



# Earthship

## BIOTECHTURE

[www.earthship.com](http://www.earthship.com)

michael reynolds



# **S**USTAINABLE **A**UTONOMY **F**OR **E**VERYONE

Michael Reynolds has been a world leader in sustainable architecture for over 40 years. He designs and builds fully self-sufficient homes made from a significant amount of natural and recycled materials. These homes are called Earthships and have been built around the world. Earthships heat and cool themselves passively, produce their own electricity, collect their own water, treat their own sewage and grow a significant amount of their own food. Michael is responsible for design and systems evolutions, leading his team on disaster relief projects, adapting building techniques to suit any climate in the world and teaching the philosophy behind living harmoniously with the planet. He is the initiator of three Earthship Communities, author of seven books, subject of the feature length documentary *Garbage Warrior* and the drafter of the Sustainable Development Testing Sites Act. In 2011 he founded the Earthship Biotecture Academy to educate students from around the world.





# History



Michael Reynolds came to Taos, New Mexico after finishing Architecture School in 1969. At the time Taos was still the “Wild West” with a pioneer spirit and no building regulations. Inspired by television news stories on the problem of trash and the lack of affordable housing, Michael created the “can brick”. 10 empty cans wired together, 4 flat and four unflattened, wired together to make a free brick, a free unit of space with which to build. Continuous experimentation with these ideas eventually evolved into what is now known as Earthships.

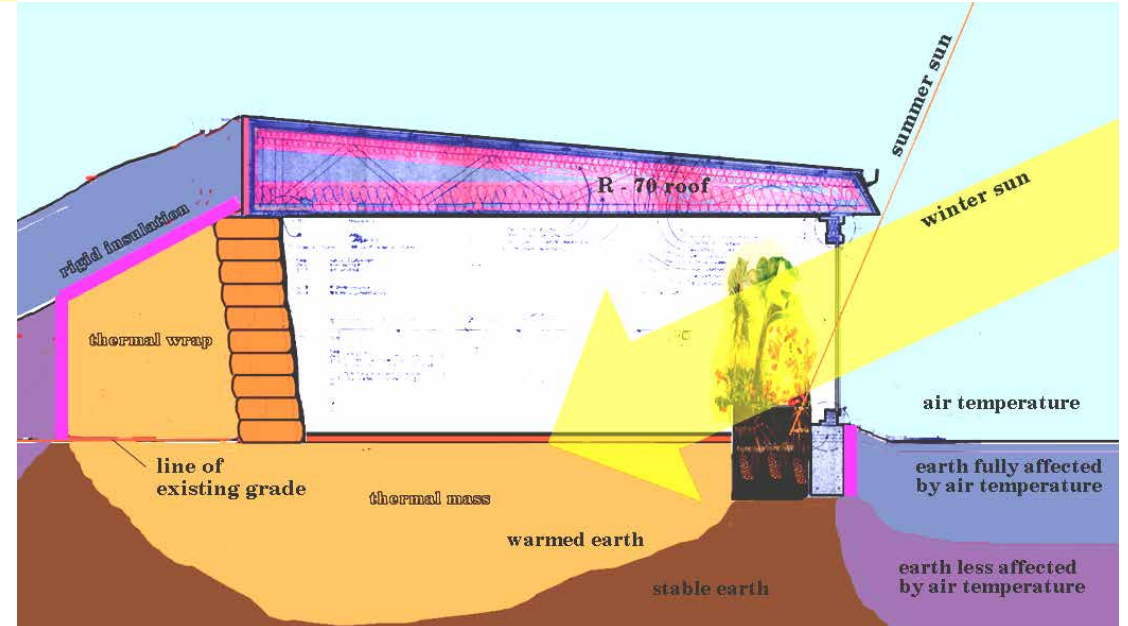


# Principles Recycled Materials



The walls of an Earthship are built with used automobile tires rammed with earth. These walls are the load bearing walls for the roof and also serve as the foundation for the building. These building blocks are filled and compacted in place and staggered like bricks. Each Earthship uses between 500-5,000 tires. Small interior walls of the Earthship may be made from aluminum cans or glass bottles. Earthen plaster (adobe) is used for the interior of many of the buildings. Other Earthship projects have incorporated sheep's wool insulation, metal paneling from discarded household appliances, adobe bricks for interior walls, straw bales as insulation for unburied tire walls, and reclaimed materials from demolition sites, etc

# Principles Solar Heat



This building heats and cools itself naturally without burning fossil fuels or having any utility bills. The constant temperature of the earth itself helps stabilize the building. The living spaces are surrounded on three sides with thermal mass in the form of used automobile tires rammed with earth. More earth is buried behind these walls, then insulated. In the winter, glass along the whole south side of the building allows in more sun, which heats the mass of the very thick walls. When the temperature in the room drops below the temperature in the walls, heat is released into the space. In the summer, with the sun high in the sky, direct light enters only in to the area designated for plants. The natural temperature of the earth cools the building. Natural ventilation from operable windows, skylights and vent tubes provide additional cooling.



