" One of our homes in Michigan has had a continuously operated air tube system for twenty-five years with no air quality problems. Their heating and cooling bills were less than $200/yr. (1980 energy costs). Of course to obtain that level of sustainability other aspects of the building’s construction, design, and engineering have to be considered."

Earth Air Tubes, by Larry Larson

The "Earth Coupled Air Tube" technology is a low cost solution to reduce the cost of heating and cooling your home. By using the Earth as a heat sink anyone can heat and cool their house for less. Unlike the ground loop heat pump, air tubes don't require deep wells, compressors, pumps, Storage tanks, coils, heat exchangers, complex plumbing, or all the problems inherent in a complex equipment/technology intensive heating and cooling system. Properly installed air tubes don't have any moving parts. They can't break. The only technology required is a fan to move the air through the tubes and into the house. Earth tubes are relatively inexpensive to install and are inexpensive to operate.

In the United States today many of our biggest problems are related to the high cost of energy, the inefficient use of that energy, and the impact of that energy use on the planet. The only way of solving the problem was to make existing equipment more efficient, more complex, and ultimately more expensive. This solution only delays the inevitable and continues the spiral of wasteful uses of energy.

Often the best solution to a problem is the simplest. The simple solution first requires a shift in how we think about the house we live in and the planet we live on. Only from this change in perspective can we hope to change the world we live in. Our home is where we can begin. By using Earth coupled air tubes to heat and cool our home we use the Earth as a source of comfort that is in tune with natural law.

In the late 1970's and early 1980's Earth air tubes gained a lot of popularity as an aid to conventional air conditioning and heating. They work by simply exposing the air we are drawing through the tubes into the house to the temperature of the soil without actually exposing the air to the soil. As air travels through the tubes they exchange temperature with the surrounding soil. The air entering the house will be warmer then the outside air in the winter and cooler than the outside air in the summer.

An Earth air tube system is a one way open-air system. Outdoor fresh air is drawn into the tubes, cooled (in the summer) by the Earth, dehumidified, and delivered to the inside of the house via the furnace fan. This system provides fresh conditioned air to every room in the house.

The tube material is high-density polyethylene formed into the common black corrugated drainage pipe. This pipe has a corrugated structure, which doubles the surface area of the pipe allowing for more Earth contact and more efficient heat exchange. It is corrosion resistant, easy to handle, non-toxic and readily available.  The optimum tube diameter is 8", but tube diameters of up to 12" can be used. The larger diameter tubes require a longer buried run for optimum performance. The tube has a single slit cut into it along the seam. This is the condensate drain for the entire tube.

The tube trench has to be very carefully constructed to assure proper drainage of ground water and air tube condensate. An experienced installer should only attempt this construction, as any mistakes can ruin the installation and possibly threaten the health of those living in the house. There are several trench design details that need to be implemented: trench profile, drainage, tube installation, materials used, as well as depth and dimension of the trench according to the diameter of the tubes.

The trench drainage can be a gravity drain to daylight or the trench can direct the drain water to a sump pump. The danger of using a sump pump is that if there is ever a loss of power for an extended period of time the tubes and trench drainage system could fill with water. As a result the interior of the tubes could become plugged beyond repair with silt and sludge.

Condensate drainage in the tubes is very important for maintaining acceptable air quality. The system is designed to assure no soil moisture or organisms ever enter the tube and possibly pollute the air stream. The preferred method of drainage is a gravity drain to daylight. A sump drain should only be used as a last resort. Alarms and backup power systems that can be employed in the case of sump failure or loss of power to the pump.

The tubes in the trench need to be on at least two-foot centers for 8" tubes. Larger diameter tubes require greater spacing between the tubes. The reason for the spacing is to minimize the chance the tubes will exchange heat with one another rather than with the surrounding soil. For 8" diameter tubes the trench will need to be 8' deep, 10' wide and 100' long. For larger diameter tubes the trench will increase in depth, width, and length. Trenches deeper than 12' will be rare and are dangerous requiring special precautions.

If the tube system is going to perform flawlessly for the life of the house, proper drainage of the trench is of the utmost importance. The bottom of the trench must fall consistently towards the drain and be relatively flat. The bottom of the trench is then filled with 4"-6" of a small diameter (1/2"-1" diameter) pea rock or river rock, washed gravel without the fines is acceptable as a last choice. The pea rock is then covered with a filter cloth so it doesn't get clogged with silt or sediment from the surrounding soil.

