

## Earthships

### Time Necessary for Building

This construction is very labor intensive, so if we had 20 people working it would probably take 2 months and the supervision of an experienced and expensive contractor.

### Materials

Tires- These will be donated by local car dealer and landfills.

Tires will provide excellent insulation for a foundation and walls. Molded into a U-shape and using different gauged tires the foundation gets thinner as it progresses vertically. According to the article "Mass Appeal" in Mother Earth News, "A 1,500-square foot Earthship uses anywhere from 500-700 tires, which can be "pounded out" by two people in less than a month (25-40 tires can be pounded by two people per eight hour day depending on the conditions present as well as the endurance and strength of the builders) (Knipe 46).

Windows- These will be acquired (hopefully donated) by Owens Corning. I obtained the name of the salesman in our area. His name is Joe Arcadi and his phone number in Cleveland is (216) 428-2287. Once I know the specific materials we need, I will be pricing windows and ordering directly through him.

Window types- Anderson- High Performance glass  
Low E argon glass

\* The windows will be double-paned, so that they provide the most efficient insulation manufactured in the form of windows.

Cistern- Located on both sides of the structure, the cisterns provide a reservoir for rainwater. This water can be used for a lot of things once it is filtered.

I am doing more research on *Greywater*.

Beams—construct the roof and are decked, well insulated and roofed with earth which is bermed up over the entire structure and joins with the 3 sides that are buried by earth.

Earth and Stucco- are required for a few things in the design of an Earthship. First, the tires that create the walls must be rammed with earth so that they are strong and full of thermal mass. Second, the earth and stucco are used to cover the tires and also the inside walls so that they contour to the desired shapes.  
(<http://www.alternative-way.com/frcans.htm>)

### Standard Features

- Solar/Thermal mass heating and cooling
- Natural convection ventilation with gravity operated skylights
- Power Organizing Module
- Batteries and Battery Vault
- Photovoltaic collection panels and mounted racks
- Water Organizing Module and catchwater system
- Catchwater Cisterns
- Gas Demand Water Heater and/or Solar Water Heater
- Grey Water containment, treatment and distribution
- Low flush toilets going to solar septic tanks and into contained, outdoor treatment planters
- Gas or DC refrigerator
- Kiva fireplace or wood stove flue hookup
- Washer/Dryer hookups

### Optional Features

Indoor Cistern  
Cistern recirculation waterfall  
Wind auxiliary power source  
Construction utility hookups  
Backup gas heaters  
Mudroom/air lock

### **Costs**

On average, Earthships cost \$20 per square foot and when properly maintained by the owner living is practically free, especially with the indoor garden that would provide food all year long. The only outside costs would be (if desired) phone and cable bills.

According to the article in MEN, Earthships "consistently cost 25% less than equivalent designs built of conventional materials" (46).

However with this low rate for actual construction and materials, the initial drawings and plans are very expensive. For a three U design, that would allow for two bedrooms, kitchen, bath, and living area, the generic drawing cost \$5,000, according to the website, <http://www.earthship.org/onevl.html>. In addition, a contractor is suggested and estimated at \$90-\$100 per square foot and all customization is about \$60 per hour. So to build a successful earthship, it will cost the owner some dinero.

### **Donors of Materials and Labor**

Local car dealers and landfills will donate used automobile tires.  
Owens Corning may be able to provide us with windows and doors.  
Barney renovation may be able to donate some scrap material.  
Other materials will most likely need to be purchased.

Students will be donating their time and energy to aid in construction.

### **Persons with Expertise**

Unfortunately, all the existing Earthships are located in the West; therefore, a trip to the west would be required to experience a fully-functioning Earthship. Michael Reynolds is the father of the Earthship and he graduated from the University of Cincinnati. I have written to the Architecture Department and no one seems to know how to get ahold of him. After calling Jonah Reynolds Earthship Global Operations (505) 751-0462, I was told to read their books Earthships Vol. 1,2, and 3.

### **Information on Earthships**

#### **Websites**

<http://www.woodwind.com/dancing-rabbit/Energy.html>

<http://www.alternative-way.com/frcans.htm>

<http://www.earthships.org>

#### **Articles**

Mother Earth News "TIREHOUSE II" Feb/March 93

Mother Earth News "Mass Appeal" Oct/ Nov 91

#### **Books**

Earthships Volumes 1,2 and 3 by Michael Reynolds

## Maintenance

Earthships are very low maintenance and merely require inhabitants and an occasional oiling of the woodwork.

## Heating Source

### Passive Solar Heating

Since the three outside walls are protected by the earth as well as below the earth's freezing point, the structure captures and maintains the temperature of the heat. This temperature is usually between 55 and 70 degrees therefore, requires no back-up heating. Another benefit of the Earthship is that the materials, (tires, aluminum cans, etc.) naturally create mass which acts as a storage for the heat.

## Energy Use

<u>Use</u>	<u>Conventional Home</u>	<u>Earthship</u>
<b>Space Heating</b>	51%, or 1250W Oil, gas, electric: environmentally Damaging and expensive.	0 W. Free solar heating and wood Stove heating.
<b>Refrigeration</b>	8%, or 200 W. Normal refrigerators are Underinsulated and place the motor Underneath the food, sending heat Directly into the area that's supposed To stay cold!	40 W. Sunfrost refrigerators are 80% more efficient than the standard. Root cellars will also be used to cut down on the amount of food stored In energy units.
<b>Cooking</b>	3%, or 75 W. Gas or electricity	0 W. Free Biogas
<b>Water heating</b>	15%, or 380 W. Keeps water hot all the time, causing Extreme inefficiency. Uses gas/power.	10 W. (small pump) Passive/active solar water heating for free. May use biogas system as backup.
<b>Clothes Drying</b>	3%, or 75 w. Expensive electrical power	0 W. Earthship has an indoor greenhouse, always Dry for a clothesline.
<b>Air Conditioning</b>	7%, or 180 W. Expensive electrical power	0 W. Efficient building design, summer shade, And air transfer keeps air cool.
<b>Lighting</b>	6%, or 150 W. Electrical power, with inefficient Incandescent lights.	30 W. Maximum use of natural lighting; Fluorescent bulbs; renewable energy Sources with batteries.
<b>Other</b>	6%, or 150 W. Low-efficiency washing machines	30 W. High-efficiency versions of the same;

And other electrical appliances.

Decreased reliance on unnecessary powered appliances.

- taken from [http://www.woodwind.com/dancing\\_rabbit/Energy.html](http://www.woodwind.com/dancing_rabbit/Energy.html)

In totaling energy use, the Earthship requires 150 W. of energy plus gas and wood for cooking and heating.

### **Impacts on Environment**

This construction will require a backhoe to dig the soil, so that there will be enough room deep in the earth to allow for three walls to be efficiently buried. This burying is essential for the design because it allows for the retention of heat.

### **Disadvantages**

For our purposes, digging into the side of the hill may be an undesired disturbance to the land. The reason for digging into the hill would be to protect the 3 outside walls leaving the south side open for window to utilize passive solar heat.

Labor intensive

Expensive

### **Advantage**

Does not require any back up heating. This reduces the pollution that is created from burning wood or fossil fuels.