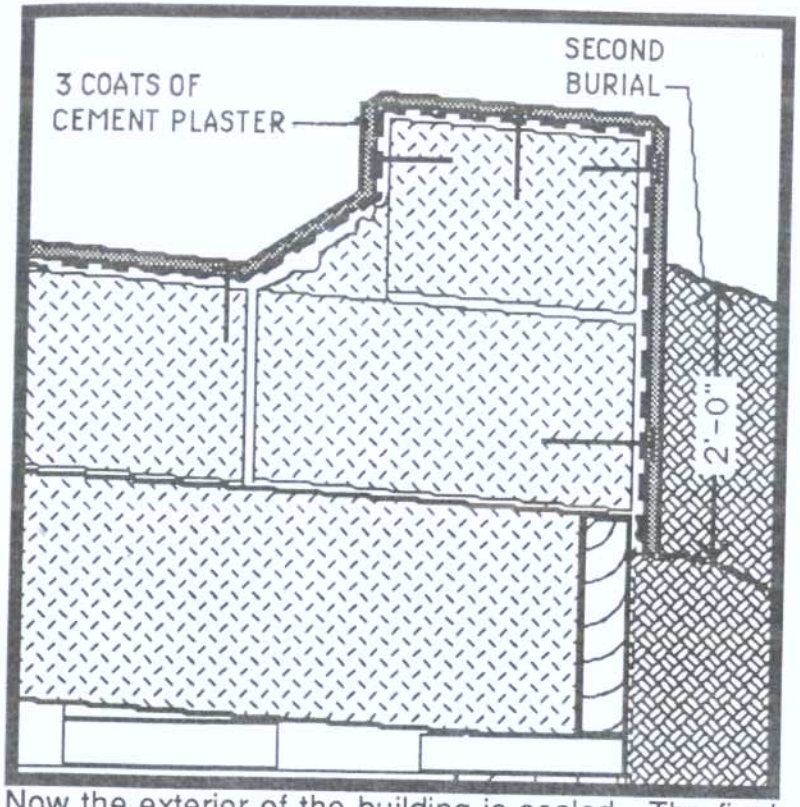
Then a second layer of bales is laid in a ring at the edge to provide a parapet wall to contain rainfall. A space approximately 24" wide should be left in the parapet at the lowest point of the roof. This will serve as the drain for the water runoff (see overview page 120).



Now you can begin to seal the exterior of the structure. First, using loose straw, make a cant where the parapet joins the roof. Then cover the entire roof and parapet with chicken wire. To keep the chicken wire secured onto the straw use 8" gutter spikes with roofing disks.



Finally the whole roof is covered with 3 coats of scratched cement plaster. This plaster mixture is one part portland cement to three parts sand with a good handful of engineering fibers with every wheelbarrow or cement mixer load. The plaster can be applied with a trowel or with your hands. Remember to always wear rubber gloves when working with cement. A final coat of smooth troweled plaster is added for a finish. This cement roof can be sealed with an acrylic coating available from SSA.

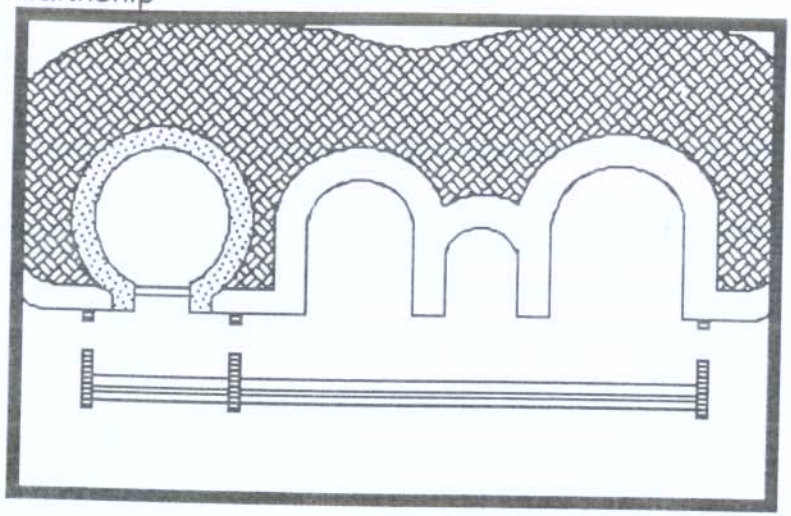


Now the exterior of the building is sealed. The final burial can come up another 2'-0".