The tubes are carefully laid on the filter cloth and staked every 10' or so with the drain slit down. All the tube couplers are taped securely and any cracks or holes are caulked with silicone. The tubes are laid in a serpentine fashion. Ideally the tubes bend at least the diameter of the tube every 6'. This has the effect of preventing the air from flowing in boundary layers inside the tubes. As a result the air crashes around constantly inside the tubes maximizing the air to wall contact for complete heat exchange and, in the summer, removal of excess air moisture through condensation.

Once the tubes are secured, the foundation penetration sealed, and the open-air intake end of the pipes secured and capped on the surface, the tubes are carefully covered with sand. The sand locks the tubes into their intended position for the final back filling with the remaining excavate. Heavy equipment can drive on the trench once it is fully back filled.

Soil types can cause a wide variance in the tube performance and in the case of a sugar sand soil type it can change dramatically the trench profile, eliminating the need for pea rock and filter cloth. Soil temperature is also affected by soil type. The heavy moisture laden soils have a higher heat exchange capacity than do rocky, dry, or sandy soils. In some parts of the country digging in the ground is nearly impossible because of bedrock or high ground water table. The air tube system will work in nearly all parts of the country where it is possible to dig a trench to daylight as described earlier.

The average soil temperature will vary throughout the country. The average soil temperature will be within a few degrees of the average air temperature. For instance in SE Iowa the average soil temperature is 53º. At a depth of 8' the soil temperature will vary 12º on either side of average. It will drop on average to 41º in the winter and rise to an average of 65º in the summer. It could temporarily dip below or above those averages if there are extended periods of severe weather. The air tube temperature will follow the soil temperatures. As a result the air volume flowing through the tubes can be reduced in the winter and increased in the summer.

Once the outside air tube system is installed, the interior ventilation system has to be installed. The interior ventilation system is a separate contract. The cost of installation is in addition to the cost of the exterior air tube system. The interior system should only be designed and installed by a contractor familiar with interfacing with an Earth air tube system.

The air system inside the house should be a forced air duct system. The design of the forced air system is highly individual, but ideally should feature some sort of passive exhaust to the outside high in the common area of the house. The air tubes should be powered 24/7. The fan used to power the tubes should be set on a medium or low velocity. One should not be able to either hear or feel the air flowing. Exposure to constant high velocity airflow can cause anxiety and nervousness.

The best system for air delivery inside each of the rooms is low delivery and high returns. This matches the natural airflow the house will experience if it were allowed to convect on its own. There should be at least one common air return located as high in the house as possible. This return should be as big as possible within reason with an option to close it off in the summer. It is important in the winter to capture high heat and return it to the rest of the house. The goal of the air circulation system is to make the people inside the house comfortable. The house doesn't care if it is hot or cold. What matters most is that the air column people contact feels comforting.

Register location does not necessarily need to be directly next to the load (i.e. under windows and doors). In the winter the primary leakage is through the doors and window. This is by design since the house has to lose air somewhere if any air is expected to come in through the air tubes. So if the primary exit points for the air were the doors and windows then you would not want to put supply registers directly in front of those areas. Ideally one wants the air to travel through the room before it exits the room. The duct system design should be left to an installer with Air tube design experience.

One of our homes in Michigan has had a continuously operated air tube system for twenty-five years with no air quality problems. Their heating and cooling bills were less than $200/yr. (1980 energy costs). Of course to obtain that level of sustainability other aspects of the buildings construction, design, and engineering have to be considered.

Engineering for maximum energy efficiency of the walls, floors, roof, and basements or craw space are critical for optimum air tube performance. As much as 17% of the heat lost through a wall is through conduction. The walls and ceilings need to be super insulated, with a thermal break built into the walls. A thermal break reduces the problem of thermal conduction from the outside through the wooden members of the walls. A thermal break reduces the load of the wall increasing the energy efficiency of the house.

A concrete basement is a big energy drain on the house. Standard Portland concrete has virtually no R-value. It is actually a conductor. Concrete wicks ground moisture, much like, if you place the corner of a towel in a pan of water soon the entire towel will be wet. Concrete releases that cold moisture into the basement via the footing if it is not stopped. Granted this is done in relative slow motion, but as much as 23% of the heat loss of the house can occur through a concrete basement. All that aside the impact on the Earth from cement production worldwide rivals that of the automobile for its contribution to green house gasses. Concrete seems benign, but its impact on the planet is huge.

We recommend pressure treated wood for basements, footings and floors. The wood comes from well-managed forests of southern yellow pine (a renewable resource). The treatment is not a petroleum-based material, is a non-polluting industry, the end product doesn't off gas or leach into the environment, and when used according to code has been proven to be safe for use in house construction. Wooden foundations are warm and are very easy to finish and insulate. Using treated lumber sequesters carbon.

