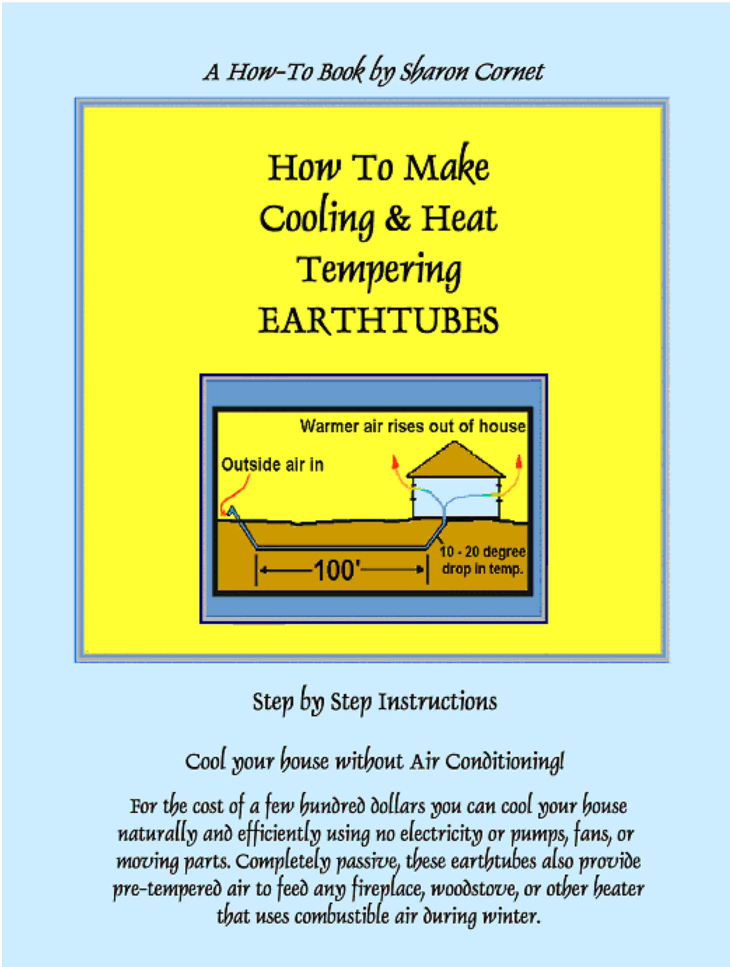
How to Make Cooling & Heat Tempering Earthtubes
By Sharon Buydens



Formerly Sharon Cornet

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Introduction

Earthtubes are an efficient way to cool or help heat your house in winter using cooling principles. They require no pumps or fans, and are completely passive (no moving parts).

This also means no electricity bill to “run” them, saving the building costs for the lifetime of the building, which keeps money in your pocket, and keeps your carbon footprint down. This is both natural cooling, and green cooling, simultaneously, and the principles take advantage of what nature already knowns how to do.

Running the A/C (air conditioning) unit in a standard electric HVAC-based house can costs up to hundreds of dollars per month, especially in homes that are not insulated well, have black roofs (which gain heat in summer when it is hot, and lose it when it is cold outside), or are designed wrong (standard designs are terribly inefficient for overhang and window placement, whereas passive solar design helps *prevent* solar gain in summer and *promotes* solar gain during winter for passive heating).

They work by harnessing what nature provides us anyway, but just utilize simple principles and allow us to cool the ambient air temperature by usually at least 10 or up to 20 degrees, depending on your home's energy efficiency values.

These earthtubes (also called earth tubes or air tubes) work fantastic in humid climates, although they work in arid climates as well. While outside it is 98 degrees, inside can be a cool 78 degrees!

The cost for making these earthtubes is minimal, perhaps several hundred dollars at the most for the entire average-sized house (approx. 1500 - 2000 sq. ft.). Larger houses just utilize more earthtubes.

Since they last for the lifetime of the house, and use no electricity, they can replace, or nearly replace any evaporative cooler (swamp cooler or Mastercool) or air conditioning unit, depending on the house, location, and efficiency of the home.

We built our first passive solar straw bale house in Nebraska and learned about earthtubes like many other people do – word of mouth – and in this case, from a man named Dale Carter. He is/was a contractor who also taught (still teaches?) different classes such as "*Handmade Solar*" and "*Owner Built Homes Under $20,000*" at Southeast Community College in Lincoln, NE.

I first took Dave's classes (for the latter) back in the mid-1990's and he aided us in the design and construction of our house there. He was the one who taught us the principles that you are about to read here in this book. I have picked up a lot of other information on earthtubes since then, as well, which I am including in this book.

Now others (like you) can benefit from this effective knowledge on how to cool a home using simple methods that are based on ideas and practices that have been used around the world for millennia, especially in the Middle East where hot deserts provide 100+ degree days, but very cool nights.

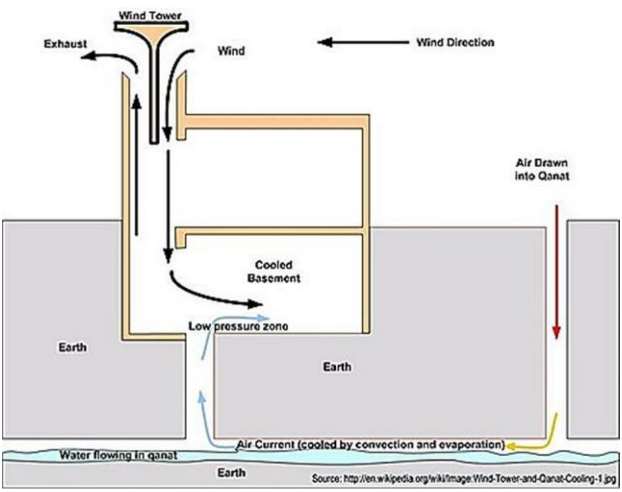
Tall buildings constructed close together, with narrow alleys, provide more shade during the daytime; but during the night the cool air falls, and it is taken advantage of within underground reservoirs (Ab anbars, similar to a cistern, but with a dome on top) and qanats, which are water management/irrigation systems – some built prior to Alexander the Great, and others still being used today.

