



SINKING THE EARTHSHIP CONCEPT IN TEMPERATE CLIMATES, ONCE AND FOR ALL!

In 2005 I discovered the Earthship concept and started reading a bit about it. I realized for the first time in my life that what I truly needed was to go off grid because this would be a huge part of the solution for most of the problems in my life. Being an artist I found it increasingly hard to combine my passions with having a job and I was increasingly getting depressed by the thought of getting up 6-7 o'clock 5 days a week to go do something that didn't fill me with joy and excitement, and to have any hope of finding a job that supported my creative passion was far from realistic. I also had philosophical problems with our current wage slave economy and felt really depressed about supporting such a degrading and corrosive system, a system that weren't doing any good for the world.

I basically knew nothing about construction, energy production or waste management but it didn't deter me in any way. The only problem as I saw it was finding more people that wanted to go off grid because something I realized right away is that you need more people in order to become self-sustainable, so the "self" in self-sustainable had more to do with building a community than it had to do with my personal conviction.

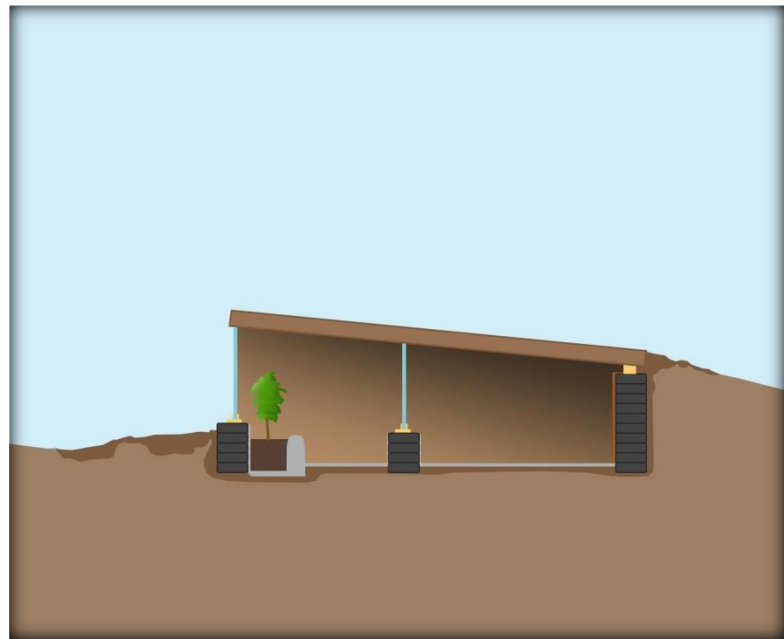
In 2008 a few friends had started thinking the same thing and loved the idea of building a self-sustainable eco village somewhere in Sweden where we could build a strong community that helped each other. I knew a little bit about how the Earthship concept was constructed but not enough to adapt one to our climate. The concept had been designed in New Mexico and I realized that such a design had to be adapted to our subarctic climate in order to work properly, so I started networking and soon found a kindred spirit dedicated to learning as much as possible about living off grid and how to adapt the Earthship concept to northern Europe. His name was Willy and ran the non-profit organization Earthship Belgium and he soon asked me to set up a sister organization in Sweden and I jumped at the idea. After 2 years of researching, reading books, meeting people that had been working on Earthships in Europe and who had tried to adapt them to our climates and lecturing about the design ourselves we realized that the Earthship design was not intended to be built here. If Michael Reynolds (the architect behind the design) had worked for 40 years on building an off grid house in Alaska the result would not have looked anything like the Earthship concept we know of today. So we changed our direction, keeping the off grid feature of this concept as this was what

really attracted us to the Earthship concept in the first place but went back completely to the drawing board regarding materials and design. We called this model the Strawship.

Now, 3 almost 4 years later, we still have to do verbal battle with people convinced by the propaganda machine of Biotope (Reynolds Company) to try and make them understand that this concept is not well suited to be built here and it's becoming increasingly frustrating as people seem to not listen to reason and logic. So this article is dedicated to once and for all hopefully explain in the most detailed manner WHY the Earthship concept should not be built in temperate or subarctic regions of our planet.