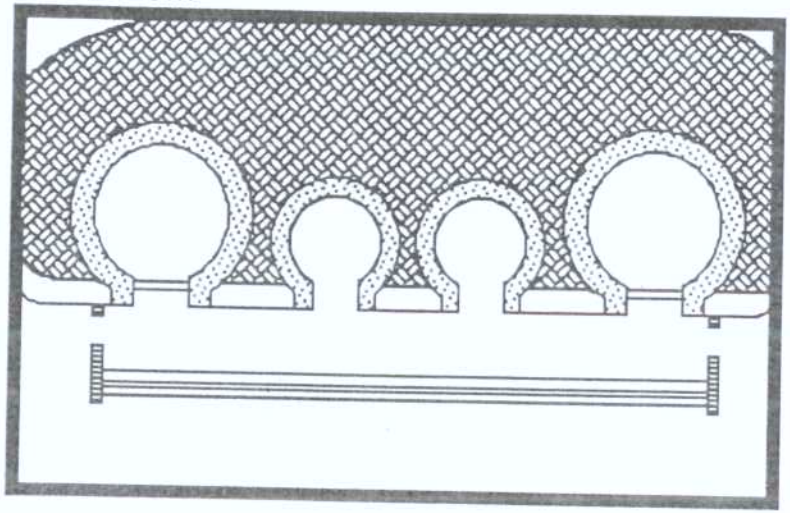
To finish the interior of the building, the ceiling can be finished with wood, fabric or plaster. The walls and floor can be finished with mud. The procedure for mudding walls and floors is explained in Chapter One of Volume III.

A spout for water runoff can be formed with metal lath and plastered. A gutter will have to be rigged up to take this water to an outside cistern or tank.

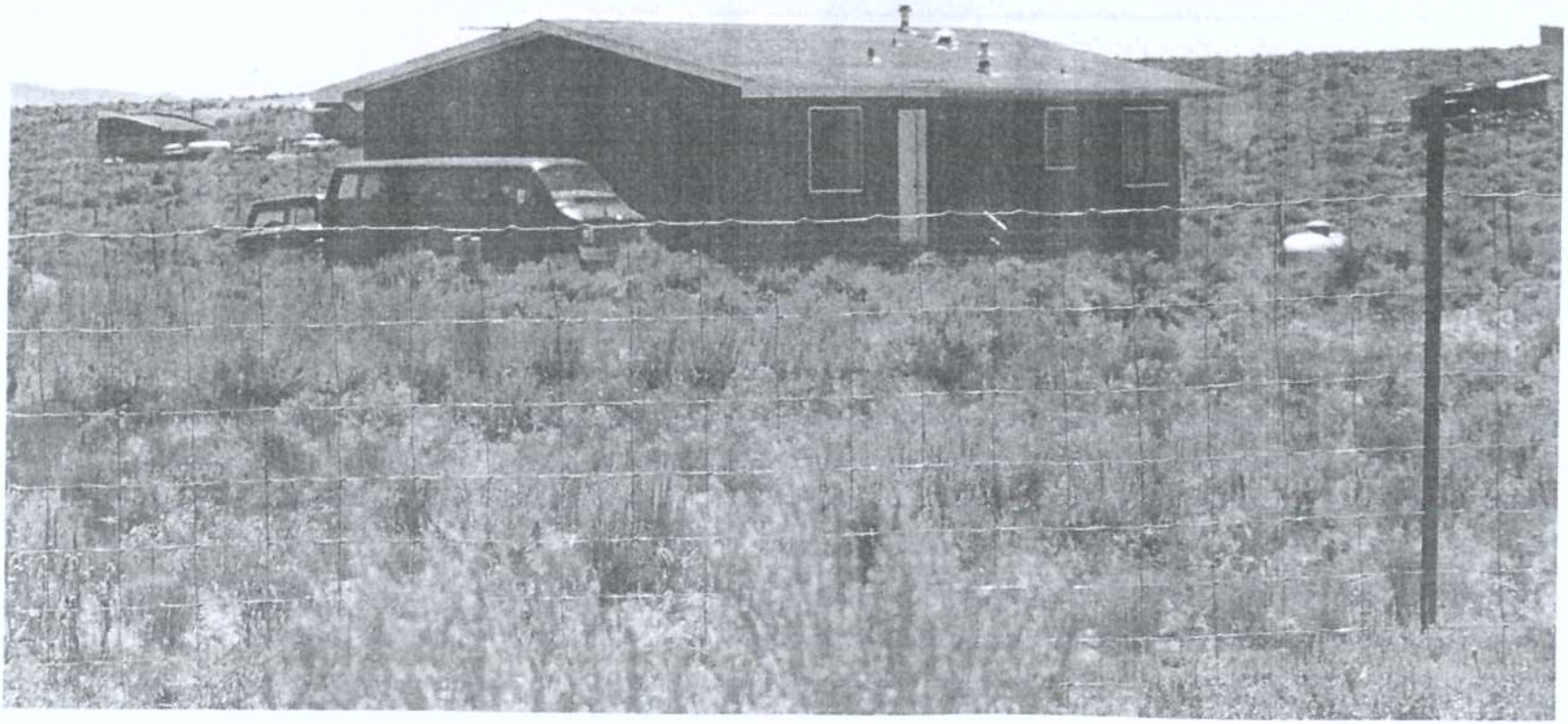
A straw bale unit can be incorporated into a future Earthship