Qanats are similar to the aqueducts that were used by Rome, and helped “air condition” some of the homes of the royals who could afford it. They are often utilized in conjunction with a wind tower. So what is a qanat exactly?

A qanat is basically a water well that is skillfully dug with vertical shafts and a horizontal shaft, keeping the water running in channels underground for up to many miles before being exposed for irrigation and other uses. Containment prevents contamination of the water.

Buildings with basements are constructed over the qanats and in some areas a Persian bagdir (i.e. “windcatcher”) tower is built that acts as a single or multi-directional wind scoop that causes an air pressure difference, drawing up the cooler air from the qanat, into the basement part of the building. This keeps the building very cool.

Qanat and Wind Tower



Source: Wikipedia

It is important to know that the buildings are constructed with materials that have a lot of thermal mass (able to hold heat or cold), such as adobe (earth) brick. The qanat brings in cool air, but this type of “thermal mass” construction is actually an important part of KEEPING it cool for long periods of time. Similarly, you will want to make sure to have plenty of thermal mass (tile, brick, rock, slate, cement, etc.) exposed in your home.

DO NOT cover thermal mass materials with laminate flooring, wood, carpeting, or any other type of insulating material. Thermal mass inside the house helps keep the house cooler by holding the temperature stable, and although it is not mandatory, it helps greatly in the long term. If you have carpeting, considering removing it and replacing it with tile, slate, or similar mass floor covering, or treat/color the concrete as is found in many newer homes these days. Throw rugs are okay to use, however.

Passive solar home designs are typically perfect for using earth-cooling tubes because thermal mass is already designed and built into the structure (you can see my book on “*How To Design A Passive Solar House*” for details). Passive solar homes (in the northern hemisphere) have ‘solar south’ facing windows with a specific glass-to-mass ratio so as to prevent overheating or under-heating.

In ancient Persia, and even today, earthen brick is often the building material of choice because it has “thermal lag” – the sun’s heat is absorbed on the outside of thick walls and slowly re-radiated to the night air, while inside the temperature stays semi-constant.

This works for both heat during winter, and to hold and release cold during summer.

A yakhchal (deep ice pit) has a cone-shaped dome, very thick walls (3' at the base) and a specially made heat-resistant exterior. It is often used with the subterranean qanat to help keep ice (brought down from the mountains in winter) frozen all summer long, which is a real treat in the hot desert.

Earthtubes are not designed to be that cold, since they just move air through about 100 feet of PVC tubing, but they will drop the outside air temperature to about 10 or 20 degrees cooler by the time it enters the house.

Earthtubes are very simple in their design, and not nearly as labor intensive as qanats or yakhchals, but where you live and what kind of soil you have, how deep your frost line is, what type of weather you have, etc., will determine just how hard (or easy) installing your earthtubes will actually be. Another consideration is whether you have a house you live in already that you want to add earthtubes to, or if you are planning on building a new house and would like to incorporate these into the infrastructure of the house prior to building.

We learned the hard way, from toil and sweat and digging by hand through HARD-pan ground that was about 70% clay, and even renting the WRONG type of trencher, in making our first earthtubes. Now, due to our mistakes, you can utilize the information so that your own attempts to make earthtubes can be via a lighter load, and easier work.

Either way, I know you will enjoy your earthtubes, and the coolness it brings on a hot summer day, for many, many years to come!

How do Earthtubes Work?

How earthtubes work is simple, and quite similar to the air cooled in a qanat, except that water will not be flowing in the tube (it will collect and drain out instead).

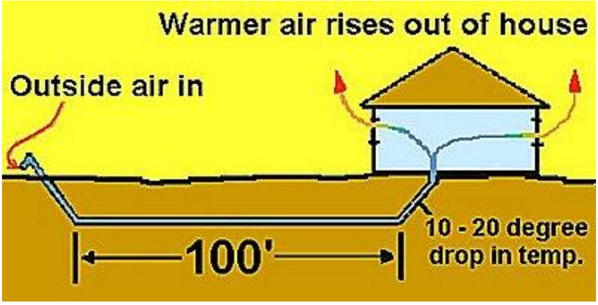
According to the picture below we have a long PVC tube (4” wide THIN-WALLED PVC) which runs underground and spans about 100 feet. One end comes up out of the ground at a 45-degree angle to bring in fresh air from the outside. The other end also comes up at a 45-degree angle to feed freshly cooled air into the house.

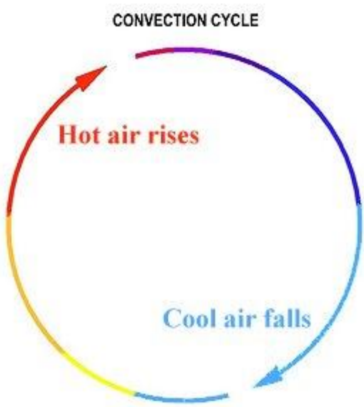
When 1 or 2 windows (especially up higher in the house such as *clerestory windows*—long narrow horizontal windows higher than your head are best), or in a *cupola* (a raised dome or area shaped like a square, hexagon, or octagon, with windows all the way around its sides, slightly higher than the roof), or in an *upstairs window* (if applicable) is opened, then what makes the earthtubes “work” is natural CONVECTION.