One of the most important and difficult items to include in your air tube house is a vapor barrier. There are a few simple rules to follow when installing a vapor barrier.

1. A vapor barrier is critical for air tubes to perform successfully. Always place the vapor barrier on the warm side of the wall, ceiling and floor.

2. You must construct the wall in such a way as to guarantee the vapor barrier never gets cold. In winter a cold spot on the vapor barrier will cause a dew point to occur, eventually causing a mold or mildew problem.

3. This is a variation to #2. A vapor barrier is not designed to, nor should it ever be expected to, stop airflow. The wall should be air tight before the vapor barrier is installed. Therefore we recommend strongly only cellulose insulation be used in the walls and ceilings. Fiberglass doesnot prevent airflow and will allow cold spots.

4. Not installing a vapor barrier will cause an uncontrollable dew point somewhere inside the exterior walls during the cold winter months. Mechanical dehumidification will be needed in the summer to maintain a comfortable humidity level.

This brings us to one of the biggest problems in housing construction, breathability, or sick house syndrome. This is a problem which air tubes solve! I have thought a lot about sealed walls –vs- breathing walls. For me it comes down to a very simple question. Can I live in a house that is both sustainable and comfortable? Comfort usually comes with a price tag especially in the weather extremes of Iowa.

The one issue that turned me towards sealed walls is the vapor issue. Do I want to live in a dry house in the winter and a humid house in the summer? What would happen if my house weren't vapor sealed on all walls, floors, and ceilings that are shared with the outside (see point #4)? I would need mechanical humidification and dehumidification.

My experience has been that when someone is describing a breathable wall they are not talking about air breathing (that is called a leak); they are talking about how permeable the wall is to vapor. If the impact of vapor loss could be described in dollars and cents people would start looking for ways to stop its random flow in and out of our houses.

Air tubes allow even the tightest vapor sealed house to breathe and be full of fresh air in every room. Air tubes make the house more organic. We breathe through our nose just like my house breathes through its air tubes. If I asked you to plug your nose and breathe through your skin, you would be dead in about 10 minutes. Why should we ask our houses to do the same? Our human skin has all kinds of marvelous vapor barriers that can open and close to keep us from drying out or getting too hot. The walls of our house should be designed likewise, to keep us comfortable in an efficient and sustainable way.

My system works. I have been watching the tube air temperature for five years now and have some data. My lowest tube air temperature in winter is near 40º F. The highest summertime temperature was near 70º F. The air tube temperature only reached those extremes when the outside temps were excessive. The average soil temp in this part of the country is 53 degrees and my air tube temps also averaged out about the same. The deeper the tubes are buried in the ground the less fluctuations in temperature they experience. As stated earlier at 8 feet the soil temp will vary 12 degrees either side of average (41º in the winter, 65º in the summer). The tube air tracks that temperature shift.

There is no problem with mold or Radon in my system. I've tested my systems for Radon and the results indicated the tube air Radon level is the same or near that of outside air.

As indicated earlier, 90 % of the air tube design and installation is to insure that they are drained properly. As a result there are no mold problems in properly installed air tubes.

If you have any questions please visit my web site at EARTHAIRTUBES.COM, or send an E-mail, LSQUARED@LISCO.COM or call me directly at 641-472-4953 or 641-919-2233.

Larry Larson

Earth Air Tube Guarantee

Dear Homeowners and Architects,

I can personally guarantee my air tube installations to be free from defect. They will perform as described in this letter. If the air tubes become spoiled by flooding or misuse they can be easily sealed off from the house. A conventional air conditioning system can then be installed as a replacement. Extra ductwork will not usually be required for this changeover. No University research or government research is available on this system. From their perspective this is an untested experimental system. Because of this fact, you must accept that there may be little or no recourse for damages or costs above and beyond the disconnecting and sealing off of the air tubes. My experience and research has shown that I can guarantee the air tubes will be mold free and radon safe if the installation is done by a contractor approved by Larry Larson. I cannot guarantee the air tube performance inside the house if the house is not built according to my specifications of energy efficiency and airflow. If my specifications are met then the air tubes will provide all your air conditioning needs and significantly supplement your wintertime heating needs.

References in Fairfield are:

Larry Larson 919-2233 – 7 years with air tubes
Lonnie Gambel 469-5240 – 6 years with air tubes
Dwight Harris 472-5447 – 6 years with air tubes
Ken Walton 472-8370 – 5 years with air tubes
David Butler 472-1935 – 4 years with air tubes
John Selarno 472-1718 – 3 years with air tubes
Bill & Stacey Hurlin 472-7484 – 2 years with air tubes

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