An entire home can be built out of straw units where codes allow.



Straw bale construction drawings $150.00

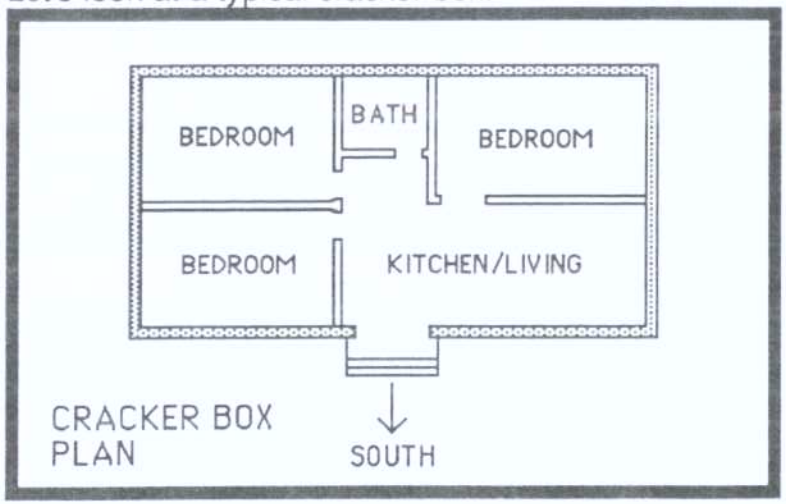


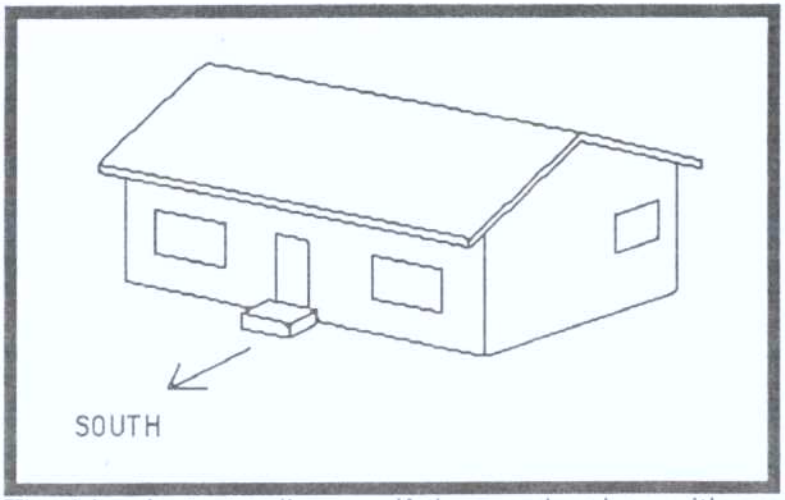
7. RETROFIT A CRACKER BOX

WE ARE ASKED OFTEN ABOUT ADDING AN EARTHSHIP TYPE ADDITION TO A REGULAR CRACKER BOX HOUSE. AT FIRST IT SEEMED RIDICULOUS BUT THERE ARE SO MANY OF THESE BUILDINGS OUT THERE THAT WE DECIDED TO PUT SOME ENERGY INTO IT. IT IS ACTUALLY A VERY GOOD IDEA BECAUSE IF YOU ALREADY LIVE IN AN INEFFICIENT CRACKER BOX YOU AT LEAST HAVE A PLACE TO LIVE WHILE YOU BUILD YOUR EARTHSHIP ADDITION. THE ONLY REQUIREMENT IS THAT THE HOUSE SHOULD HAVE A SIDE FACING SOUTH OR CLOSE TO SOUTH. IF YOU HAVE THIS SITUATION YOU CAN VIRTUALLY TURN YOUR CRACKER BOX INTO AN EARTHSHIP.