Note that *any* window will work, even in single story buildings. The idea is to open a window that is at/near the highest part of the house so that naturally rising HOT air will escape, creating a pressure difference to suck in the cooler air from the earthtubes. This works because hot air naturally rises, so you are simply letting it out. DO NOT open too many windows or you will get a cross-breeze and will cause hot air to come INTO the house, instead of drawing the cooler air from the tubes.

Convection brings cooler air inside the house

Convection occurs in nature and is most often seen in weather patterns. Warm and cold fronts are masses of air that rise and fall and move across the landscape, all generated by the sun's energy. Warm air rises, cools off in the upper atmosphere, and then falls back down again, creating a cycle – a convection cycle.





In a qanat there is cold water in the earth that flows steadily and helps cool buildings down (with the help of a wind scoop tower to aid the convection process). So what exactly makes the earthtubes' air cooler, especially since the air outside the house during summer is usually hotter than the inside air, and there is no flowing water?

It would first appear that since HEAT SEEKS OUT COLD the hot air would want to naturally enter the roof-shaded cooler house (this is actually what happens and is why your air conditioner has to work so hard to KEEP your house cool during the summer!). The heat radiates through windows, and even through insulated walls. Realize, though, that heat also rises, and that the hot air outside would want to rise, rather than go down into a tube, but any cool air (especially air under trees/bushes since foliage cools the air naturally) would automatically go down into the earthtube. However, convection and natural pressure difference is what makes it work. However, it is not just convection, but also evaporation and condensation.

Evaporation and condensation

When the hot outside air enters the earthtube the cooler temperature of the earth itself, which surrounds the tube, also cools the air, causing a natural downward flow.

When air passes through the tube, the water vapor leaves the air itself and condenses on the inside of the tube, much like water that condenses in an air conditioning system (remember those old window A/C units that constantly drip?). Water vapor also condenses out of the air and forms droplets of water on the outside of a tall, icy-cool glass that has your favorite drink in it. This is why the glass gets wet on the outside and drips down and makes a circle-stain on your table.

In the earthtube, the condensed water drips down to the bottom of the tube, and exits through small holes that have been pre-drilled along the bottom of the tube's length.

What is left is cooler, dryer air that then enters into the house via convection.

This is the bottom line of how an earthtube works: The hot air rising inside the house carries moisture outside to evaporate outside by escaping out of a high window. This exiting of warm air causes a pressure difference inside the house, which pulls air in from the only other open places it can get it—the earthtubes. The air inside the tubes drops in temperature from the coolness under the ground, condenses out the water and lets it go back to the earth, so the air that comes into the house is then cooler and dryer.

This is what cools the inside of your home, in a continual passive-flowing process that "runs" all day long without you ever having to flip a switch or pay a penny for its use (outside of building them initially). The payback period for these tubes, at around $150 each or so, is incredibly fast, sometimes within the first year of use.

The temperature difference between outside air, let's say, 98 degrees, is cooled off to as much as 20 degrees less so that the air entering the house is around 78 degrees or so. Generally a 10 – 20 degree drop in temperature is average and normal.

Some weather conditions may change this number as well as how energy efficient the house itself is. If the house is hard to heat and cool with a standard heater or air conditioner, respectively, then it is safe to say that earthtubes might not help that much (unless you have a lot of them). However, in an efficiently designed home, they can make a unbearably *hot* day become a cooler, more *comfortable* day INSIDE your house instead!

We had a passive solar straw bale house that we built when we lived in Nebraska in the late 90's, and when it was 99 degrees F outside, with 99% humidity, it was 70 degrees F inside. That is a 30 degree difference, but our house was especially designed well to keep the sun out during summer, plus was super energy efficient with R-50 insulation values in the walls and ceiling. The better the design of the house, the more efficiently your earthtubes will work.

It is important to note that earthtubes work best when they are used in humid climates as the principle behind them is to REMOVE the humidity from the air. In arid climates it is common to see evaporative coolers (also called swamp coolers) on rooftops of homes because the already dry air needs moisture ADDED back in to the air in order to cool it.

However, standard air conditioning units are also found all over in homes and businesses in arid climates so earthtubes will also work in these areas, especially on those hot humid "rainy season" days in summer, when the swamp cooler just adds to the already hot humidity, rather than cooling it. Earthtubes would be ideal during monsoon season in the desert!

How Many Earthtubes Do I Need?

In order to determine how many earthtubes you need, you must first figure out how many rooms you have in your house, or in the floor plan of the house you intend to build. It is much easier to make earthtubes for a house before the foundation is made (before any slabs are poured or basements are formed) than it is to make them and retrofit them into an existing house, but it can be done either way.

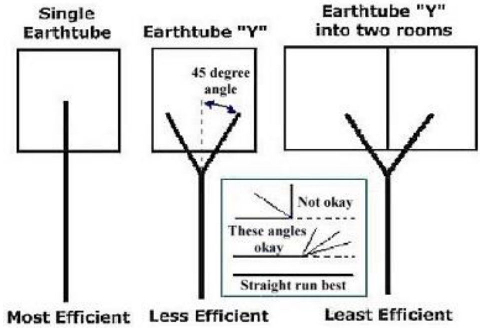
Figure on having one 4” wide and 100’ (minimum) earthtube per standard sized bedroom (do not include closets or utility rooms, pantries, or bathrooms). For larger rooms such as a Great Room it is recommended to put in two earthtubes to cool it effectively. Upstairs rooms do not usually require earthtubes although they may be run through the walls up to vents in rooms that are particularly hot (such as a south or west wall).