# Principles Energy Collection



This building is completely “off the grid” meaning it is not attached to any main utility lines. It produces all of its electric power with solar panels (windmills can also be used). These onsite renewable energy sources charge a bank of batteries in the systems room. The Power Organizing Module distributes energy from the batteries throughout the house. Super efficient lighting, pumps and refrigeration reduce the energy load. Natural lighting and natural heating and cooling are also part of “designed down” energy requirements.

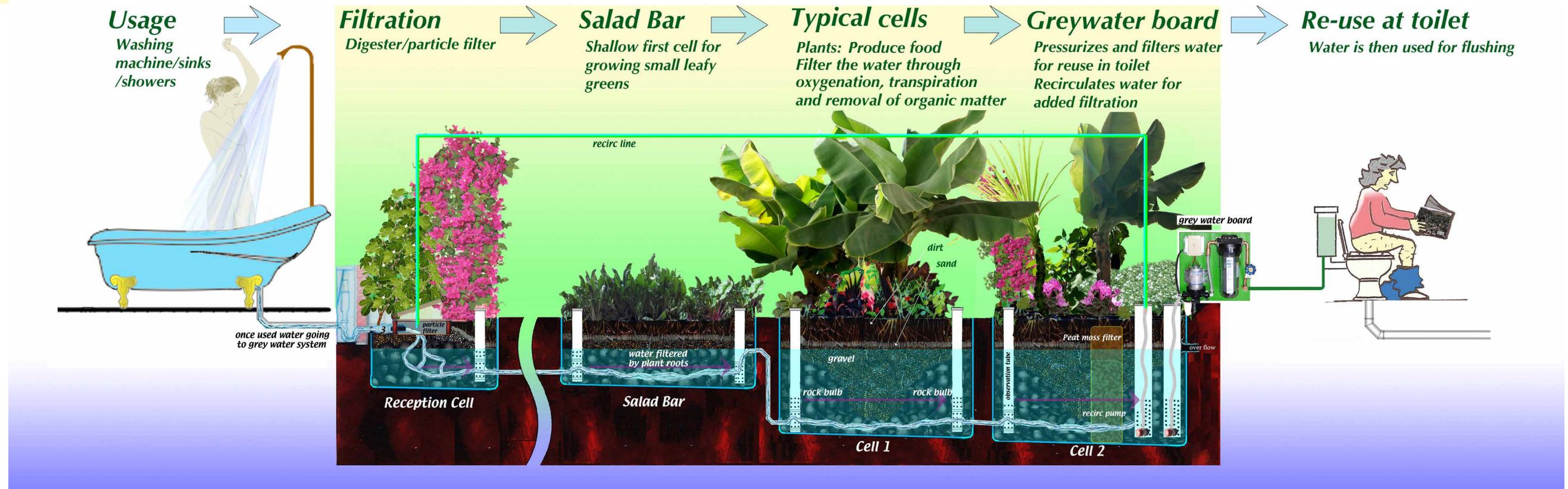
# Principles Water Harvesting



Every Earthship harvests all of its own water from rain and snow that falls of the roof. This water is stored in cisterns buried outside the building. The water then gravity-feeds a panel called the Water Organizing Module. This unit filters, pressurizes and pumps the water to fixtures throughout the building and to the solar hot water heater mounted on the roof. An Earthship uses all of its water four times. This water harvesting help preserve existing aquifers and may be used in climates that get as little as 8 inches a year of annual precipitation.



# Principles Water & Sewage



An Earthship uses all of its water four times and treats it on site in contained sewage treatment planters. Once-used water from the sinks and shower travel through a grease and particle filter into interior grey water treatment planters. As the grey water travels through the rubber lined planters it grows plants, is aerated by the plant roots and cleaned up enough to be used for toilet flushing. A pump panel at the end of the planter draws cleaned grey water from a well and fills the toilet tank for flushing. The black water from the toilet then goes outside to a conventional septic tank which overflows in to a rubber-lined planter. Plants are grown with black water and ground water supplies are protected from contamination.