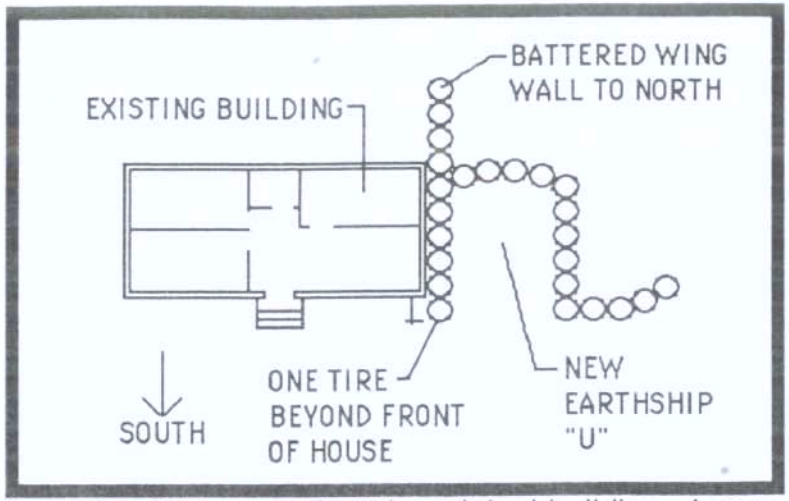
Graphics by Claire Blanchard

Let's look at a typical cracker box.

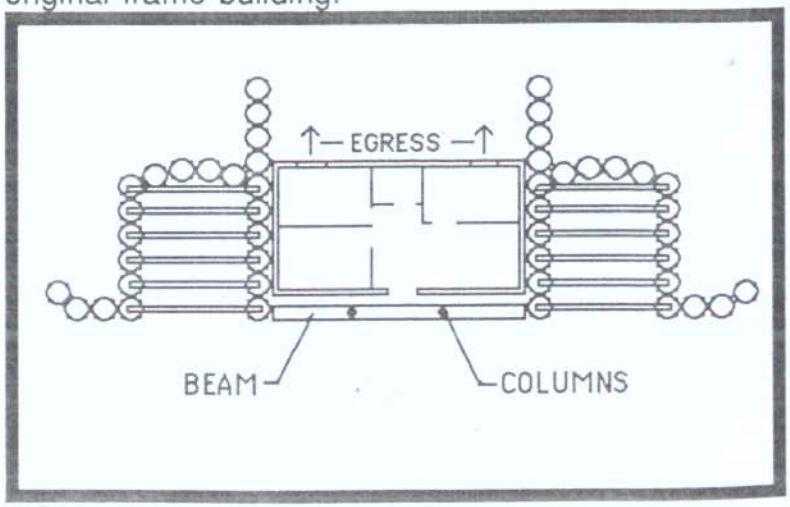




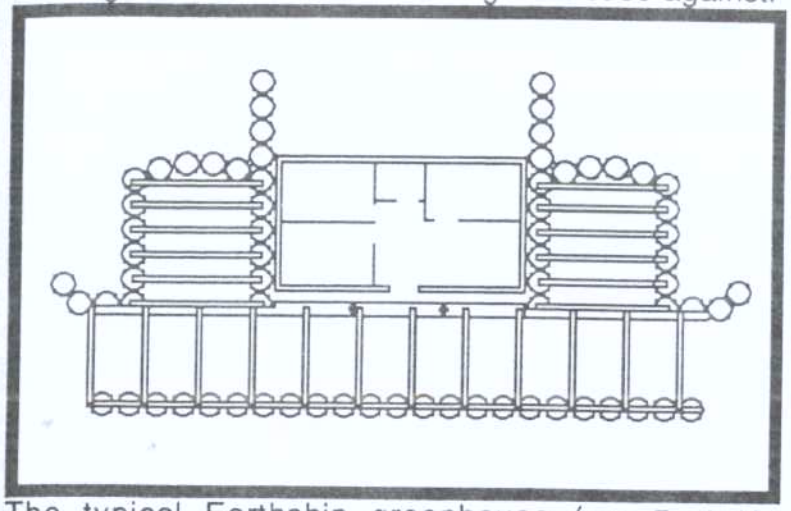
The idea is to totally engulf the cracker box with an Earthship. Start by adding a "U" to the east or west. It must be ***totally structurally independent*** of the original structure. Let it extend out beyond the south face of the house by the diameter of one tire.