IMPORTANT NOTE: Remember to only open one window only (in the whole house) so proper draw can occur through the tubes. If too many windows are open then you’ll get a cross-draft and no air will be pulled through the tubes into the house, hence the house will remain as hot as the air outside. Make sure the window you choose to *crack open* is one of the highest ones in the house.

The earthtubes can be made 100’ long at the bottom of the run, plus the 45-degree elbows coming up off each end, but if you need to save on costs, you can make them 100’ from end to end (which would include the 45 degree bends). If you really need to scrimp on costs then you can also make one earthtube for two rooms, splitting them off with a Y under the ground at 45 degree (up to 75 degree) angles, but you will lose efficiency in the cooling effect, perhaps by half.

Typically, the more earthtubes the better when it comes to cooling down your house! If there are not enough to be effective, then they are basically a waste of your time, energy, and money to make them at all, so do it right the first time (plus it is not like they cost much). Please keep this in mind when designing your earthtubes for your home.

Diagram showing the “Y” option



Normally you will see one earthtube for each of these rooms (this example is a single level home):

Living room, Kitchen, Dining, Bedrooms (3). Bedrooms can be split off into the Y type earthtubes unless you spend a lot of time in there during the daytime. Sometimes the kitchen and dining rooms are also on a shared earthtube, especially if they are not separated by a wall. Living rooms, if small, can have one earthtube, but really large ones are recommended to have at least 2 earthtubes. All in all, the typical house will probably utilize a total of about 4-7 earthtubes (the more the better). Remember that kitchens generate their own heat, so you may want to have at least one earthtube for that room alone.

NOTE: It is best if earthtubes are run in straight lines. For every 45 degree bend (up to 75 degrees – NEVER use angles at 90+ degrees or air flow can be almost completely stifled!) you lose efficiency because the air is not able to move through the tube as quickly. Too many bends and it will nearly stop the natural flow altogether.

The cost for each earthtube can run about $100-150 each including the length of all the 4” PVC pipe (schedule 40 or schedule 80 is fine), and all connectors (couplings), and elbows. Price depends a lot on if you have any leftover *new* PVC on hand, or what the cost is for the pipe in your area. If you already have a good source for inexpensive PVC pipe then go for it, but do NOT use USED PVC pipe for your earthtubes unless you KNOW it was not previously used by something that could have tainted it (typically clean water only, and you should still scrub it well with a bleach-and-water solution before use).

Some types of tubing have an anti-microbial coating on the inside, which might be a good choice. The inside of the tubes need to be perfectly clean and sanitary so as not to cause respiratory problems later on during use. I'll go into this more at the end of this book in the section called "A note about air quality."

Making the Earthtubes

First things first… Always make sure to pre-measure the land where you are to place the earthtubes, and to double-check your floor plans as compared to where your land boundaries are. There is no sense in putting 100’ long earthtubes in a yard that is only the size of a small city lot that cannot accommodate their lengths! Without the proper length the efficiency of the earthtubes will be cut way down and you will wonder if even making them will have been worth your time. Do not waste your time and money and effort on something that may not work because you did not have the foresight to plan well.

Once your plan is set, then you are ready to get your tubes prepared. Eventually you will need to get the 10’ lengths of 4” PVC tube glued together, but not before the trenches are made. Trenches will be covered in the next section. For now, just concentrate on how the tubes are made.

Each 10’ length will need to have holes drilled in them with a drill, using a paddle-type drill bit (1/2” works fine, but any similar size will do). Depending on the tube thickness you use there *might* be a need to purchase 2 or so of these drill bits in case they break or go dull. They are fairly cheap at only $2-$5 per bit.

You will need to drill holes all along the length of the tube ON ONE SIDE ONLY so that they run in a straight line, all about 6” to 12” apart. These will serve as the exit holes (when turned to face down) for condensed water when the tubes are “working.” If the water is not allowed to run out into the ground then they will eventually fill up with stagnant water and cause problems (health concerns as well as plugging up the tube with a pond inside the tubes themselves).

Drilled homes for condensation escape

Make sure you have the right number of couplings and elbows on hand, as well as PVC primer and glue for

when the time comes to put the earthtubes together.

However, before you put the earthtubes together, you will need to dig the trenches.

Trenches

There are different ways to make the trenches for the earthtubes. One is to dig them by hand, but with a number of earthtubes, all being 100 or more feet in length, this can be a very laborious task! We tried this method at first, but the high clay content in our soil at the time prohibited us from doing it very long. Our backs just simply couldn't take it.

In cases like ours I highly recommend renting or borrowing a trencher for the task. If you know someone with a tractor or other equipment that can also help you with this task then all the better.

We were trying to save money when we rented a small trencher and we were sorely disappointed in the way it "behaved" for us. It was hard to manage as it was walked behind instead of ridden. Perhaps we got a moody trencher, but it loved to just take off on its own and make a curved trench going all directions. We fought and fought with it and I do not know if it was the trencher itself or the people running it (even me!). That was mistake #1. Make SURE to get a riding trencher as you have much better control, plus it will make much wider and deeper trenches (easier to work with).