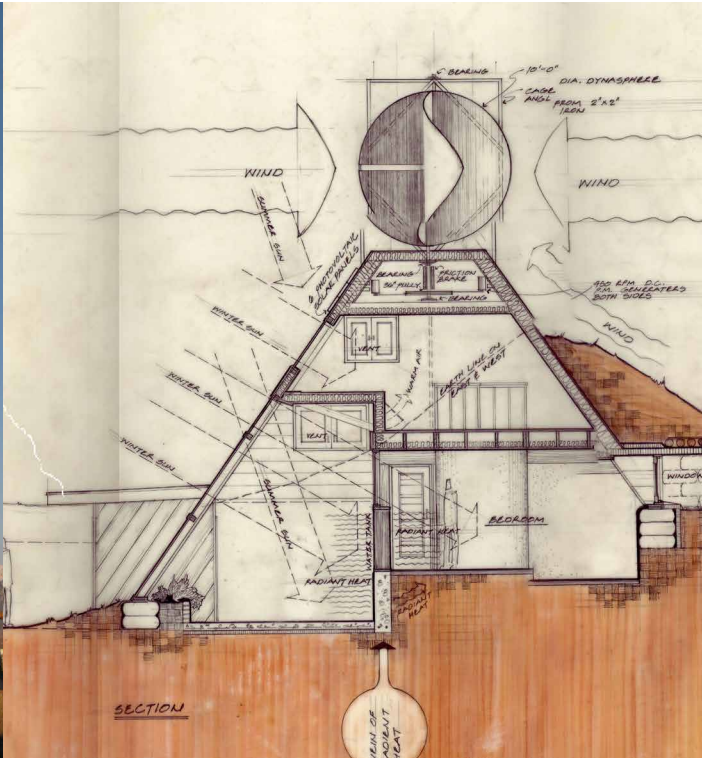
# Principles Food Production



In an Earthship's interior grey water planters you are able to grow food year round. Tropical plants such as banana trees and hibiscus flourish even when there is snow outside. Earthship residents pick fresh and organic produce for any meal! The latest Earthship design, the Phoenix, features expanded capabilities with a second greenhouse, tilapia pond, and over one-third of the total square footage dedicated to food production



# Dynasphere



The Dynasphere is the fourth generation of a vertical axis windmill designed by Michael Reynolds. Earlier models produced power for 20 years. These windmills have two 1.5 KW generators and can produce electricity at very low speeds. They are quiet, reliable and need very little maintenance. There will be a dynasphere for power production on the Czech Earthship project.



# The Nautilus



The Nautilus Earthship design was based on the Fibonacci series and the floor plan resembles a chambered Nautilus shell. It was built from the ground up on a lava rock site with rammed earth tires sheathed in straw bales. The spiral shaped floor plan wraps around a bedroom loft with a fireplace. The tire wall bends back in reverse to form a cistern for water storage.



# The Hut



The Hut Earthship is two Earthship Hut Modules connected by a sloped face greenhouse. This design evolved after a hurricane-relief project in Honduras. The Huts are built with circular shaped rooms built with tire walls. The domed roof structures are built on the ground with steel rebar bent, wired together, sheathed in wire mesh and lifted in place on top of the tire walls. The roof is then plastered with cement.



# Hybrid Model



The Hybrid Earthship combines the simplicity of the Packaged Earthship with the sculptural qualities of the Modular Earthship. The Hybrid Earthship design was used both in Taos, New Mexico and Brighton, England. The round bedroom is a Hut Earthship Module and could be built as a small stand-alone shelter for disaster relief or built and later added on to. The Hybrid also marked the beginning of experimenting with the double greenhouse concept. The outer angled glass provides an area for water treatment and food production while also creating a thermal buffer between the inside living space and the outside temperature.



# Global Model



The Global Earthship design evolved from an Earthship project in Normandy, France in 2007. The Global Earthship is aimed at performing in almost any climate around the world. The main evolutions to this design include a north-sloping roof to simplify construction and the use of underground cooling tubes and convection skylights which work together to provide ventilation and natural air conditioning for the building. The Global Model Earthship has been built in Holland, Mexico, Canada and across the USA. Plans are underway to build an Earthship City based on the Global Model Earthship in Turkey.