What is an Earthship?

First of all we need to determine what an Earthship actually is. The "Earth" in its name is referring to the fact that the concept is somewhat dug down into the ground with a huge earthen berm behind the north side of the entire building as well as on the east and west sides. The walls holding back this berm are made from discarded automobile tyres, rammed with dirt traditionally using a sledgehammer. The entire south façade is covered with windows to let as much sun in as possible. The excessive heat accumulated on the



inside of the house is stored in the HUGE elements of thermal mass that the rammed tyre walls make out, supposedly making the indoor climate cool and comfortable. When the temperature drops in night time this heat is released from the walls to regulate the indoor temperature, keeping a comfortable level all day and night. But this thermal mass is not just there to store heat from daytime to nighttime but some of it is intended to stay inside the walls and is first released when winter comes and the amount of sunlight is reduced i.e. dropping the temperature indoors as well, at least this is the INTENT of this design. The concept also uses as much recycled materials as possible such as the tyres, aluminum cans that works as infill in all the cement that is used in an Earthship (and there is lots of that stuff in an Earthship).

The "Ship" part of the name is referring to the design being off grid. Behind the windows the design takes care of all of the house's gray water (water from kitchen, washing machines, showers etc.) with the help of planter cells where you can grow food all year round. The roof is designed to harvest rain and melt water from snow, and with the help of wind turbines and solar panels it also produces its own electricity, rendering its inhabitants completely off grid, "sailing" free just like a ship. The house is basically a dug down passive solar design integrated with a greenhouse and all of it made out of dirt-rammed tyres, cans and cement. Now, when discussing whether the Earthship design is a good design for our climate or not it's not important to talk about electricity production, water harvesting or waste management systems as these aspects can be used, designed and implemented into any

concept in a beneficial way. However, while on the topic of water harvesting - I would generally speaking say that rain water harvesting is not a good idea here in Scandinavia as we in most places have very pure water in the ground, cleaner than the rain water and it's mineralized which rain water is not until it has passed through all the layers of earth, rocks and clay ending up in the ground water, so digging a well is highly recommended.

But anyway, in this article I'm going to focus on the main design/construction points that make out the Earthship concept, let's call this the Earthship construction template. I will explain why this is a bad template for subarctic climates no matter how much you try to adapt it.

- **Massive amounts of thermal mass**

Thermal mass is anything heavy and solid such as rocks, metal, water or as in the Earthship concept – rammed earth. When heat from any source comes into contact with thermal mass the mass absorbs the heat until its temperature is about the same as the temperature in the air so it has a cooling effect when it's too warm and a heating effect when temperature in the air drops beneath the temperature of the thermal mass. But in our climate due to the lack of sun during winter it's not going to work very well with ANNUAL heat storage as with the Earthship concept, this doesn't mean that thermal mass should be disregarded completely, it just means that it should be implemented in a way that is beneficial in the climate you're in. A 3 – 12 cm coat of plaster (depending on your exact situation) is sufficient for storing heat from daytime to nighttime and will regulate the indoor temperature very well, I'd say about 5 cm on a straw bale wall is good enough for this purpose. But we can forget about trying to store heat from the sun from summer to winter, we just don't have enough sun hours for this to work properly and additional heating will be required. Then the huge amounts of thermal mass in an Earthship will be redundant to say the least as it will swallow all heat produced before leveling out with the temperature in the indoor air. It doesn't matter if you burn wood, oil, coal or whatever you choose to use as the main source of heat for your house, it will take a long time to heat up all that thermal mass before the temperature in the mass is equivalent to the temperature in the indoor air where you need it. So if you leave your home for a few days in winter time or late fall when there's almost no direct sunlight, you will have to burn a lot of wood when returning home before the temperature rises in your house again. More thermal mass is not inherently better; it all depends on what latitude you are building on. This could almost certainly be fixed with high tech solutions that switch on when the temperature drops to a certain level etc. but why do that if there are other ways of building a house that doesn't need such solutions? Designs that don't require you to burn wood for hours and hours before your home reaches a comfortable temperature.