The little trencher we used barely made a trench just wide enough for the 4” tube to be stuffed down into the hole. We constantly had to trim the insides of the trench down using a flat shovel (more digging!) and a posthole digger, which made for a LOT of extra work! It also made the trench only 2 feet deep and we should have placed the tubes at a minimum of 4-6 feet due to the frost line (6’-10’ is typical for homes in Europe that utilize earthtubes).

We had no plans to use these earthtubes in winter though (except one to feed the air to our woodstove) so we thought we could deal with the fact that they were only set down a mere 2 feet. This was mistake #2. DO make sure to go *at least* the 4’ depth to set the earthtubes as the temperature of the earth is far more stable at that depth. If you live up north, then you’ll have to go even deeper (just below the frost line – so you’ll have to find out from a builder or the internet as to how deep it is in your area).

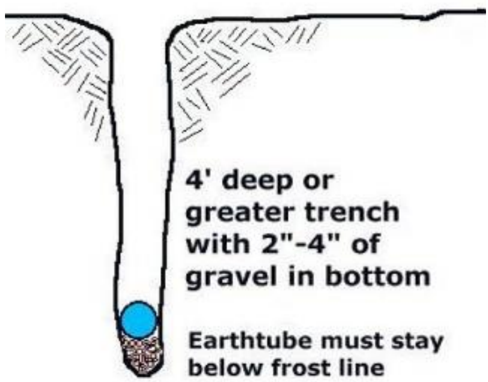
Laying the earthtubes

The first thing to do, once your trenches are made, is to lay about 2” to 4” of gravel down in the entire length of each trench. This allows the condensate to run out freely from the earthtubes instead of making mud or having a flow problem when exiting the tubes. It also keeps earthworms or other little creatures from tunneling up into the holes of the earthtubes by having this gravel in place.

Once your trenches are properly made and “graveled” then you may start placing the tubes (with holes face down) into the trench, using primer and then PVC glue on each end and sticking them together with the couplings. Press hard so that the pieces stay together all the way, at least for 60 seconds until the glue is “set.” Always double-check so that the holes are faced down!

Once the glue dries (and it does dry pretty fast!) they are nearly impossible to pull apart as the glue actually melts part of the PVC plastic together to form a bond. After that happens you would have to cut them off with a jigsaw or hacksaw in order to get them apart.

Placing the tubes in the trench



Dealing with Elbows

When you get to the ends where the 45 degree elbows allow the earthtubes to turn upwards you'll need to be *extra careful* in gluing on both the elbows themselves as well as the tubes leading up from them.

IMPORTANT: Make sure to double-check all angles with a non-glued test before actually gluing them in place!

Once glued then make sure to stick some dirt under the diagonal part of the tube, pack it, and set some rocks in there to help support the tube. Sometimes after the tubes are glued, and the dirt is placed back in the trench, then *underneath* the diagonal part of the tube packs and presses down later causing a gap underneath the tube. How do I know? Because it happened to us.

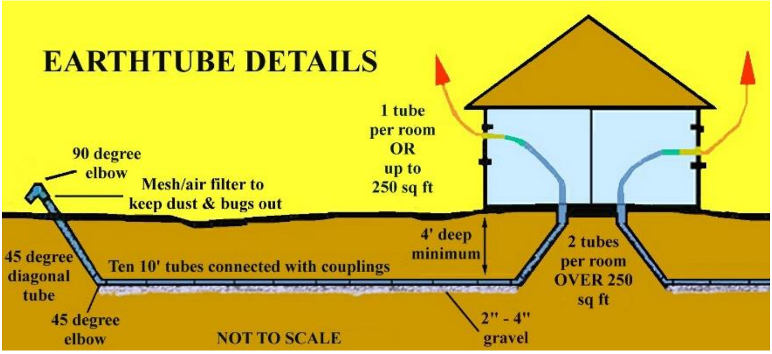
The stresses on the tube after more dirt is placed on top can be overwhelming and it might push the tube downward, causing a break at the elbow. Just make sure to pack the dirt well and/or use rocks under the diagonals to ensure success and less hassles in the end. Just something to be careful about.

When you bring the diagonal up from the elbow make sure that it does NOT have holes in it as this is the lead pipe up to the surface and will not have water settling in it.

It is very important to put a 90-degree elbow and screen on the inlet tube:

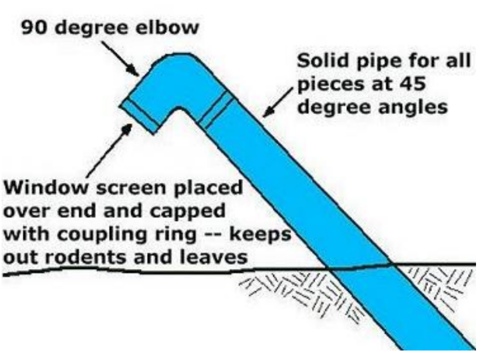
On top of this lead pipe that leads away from the house (this is for the outside section, where the air is drawn in) place a 90 degree elbow, faced down, so that the air can go in, but will keep the rain and debris out.

Also place a piece of window screen (metal is probably best, but nylon is ok too) and/or air filter (a piece of a furnace filter works as long as it does not get wet) over the end and fasten it with a coupling or band. This keeps rodents, dust, and leaves, etc., from entering the tube.



NOTE: When the earthtubes are completely finished this outer section coming above ground will be the ONLY part of the earthtube that will ever be seen. One way to disguise it (if you prefer) is to hide it with brush or bushes around it. This serves a dual purpose in that the leaves of the bushes pre-cool the air and shade the tube from harmful rays of the sun, which may degrade the PVC over time. Painting the tube with white paint, or black and then white will also help protect it from UV.