It can be right up against the original building. Leave a battered wing wall (see Chapter 1) extending out to the north to retain the burial of the new "U". Now do the same thing on the other end of the house. Original east-west egress windows in bedrooms will have to punch in the north or south walls of the original frame building.

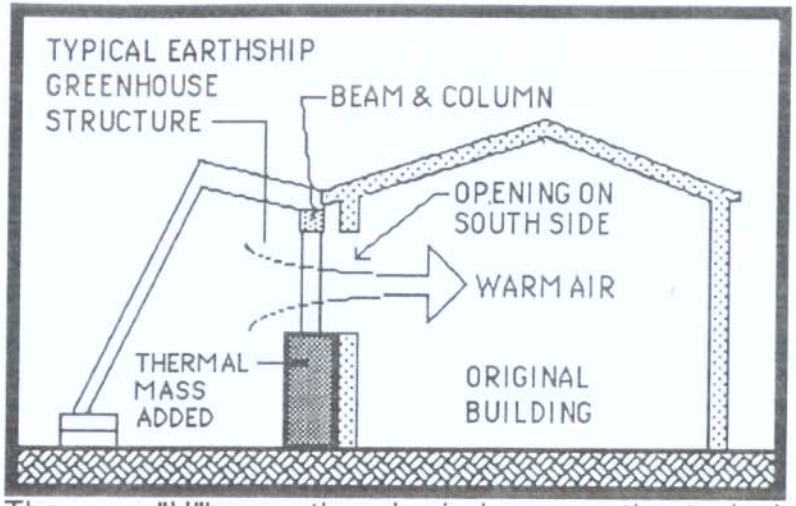


Now add a typical Earthship greenhouse. You will have to install some columns and a beam in front of the original structure to lean the greenhouse against.

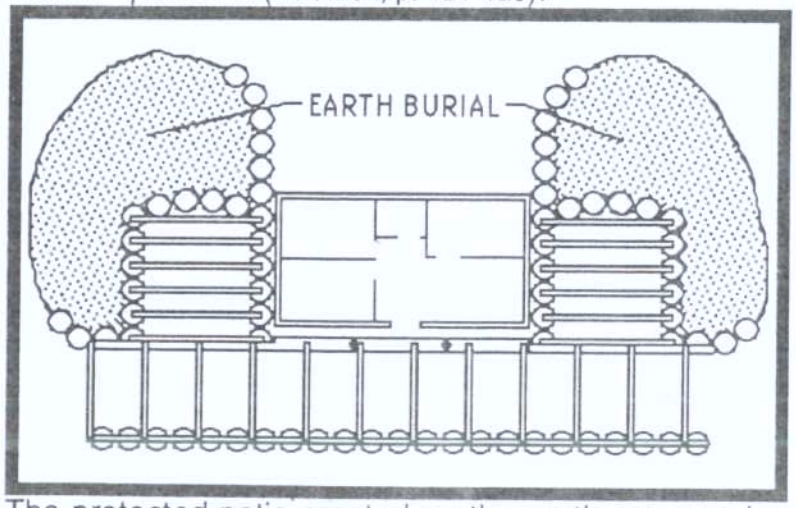


The typical Earthship greenhouse (see Earthship Volume I, Ch. 7) covers the entire south face of the original structure and the new "U"'s. Some form of thermal mass (stone, rock, water, adobe bricks, small tires plastered) can be added to the south side of the original structure if you desire to add thermal storage.

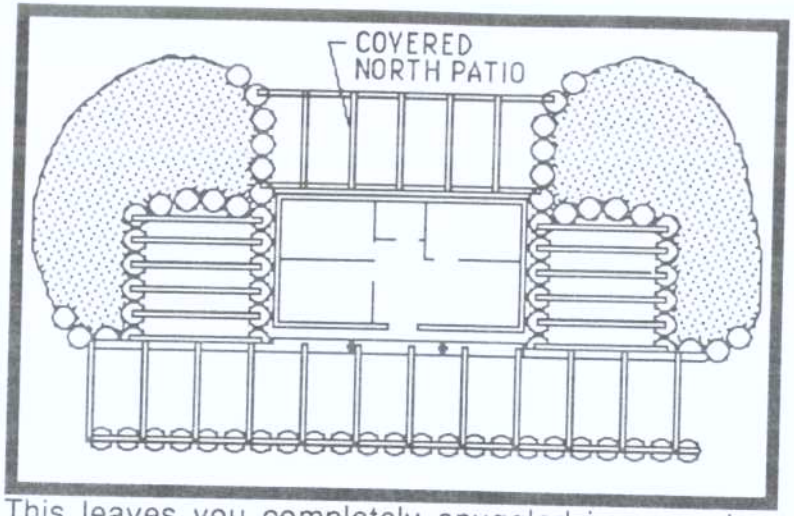
You may wish to increase the size of openings on the south side of the original building in order to draw warm air from the greenhouse into the house



The new "U"'s are then buried as per the typical Earthship details (Volume I, p. 121-128).