Our conclusion

A 5 cm thick layer of plaster is well enough for our climate so there's no need to pound 1500-2000 automobile tyres for walls which is A LOT of work. Here in Scandinavia it's better to use what we have in abundance which doesn't need such heavy work as with pounding tyres and timber/wood is a much better, faster and easier alternative for a load bearing structure here in the north.



- **Insulation and moisture issues**

Any house built in a subarctic climate should have really good insulation and be well protected against moisture, even an Earthship in New Mexico should be insulated properly. Our goal as a movement is to use as much natural materials as possible and when digging down into the ground you cannot expect to use natural materials as these need to breathe in order to keep its R-value and not decompose. Michael Reynolds uses rigid insulation that is made from oil and almost all insulation products has a very high energy demand even if it's not oil based. So even if you choose to insulate underneath the floors and tyre walls of your Earthship you cannot use natural materials which is a huge drawback because of the very important part that insulation plays when building a house, especially here in Scandinavia. We don't like to depend on industrial materials for the most important parts of our designs so on this account alone the Earthship fails our standards. The original New Mexico template for an Earthship however does not have any insulation in the floors. This is due to the very low moisture content in New Mexico, thus not that deep frost as here and the idea is also to use the constant temperature of the earth underneath the frost line and then it cannot be insulated. This frost line is at a depth of about 1,5 meters into the ground here in Scandinavia where I am located and if you dig your way down to this depth you will get a constant temperature of about 4-5 degrees Celsius which is completely useless. You will also in many cases run into huge problems with the ground water level instead, and then I'm not even talking about the other over-all design problems that such actions would pose. Living 1,5 meters underground is not desirable for most people as this is basically living in a cellar. You also have the same problems with insulating using natural materials on the north, east and west sides of the Earthship as these are covered with huge earthen berms. So going into the ground and expecting the level of comfort that we nowadays expect can't be achieved without oil based rigid insulation or other high energy demanding industrial materials such as Foamglas. As I said, by our standards this cannot be considered a sustainable solution in the true meaning of the expression "sustainable".

Our conclusion

There is no point in digging yourself in as this will only complicate things, create problems and you are left having to use industrial produced materials for insulation and vapor barriers. This is not needed when raising the house above ground, away from direct contact with moisture and frost. This allows you to basically use any natural material that can be sourced locally such as straw, sheep wool, reed, (hemp would have worked if not for the very hard restrictions in Sweden) or even moss like people in the old days used for insulating their log cabins.



- **All south facing windows**

Using the sun as the main source of heat is not going to work in Scandinavia, I think we've already established that so why only have windows on the south side? Besides, most people want to be able to look out at more directions than one and having huge windows on the south side will also create hot and cold spots in your house, a common



problem with the Earthship design. When glazing your south side it's recommended to not have more than 25% of the total wall area glazed in order to not get a too hot climate indoors and not too much and too big windows on the north side. The south facing windows also make the south side into a greenhouse which is also going to block your view a great deal and may lead to moisture issues as well, therefore it's better to place a possible greenhouse on the west side of your house with a separating wall or completely separating it from the main house. A greenhouse doesn't need to be heated to the same temperature as your indoor living space in order to grow all year round, plants can handle living in a lower temperature than our sense of comfort can.