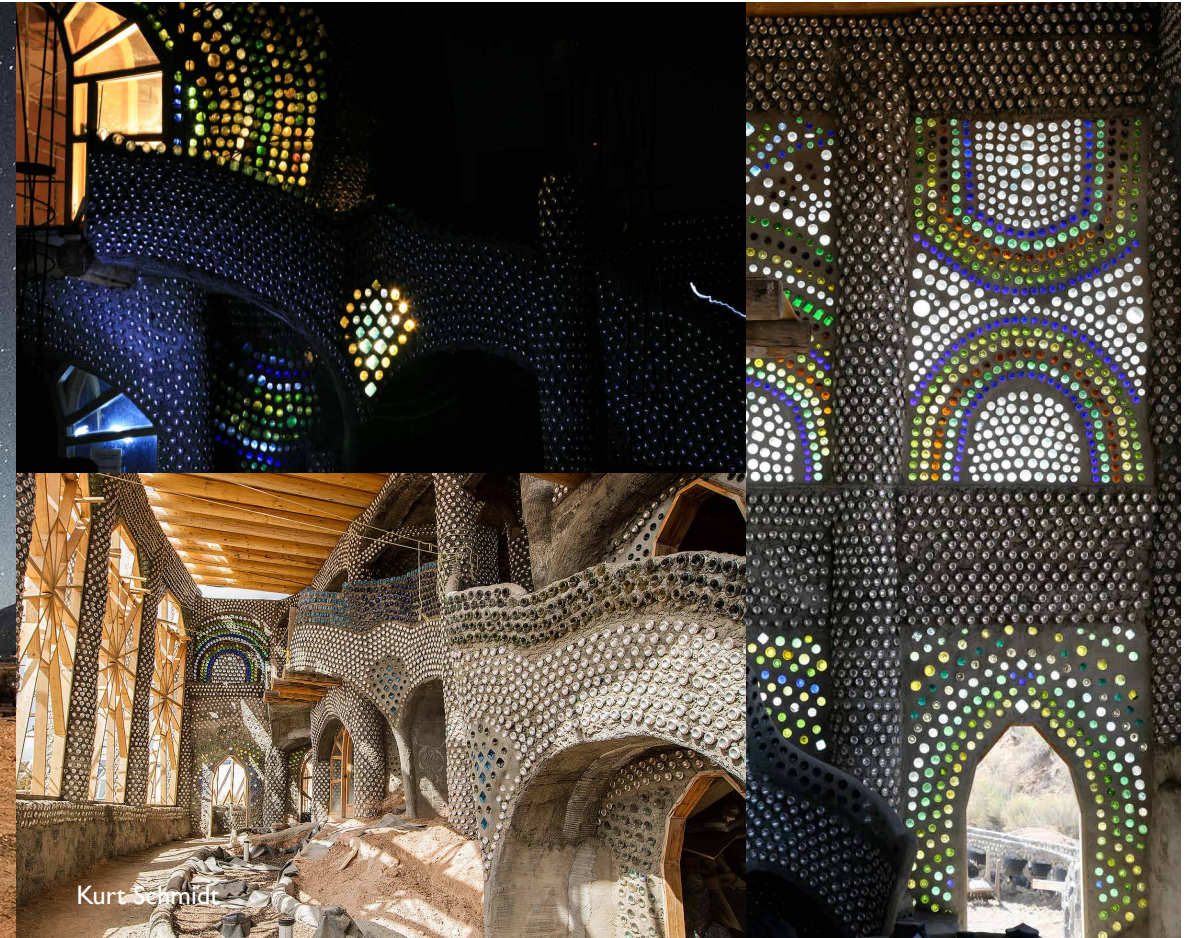
# The Phoenix



The Phoenix Earthship is a 5300 square foot custom Earthship based on the “U” module. The building has over 1/3 of its area dedicated to food production. It has 3 bedrooms and 2 bathrooms and has been an Earthship nightly rental since 2006. People from all over the world have come to stay in it for a night or more to experience off-grid living in a luxurious environment.