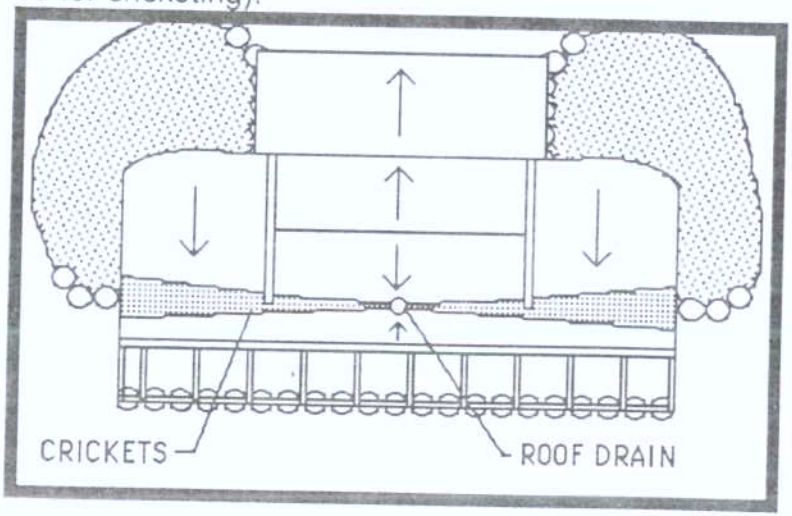


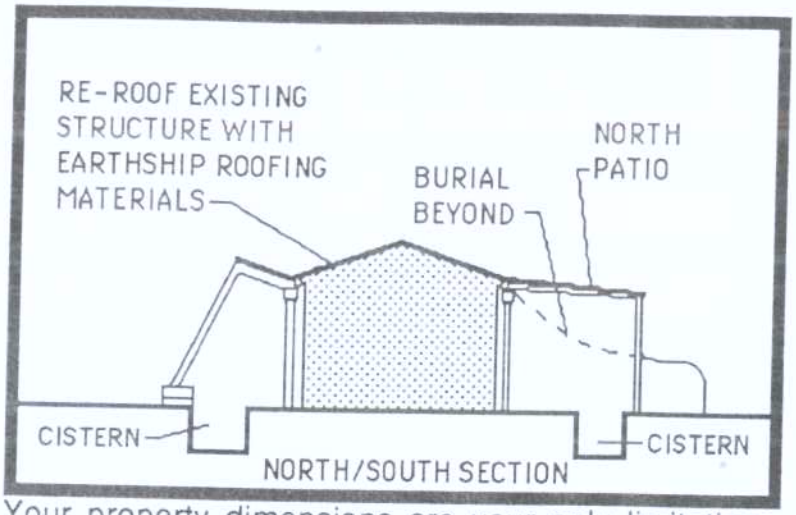
The protected patio created on the north can now be covered and enclosed for more northern protection.



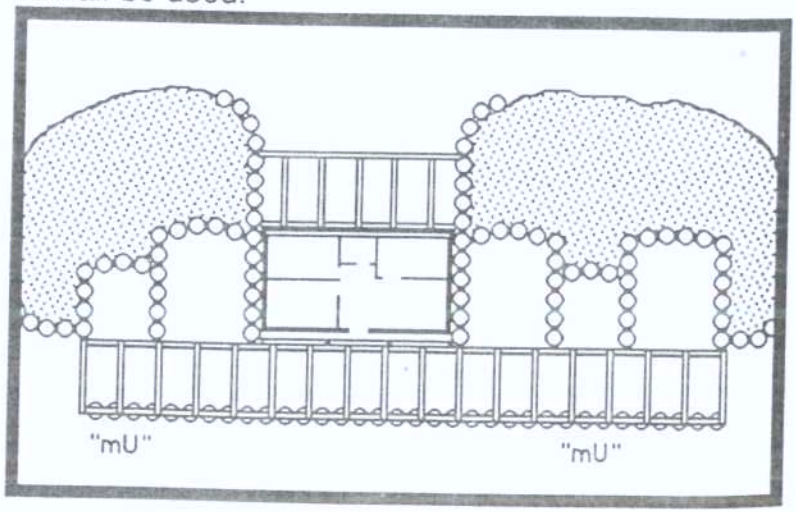
This leaves you completely snuggled in a cracker box that can function much like an Earthship.