Diagonal with 90-degree elbow



Floor Registers and Side Vents

The diagonals that come up inside the house are another story. You will have the choice of putting these tubes up through the floor with a floor vent, or at the lower part of a wall so they will have a side vent into the room. Each option has its pros and cons.

Floor vents are probably the easiest as the tubes come straight up and out of the ground anyway. Sometimes it is hard to tell exactly where these tubes will arrive at even though one "plans" it on paper. The extra thickness of the couplings, or an error in calculations can sometimes throw it off by a few inches over the course of its length.

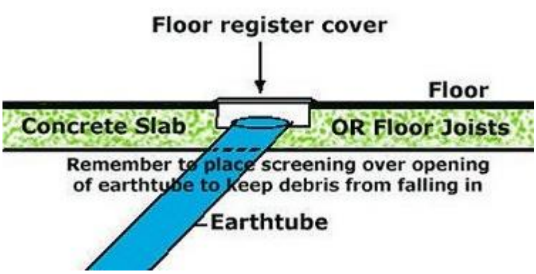
If your tube is meant for a sideways wall vent then you had better make SURE that your calculations are correct, and that your work is error-free so that you can ensure the wall will be placed at the tube end, or you'll be having to fix it by adding lengths (and hopefully not elbows or you'll stifle the air flow more) or else moving the entire interior wall! You could work backwards and start at the wall vent, and begin gluing the PVC parts together as you work heading away from the house (vent).

When making a floor vent for a house that is being built, it is a rather simple process. Make your earthtubes first, along the lines of when you are doing your plumbing (if underground). Just make sure that a *couple of feet* of tube are sticking out *above* the ground and that you cap them with a piece of strong plastic and a coupling temporarily (to keep debris out… this is VERY important).

Once your concrete slab is poured (if you go that route) then the tubes will already be there, in place, and all you will have to do is make sure that there is a small box or something placed to create room for the floor vent when it comes time (or you will have to chip out some of the concrete later on).

Once your floor is in, the excess tube (which was sticking out) is cut off, and you've put screen over the end of the tube, then you place the pre-bought and/or pre-measured floor vents on top and you're good to go! Don't forget to use 100% pure silicone (the kind that comes out of a tube) to seal around the edges between the slab and the earthtube.

Using a floor vent for earthtubes



How to make them work

Once your house is built, then your earthtubes are ready to be used. If it's summer then all you have to do now is to make sure your screens are clear and not punctured, or clogged up with spider webs or debris or dust (at both ends). Then close up the house completely except for one window high up in the house. It is good to use a window that is near to where you "live" at in the house, or else, if you want it to circulate through the entire house then you'll want to open a window at the far end of the house to pull the cool air through your home.

Since hot air rises naturally, and cool air falls, the open window will cause a pressure difference inside the house so that the hot air escapes and the cooler air is drawn through the earthtubes and into the house. The air will naturally warm up a little once entering the house, and it will want to rise again, keeping the pressure difference going at a nice calm but fair air exchange rate. With earthtubes you will not have a problem with indoor air pollution caused by smoke or odors as the air will quickly be replaced with newer fresher air from outside. For those with allergies this could pose a problem since it might bring in pollen from outside, but usually the water condensing on the inside of the tubes, will cause much of the pollen to drop down with it therefore cleaning the air somewhat. Air filters also help in this regard (especially HEPA air filters).

What to Do In Winter (Heat Tempering)

Although you can use the earthtubes during winter to utilize the natural heat from the ground, I would not recommend it for all your earthtubes to be open as it does not really "heat" your house, but only pre-tempers the air instead. It is recommended that the tubes are all closed off using plastic and/or a foam block or flat section of folded newspaper set over the hole, *except for one earthtube*. This single earthtube is usually only used to draw in tempered air to feed a fireplace or woodstove or furnace. Make sure that earthtube comes right up near the edge (within 3 feet) of your heating source, but not so close it will melt anything.

When you have a live fire burning in your house from one of these heating systems it burns the oxygen that's in the air in your home, therefore causing a draft around windows, doors, and any other leak in the house walls, ceiling, etc. Instead of feeling this cold draft draw across the floor (and your feet!), the earthtube can be set directly in front of, and close to the woodstove/fireplace to feed that fire with the warmed air instead. This makes the fire burn far more efficiently and keeps your house much warmer in the long run!

A Note About Air Quality

You will want to use ONLY 4” PVC pipes for the earthtubes as the old fashioned **clay tiles** and other products can become saturated with water and cause **mold and mildew** to grow. **Toxic** mold is a serious problem in porous materials (including concrete) that are placed underground where damp conditions are a constant. PVC is made for water, and is non-porous as well as having qualities that do not allow normal mold or mildew growth. Dave Carter explained this to us back years ago when we first were worried about this problem that has occurred with others’ earthtubes. So please stick to the PVC, especially if there is an anti-microbial surface inside!