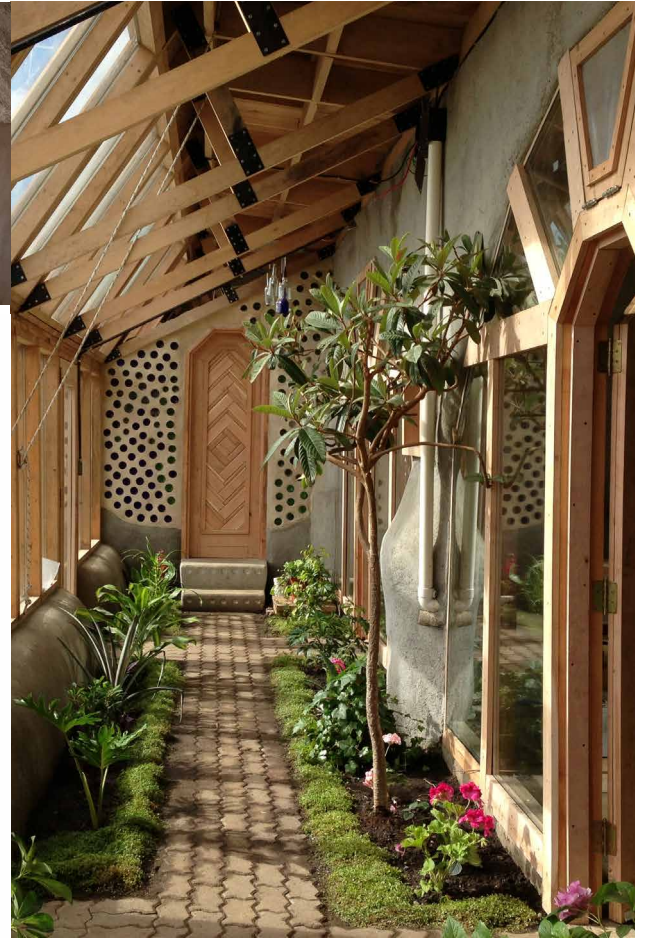
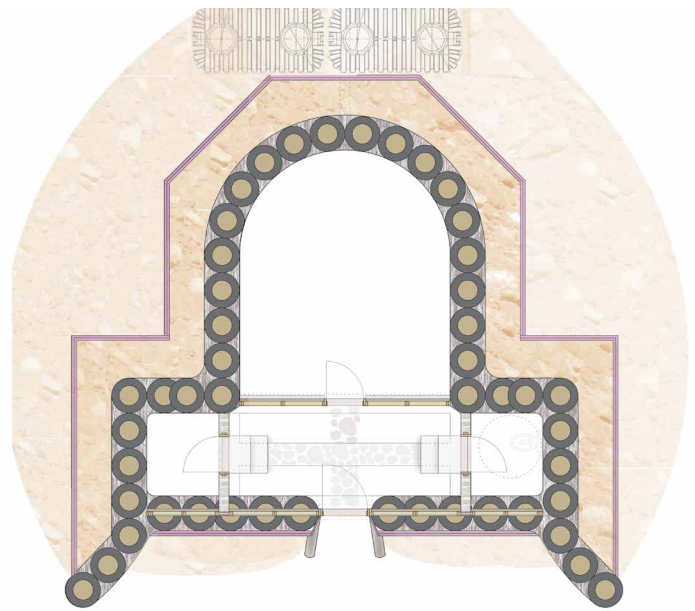
# Earthship Village Ecologies EVE



EVE is a planned high-density community where 25 people will live, work and grow their own food. This is an attempt to address an additional issue beyond power, water, sewage, and comfort...the economy. This project is located on the world's first Sustainable Development Testing Site. Michael Reynolds' fight to get the law for this site passed is the central story in the documentary, Garbage Warrior. On this test site we are able to experiment with methods of sustainable living without having to go through the conventional permitting process. This helps evolve systems more rapidly and bring down costs.



# Simple Survival



The Simple Survival Earthship is designed to provide comfortable shelter, clean water, contained sewage and basic solar power for lights and charging small electronics at a very low price. This building uses simple systems developed for the earthquake-relief demonstration project in Haiti. The Simple Survival Earthship is based on the "U" module and can be built with one, two or three rooms. The Earthship Academy build the first Simple Survival then another was built in the Czech Republic by the crew and volunteers.



# Earthship Demonstration Projects



Earthship Biotecture has designed and built successful projects that demonstrate sustainable, autonomous technology in: Japan, Bolivia, Scotland, Belgium, England, France, Spain, The Netherlands, Guatemala, Nicaragua, Jamaica, Bonaire, Canada and China. Earthship Biotecture has also built Disaster Relief projects in Honduras, Mexico, India (after the tsunami) and Haiti (after the earthquake). Current projects include a school in Sierra Leone, an earth monastery in the Czech Republic, a home for a wildfire victim in Australia and a residence in New York City.