If you want to catch water, the roof of the existing structure can be coated with Earthship roofing materials over appropriate cricketing (see page 49-50 for cricketing).

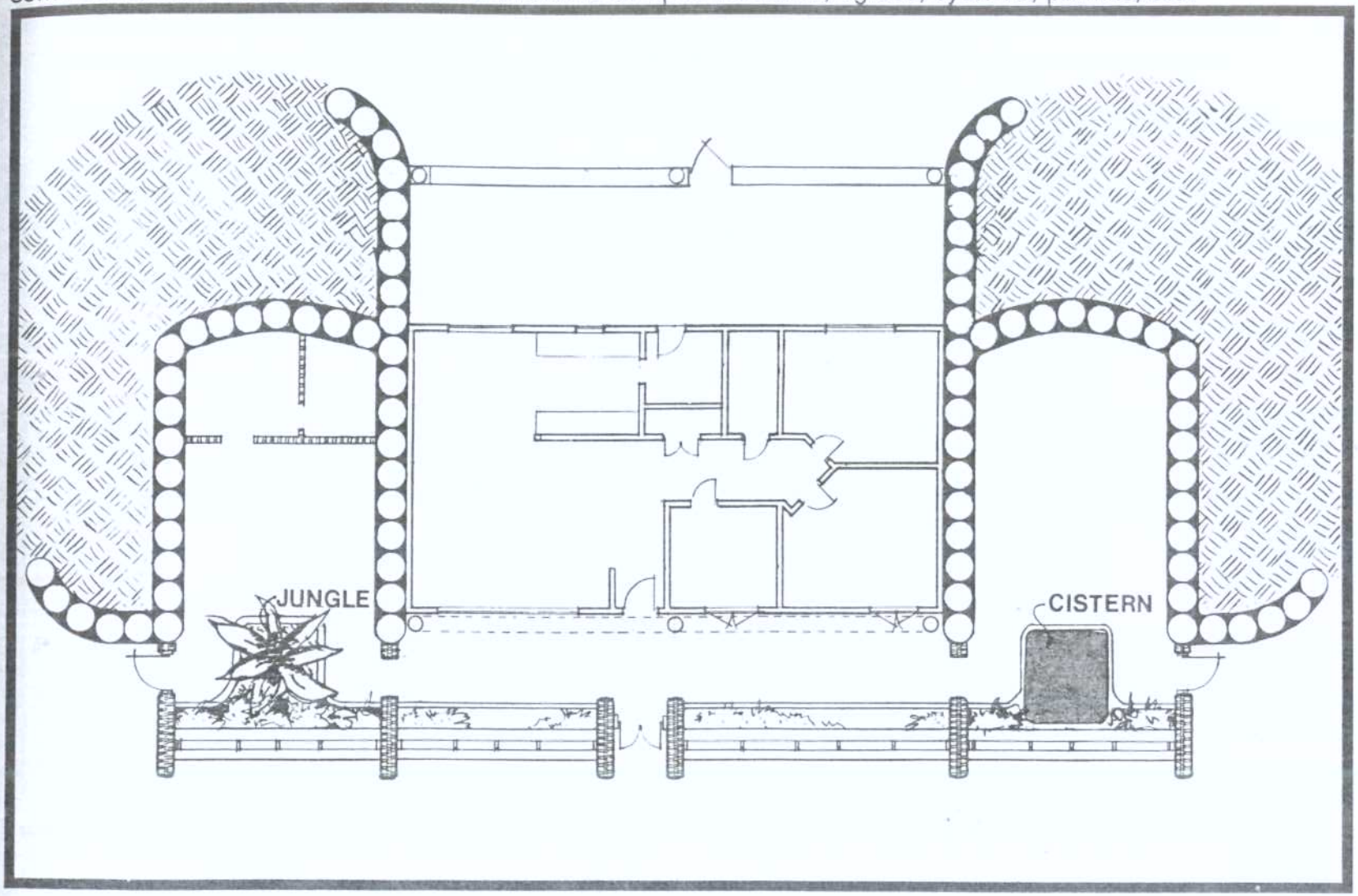




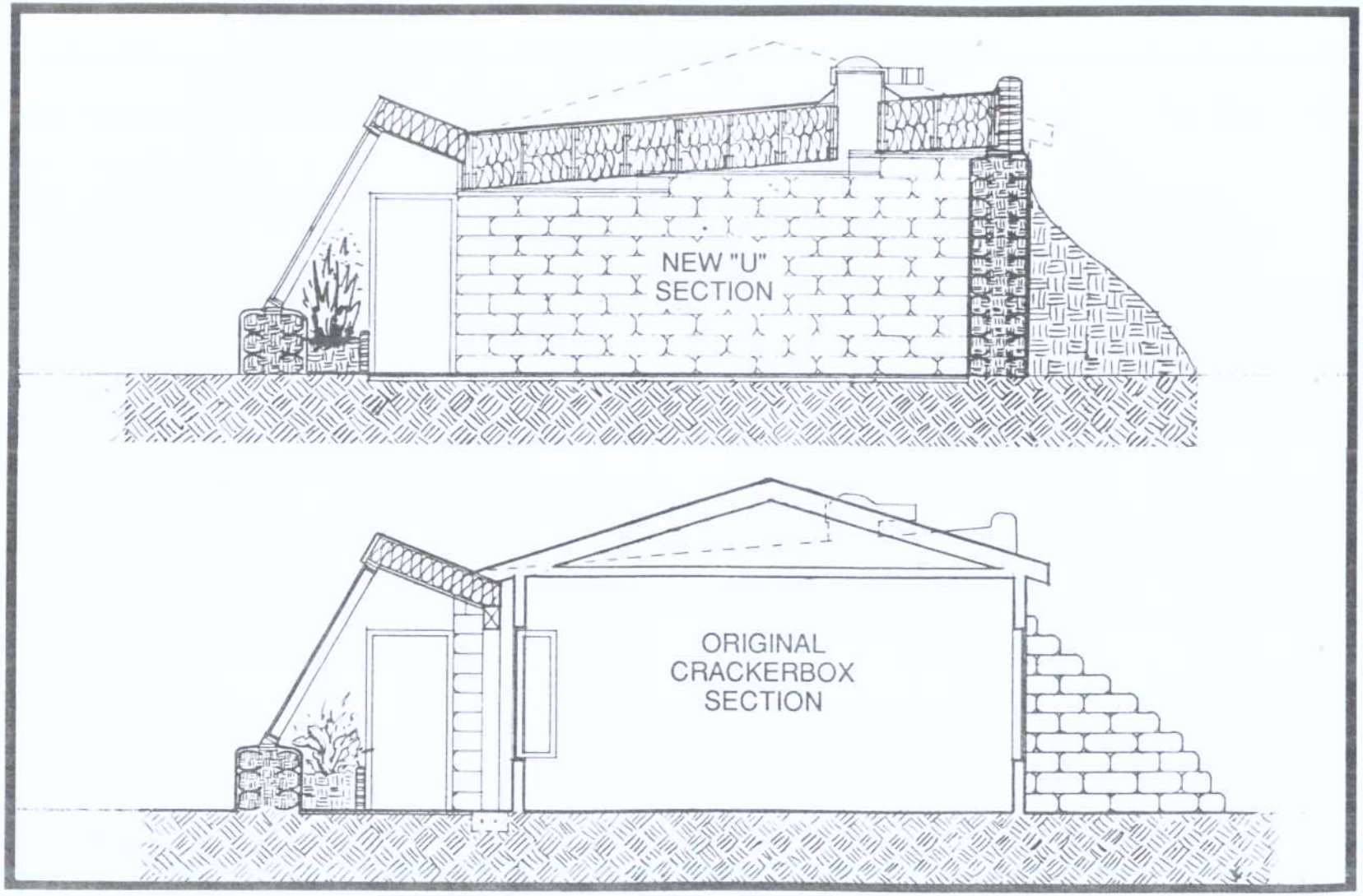
Your property dimensions are your only limitations on how far you can go with this concept. The new generics (see Chapter 13) can be applied with variations of the "U"'s and "mU"s placed where necessary. The catch water and grey water jungle systems as well as the solar toilets and solar ovens can all be used.



So if the real world dealt you a cracker box - be a magician - turn it into an Earthship. We do suggest that you get some consultation from Solar Survival Architecture on specific details, egress, systems, permits, etc.



FLOOR PLAN



SECTION