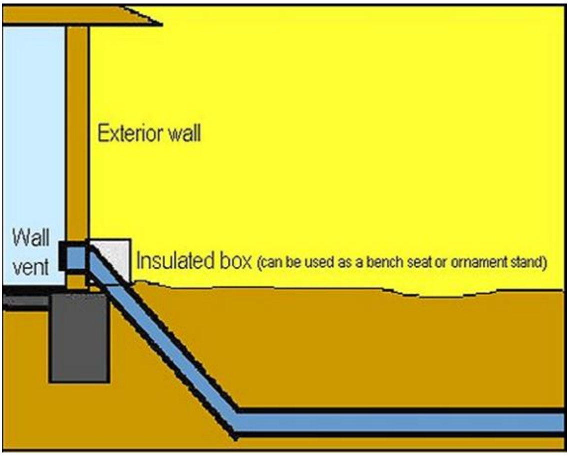
Another important thing to remember is to keep unpunctured screens on the tube holes at both ends to prevent rodents, dust bunnies, or debris down into the tubes. Rodents urinating into uncovered tubes can cause growth of **bacteria, spores**, etc. which causes diseases to proliferate among the households’ inhabitants. **Legionnaires disease** is a very serious disease that can be caused by rodents (or other bacteria) in this way. It can cause severe sickness, and if left untreated can cause death.

Of course, as long as you keep up with the screens (they should stay in place and not have any problems at all under normal use, nor have I ever heard of anyone having any problems with this) all should be fine. I have personally spoken with some people in Nebraska (besides our own home we built, and then later sold to friends who have lived there since 1999) who built and have lived using their earthtubes for many, many years without incident. In fact, they love them and rave about them anytime you ask them about it!

Adding Earthtubes to an Existing House

An idea for adding earthtubes to an existing house would be to cut a hole in the outside wall (at the very base above the foundation) and trench it out away from the house from there. Put in a wall vent, place the diagonal of your earthtube in there FIRST, and then make the earthtube "run" the rest of the way out away from the house. Make sure to place an exterior "insulated box" outside over the edge of the earthtube where it comes up out of the ground and into the outside wall so both UV from sunlight and outside temperature changes do not affect it.

Adding earthtubes to an existing house



Another option that I have heard used (especially if you live in a hilly area or want hills surrounding your home) is to make above-ground earthtubes by laying the tubes on the ground (on gravel) and covering them over with a very thick amount of soil/dirt via a tractor. This is a LOT of earth moving, however, but can be effective if you have a lot of extra dirt lying around. You can also use the same idea if you have shallower trenches (in places that you can't dig deep due to a high water table, or bedrock, etc.) and don't mind the long and high hill in your yard.

Solar Chimneys and Other Ideas

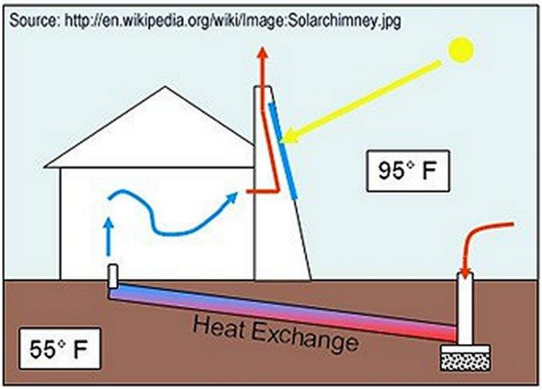
There are other ways to cool your house other than earthtubes, although some of them utilize similar principles of physics, and sometimes opposite ones.

Solar Chimney

A solar chimney is an excellent way to avoid having to open windows upstairs, or in the attic, or trying to choose which window to open in a single-story home (which can be frustrating). Solar chimneys help warm the upper air in the house, aiding the convection and draw of the colder air into the rooms from the earthtubes.

Solar chimneys are basically located at a high point in the house as a chimney that goes up through (or beside) and above the roof. They can be made of brick and painted black (to absorb more heat from the sun), or a piece of glass can be placed (with insulated sides, forming a small airspace between the glass and the southern-facing side of the chimney) to warm the chimney up. Other options are to use black stovepipe, or regular stovepipe painted black, with a twirling/spinning wind-catcher on top (to draw air up and out, similar to what people put on their roofs to draw hot air out of their attics, or on outhouses to draw up the smell to the outside). The chimney (a vertical shaft) works on the natural stack ventilation process that causes an updraft.

Solar chimney



The design above shows an earthtube design slightly different than the kind covered in this book. There is a slight 2-3 degree grade on the earthtube, so that the water conveniently (without the need for gravel or holes drilled along the tube) drains down the tube into a much deeper rock drainage pit. A vertical tube goes up to the outside from there, which is where the air drops down.

Again, it would be important to shield the incoming air with an air filter and/or mesh to keep sand, debris, rodents, and other sources of bacteria out of the rock pit; but like the qanat, the cold air that drops down into the pit cannot get out except by being drawn out.

A solar chimney would almost be essential with this design since the “hot air rises and cold air falls” rule would be violated based on the angle of the earthtube. The cold air would have to be “sucked” up the tube into the house, and the solar chimney would help this process along. Of course, one could argue that this is not much different than the 45 degree angles on the earthtubes this book presents, therefore also violating the rule. Perhaps a solar chimney, or wind scoop, might also be applicable here.

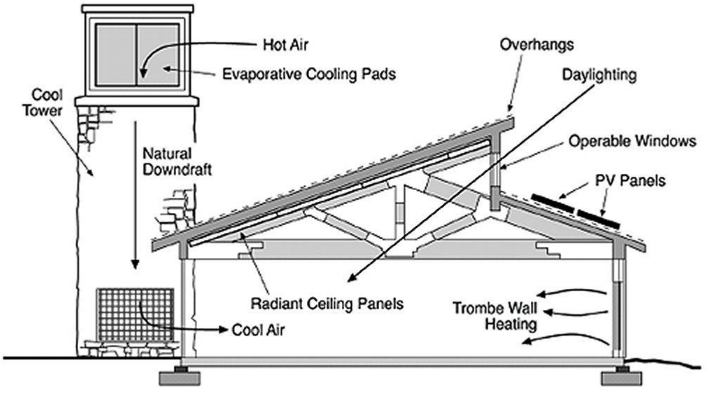
Cooling Tower

I have covered earthtubes as being aids to removing moisture/vapor from the air, making it cool and dry when it enters the house. In arid climates, where evaporative/swamp coolers are utilized a passive downdraft cooling tower could also be useful. This is a tower, similar to the solar chimney, but without any solar impact.