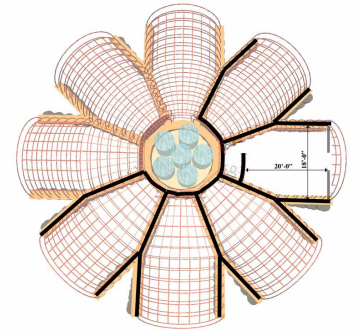
# Demo Build Haiti



After the devastating earthquake in Haiti, Earthship Biotecture was invited to build a demonstration project on the grounds of an existing non-profit in Port-au-Prince. During the time in Haiti, Earthship Biotecture trained 30 Haitians the techniques of building self-sufficient housing from garbage and rubble from the earthquake. The greatest advances in Earthship systems happened on this project in the realm of simple survival. Power and water systems were streamlined and built for a small fraction of the cost required in a “first world” home.



# Demo Build Sierra Leone



In October 2011, Michael Reynolds led a small team from Earthship Biotecture to Sierra Leone to begin construction of a Waldorf School for local children. The team was assisted by intern volunteers from around the world and by local people who learned how to replicate the design. The floor plan for this building was based on an 8 petaled flower. Each petal will be a classroom. Over the course of two weeks, the team completed 2 of the classrooms. By December, the local crew had completed 2 more “petals” (classrooms). Michael Reynolds believes this to be the most successful Earthship Demonstration Project to date as the locals have been able to replicate the design and continue construction after the crew’s departure.



# Earthship Academy



The Earthship Academy was founded in 2011 and is an international school dedicating to teaching the philosophical, scientific and pragmatic concepts behind Earthship construction. Students spend time in the classroom and on construction sites learning how to build completely off-grid structures from natural and recycled materials. The Earthship Academy campus is located in Taos, New Mexico with plans underway to open up a second campus in the Southern Hemisphere.



## Photo Credits

Michael Reynolds

Kirsten Jacobsen

Bert Eke

Michelle Locher

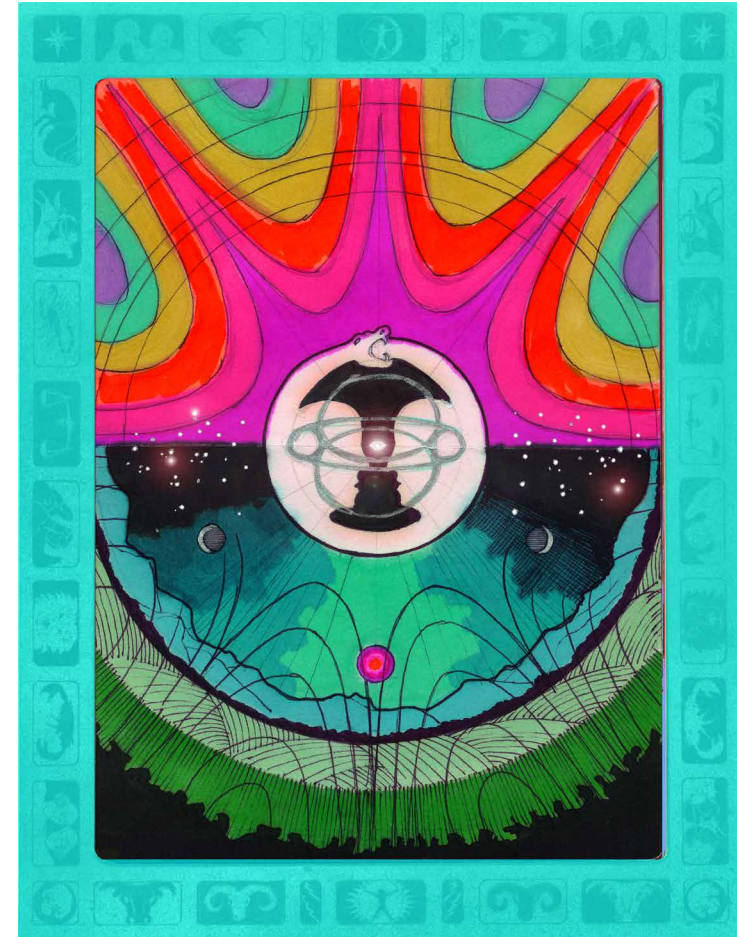
Patrizio Sorrentino

Jonah Reynolds

Alix Henry

Wei Quek

Kurt Schmidt



*"Caring is the seed of a new Reality."*

- michael reynolds



This book was designed  
on computers powered by the sun



**Earthship**  
BIOTECTURE