Our conclusion

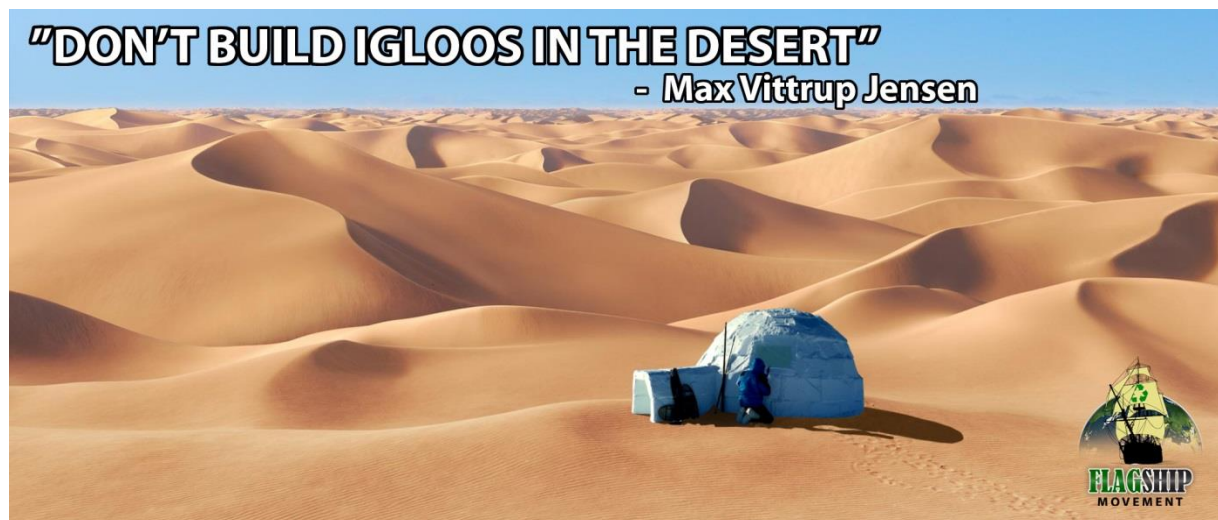
Spread out the windows on all sides of your house but not too big ones on the north, just so you get some light in from as many directions as possible. Place the greenhouse on the west side with a separating wall or separate it completely. The west side will get over-all more light during the year than the east side so the west side is a better place for a greenhouse than the east.

If you made these adaptations to the Earthship concept it would basically cease to be an Earthship. You have a raised house above ground, load bearing structure out of wood (if not building a Nebraska style straw bale house where the straw bales themselves act as the load bearing structure), windows on all or more than one side, no tyres or excessive amounts of rammed earth/thermal mass walls, natural insulation materials all around (why not straw, cellulose, hemp or a combination of them in different places where it's beneficial?) a nice layer of clay plaster both on the inside and outside (mixed with lime on the outside) to deal with moisture in all forms. This starts to look like almost any house in Scandinavia or at least you are free to make it look like any house in Scandinavia. Better up, you are free to build it in any form if the standard square box doesn't fit your idea of a beautiful house and you don't have to conform to the basic shape of an Earthship. This will give you a better working house than an Earthship and you will be able to be just as much off grid. And, in the case of anyone for some reason likes having only south facing windows they just have to make sure they have some insulated spacing in between them and if you like the idea of the roof continuing

down on the north side (as with the effect of the earthen berm in the Earthship concept) you are free to make a roof that achieves this by extending all the way down to the ground with a green roof melting the house into the landscape, giving the design a basic Earthship look, but this will NOT be an Earthship but will work one hell of a lot better. Just remember to give your roof design a nice overhang to shade the south windows from the summer sun but at the same time let the low sun during winter in, and that also protects your plaster from direct rain as much as possible.

We have coined a new term – [Flagship](#) – which means an off grid house, built using natural healthy materials locally sourced, designed to be optimized for its specific climate. The Earthship concept COULD be a New Mexico Flagship as there are little or no trees to use as building materials thus making the rammed tyres a good solution, you have huge amounts of dirt and many sun hours during both summer and winter thus passive solar design with large amounts of thermal mass to store all that free heat from the sun, you have very polluted ground water, thus rain water harvesting. So it is a good solution for areas like that but when you go to Sweden or Scandinavia in general you will find lots and lots, miles after miles of just trees, you will have harsh winters with very few sun hours, thus insulation is very important, you have the cleanest ground water in the world, thus a well is a much better option than rain water harvesting.

So when building a house, no matter where in the world, look around you and see what you have to work with and design your house accordingly. Don't take a model and try to force it to work in all climates because that's not a logical approach and it's not energy or time efficient.



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