In fact, there are “pads” at the top of the tower (multi-directional) that are saturated with water (continually, or via a misting system that causes flash evaporation), and the air is cooled when it enters the tower. The cool air falls down through the tower and enters the house via horizontal slats. If the tower is central to the house, with rooms branching off of this area, then potentially all of the rooms could be cooled this way. This is a system that works on the OPPOSITE principle that earthtubes work on though.

Cooling towers ADD moisture to the air (in arid areas only), while earthtubes REMOVE moisture from the air, so cooling towers work best in arid or semi-humid areas—but a warning(!)… they are hard pressed to work effectively in areas of very high humidity.

Cooling tower for arid areas



Source: NREL and NPS drawings, Zion Visitors Center (cooling tower), and the website: http://upload.wikimedia.org/wikipedia/commons/c/c5/Zion_Visitors_Center_Cool_Tower.PNG

Earth Berming

If you live in an area of high humidity, then you could cool your home by earth berming, building an Earthship (tires with rammed earth), or utilizing all or partial underground house construction. Earthtubes would be essential at this point, not to cool the home, but to remove excess moisture that these homes tend to accumulate.

Bentonite clay is often used as a layer in berming, etc. to shed water away from the structure. This, along with earthtubes, keeps mold and mildew from forming as well. The ground itself, surrounding the house, would be the cooling mechanism – much like walking into a well-lit cave where the earth shelter creates the buffer between the inside of the home and the outside elements (whether cold or hot).

Roof Options

Some people cool their homes by shielding their roof from the sun via a **green roof**. Specially designed to hold the weight, a green roof has soil and grows plants such as grass to act as the temperature buffer.

Solar **roof ponds**, invented by one of the original solar pioneers Harold Hay, are another way to absorb and release heat to/from a house. Water is actually the best medium for thermal mass (thermal storage) since it can absorb and release heat (or cold) four times as efficiently (as fast) as adobe, rock, cement, brick, etc. Roof ponds require special building construction as well since water weights 8 lbs./gal.

Trees and Shrubs

Trees and bushes are also excellent additions to any yard outside of the home to cool passively. Trellises with vines help shield the hot southern or westerly sun from beating down on your west walls in summer, or they can keep the sun out of windows on the south side.

Alternatively, tall pine trees about 25' away from the house can produce shade on the west side in the late afternoons; however, you will want only deciduous (trees that lose their leaves in winter) placed in the south so that it shades the house in summer, but allows the sunlight through the windows during winter so you can take advantage of the solar gain into your home for passive heating.

Of course, the only real expenses with plants/trees are their initial cost, and for fertilizer, and water to keep them alive. You can collect and store or even reuse water to cut down on your water bill. Ways of collecting water (plants especially like rainwater) include rain catching systems, and gray water systems that recycle washer and shower water. Arroyo/canal and other water harvesting techniques are also viable alternatives in certain areas. This way you can water trees and bushes and other plants without the high cost of buying water from the local utility/service company. Check with your state regulations on systems such as these.

Solar and Alternative Design

For those who are into passive solar design, and alternative construction, there are other ways to construct homes that could be well suited to where you live. Some of these could include: sod houses, straw bale homes (very popular for their high insulation value of R-50, even though the price of straw has tripled because of its popularity and scarcity of the straw), and good old fashioned adobe (earth brick), or even cob (clayey wattle-and-daub type construction) or cordwood.

With thermal mass on the inside of the house (thermal mass WALLS are 4x more efficient than thermal mass in the floors), and insulation on the exterior walls, plus passive solar design coupled with earthtubes for cooling during summer and heat tempering during winter, should make for a very comfortable living style.

Regardless of the house you have – even if standard construction – or the house you plan to build, installing earthtubes will help cool your house 10-20 degrees Fahrenheit compared to the outside temperature. Combo systems could be utilized as well, depending on where you live or what the weather is like.

Earthtubes incorporated into storm shelters allow for fresh air to enter, which is very important in case the rest of the house falls in around you, with you safe in the storm shelter until help arrives to dig you out (see my free ebook on "*How to Make a Tornado and Hurricane Resistant Home*" at my website:

www.sunstar-solutions.com – it includes plans on building an in-the-house storm shelter).

All said and done, there are probably a variety of ways to build and use earthtubes (including using larger diameter 6” – 24” tubes for the 100’ run and splitting off smaller ones from there to the rooms, which allows more surface area in the tube for condensation, and more efficient air flow).

However, the directions shown above is the way I learned how to make earthtubes, and they are cheap to build, simple to use, and wonderful as a viable alternative to expensive air conditioning.

Good luck in your endeavors and enjoy your earthtubes! Enjoy even more the savings you’ll see over the lifetime of the house… This you’ll be able to view monthly by the savings in your electric bill!

The expanded 2nd version of this book is titled:

DIY: How to Make Cheap Air Conditioning Earth Tubes

It is available for $15 on www.amazon.com or my website www.sunstar-solutions.com

This free version (v1), including many other titles on different solar and other subjects, can also be downloaded at my website at no cost.

This is a free book by Sharon Buydens

PLEASE PASS IT ON

FREE TO OTHERS!