Earthship Biotecture

Earthship Biotecture

„Earthship“ definition - An Earthship is a type of passive solar house that is made of both natural and upcycled materials such as earth-packed tires, pioneered by architect **Michael Reynolds**.

The term Earthship, is derived from the homes being in and of the Earth - constructed responsibly out of earthen materials and also refers to living in a ship, which requires inhabitants to be autonomous from outside help.

sources: https://www.earthshipglobal.com/projects, https://www.scientificamerican.com/article/earth-talks-earthship/

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Michael Reynolds,

the founder and creator of the Earthship concept, is an American architect based in New Mexico.

He is an advocate of "radically sustainable living" and is known to be critical of the profession of architecture for its adherence to conventional theory and practice. He promotes the reuse of unconventional building materials from waste streams, such as automobile tires, and is known for designs that test the limits of conventional building codes.

sources: https://alchetron.com/Mike-Reynolds-(architect)

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Michael Reynolds,

Inspired by television news stories about the problem of trash and the lack of affordable housing his designs constantly evolved to incorporate thermal mass, passive solar and natural ventilation.

sources: https://www.earthshipglobal.com/projects

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The term Earthship, came to refer to any of the several passive solar houses based on the design principles developed by Michael Reynolds to promote sustainability.

Reynolds goal was to create a home that would do three things:

first, it would utilize sustainable architecture, and material indigenous to the local area or recycled materials wherever possible;
second, the homes would rely on natural energy sources and be independent from the "grid";
thirdly, it would be feasible for a person with no specialized construction skills to build.

sources: https://taos.org/places/earthship-biotecture/

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The designs have been used around the world, and about 3,000 Earthships have been built, most of which are located in the United States.

sources: https://www.britannica.com/topic/Earthship

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Reynolds's buildings use wind turbines, solar panels, and biodiesel generators to generate energy for heating and cooling.

Each Earthship features a giant cistern designed to catch rainwater from the roof and transfer it to a Water Organization Module (WOM) that both purifies drinking water and transports wastewater to living plants scattered both inside and outside the building.

sources: https://www.britannica.com/topic/Earthship

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In order to achieve maximum sustainability, the rear walls of Earthships are typically covered by dirt or are built directly into hillsides to promote the generation of passive energy.

In the Northern Hemisphere, the structures generally face south to absorb maximum heat, and the slanted southern walls are usually made of glass, a material rarely used elsewhere in the structures.

sources: https://www.britannica.com/topic/Earthship

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Outside walls are often constructed of two rows of recycled aluminum cans separated by insulated air space and then covered with materials such as adobe,whereas inside, walls are made of old tires filled with dirt, and open spaces are often filled with recycled aluminum cans or bottles. The interior walls are covered by adobe, plaster, or stucco.

sources: https://www.britannica.com/topic/Earthship

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Earthships are generally built below the frost line, allowing the temperature of the internal mass walls to be naturally maintained at around 15.5 degrees Celsius regardless of the weather outside.

In Reynolds's home in Taos, New Mexico, where the summer temperatures are generally high, the internal temperature of his Earthship ranges from 18 to 24 degrees Celsius without using outside resources. The heat absorbed by the walls during the day is retained for hours after the sun sets, and the design of the walls ensures that they slowly release heat as the internal temperatures drop.

sources: https://www.britannica.com/topic/Earthship

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In the mid-1990s, Reynolds built three Earthships near Taos: Lemuria, located in the nearby desert.

By the end of the decade, there were around 20 contractors in North America building Earthships, and independent home builders were able to erect Earthships for less than $100,000 by studying with Reynolds's firm, Solar Survival Architecture (later Earthship Biotecture).

sources: https://www.britannica.com/topic/Earthship

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Some of the major selling points included the Earthship's self-sufficiency and its low operational costs.

The project also spread to Canada in the 1990s,
as environmental activists Pat and Chuck Potter set out to adapt Reynolds's design for the long Canadian winters after studying with him in Taos.

Cold-adapted homes have in turn served as models for Earthships in Belgium, the Netherlands, the United Kingdom, southern Argentina, and other temperate locations.

sources: https://www.britannica.com/topic/Earthship

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Earthship design principles

Earthships are defined by six basic design principles,
all of which take advantage of existing natural phenomena

- Building with natural and repurposed materials
- Solar and wind electricity
- Water harvesting
- Contained sewage treatment
- Thermal/solar heating and cooling
- food production

sources: https://www.earthshipglobal.com/design-principles

Earthship Biotecture

1. Building with natural and repurposed materials

Earthships incorporate many natural and reclaimed materials in their construction. Tires are used as a rammed-earth brick. With at least 2.5 billion currently stockpiled in the United States, with 2.5 million more discarded every year, there's no shortage of used tires. According to Reynolds “Tires can be seen as a globally available natural resource."

sources: https://www.earthshipglobal.com/design-principles

Earthship Biotecture

1. Building with natural and repurposed materials

Other materials such as cans and bottles are optional, although bottle brick walls are a familiar stand-out feature of many Earthships.
All interior walls are packed out between the tires and plastered with adobe mud. Mud can also be used for floors, and reclaimed wood and metal are often used.

sources: https://www.earthshipglobal.com/design-principles

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2. Thermal/solar heating and cooling

At their most fundamental, Earthships are structures that heat and cool themselves without electric heat, burning fossil fuels or wood.

By using thermal mass and solar gain, Earthships are capable of maintaining a comfortable temperature without additional fuels in any climate in the world. The tire-bricks that function as thermal mass bricks and make up the structural walls of the building, weigh around 140 kg each, are pounded into place and staggered like bricks to form the load-bearing walls for the roof.

The tires are also wide enough to eliminate the need for a concrete foundation.

sources: https://www.earthshipglobal.com/design-principles

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2. Thermal/solar heating and cooling

The densely packed walls, considered to be self-supporting monolithic walls, also store temperature (heat or cold) because their solidity imbues them with the quality of thermal mass.

The basic idea is to surround each living space with mass on three sides and line the south side of the building with windows. This way sun can enter through the glass and heats up the mass of the floors and walls. In the evening, when the air temperature drops below the stored wall temperature, heat is naturally released into the space. In the summer, with the sun high in the sky, the building stays cool with the constant temperature of the earth. The cooling is further enhanced with natural ventilation through buried cooling tubes and operable vent boxes.

sources: https://www.earthshipglobal.com/design-principles

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3. Solar and wind electricity

Every building has its own renewable “power plant” with photovoltaic panels, batteries, charge controller, and inverter. The key step in making these systems affordable for residential use is to “design down” the electrical requirements of the home before the solar system is sized. Super efficient lighting, pumps, and refrigeration help lower the load, as does the lack of any need for electric heat or air conditioning.

sources: https://www.earthshipglobal.com/design-principles

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3. Solar and wind electricity

Add in daylight from the windows and skylights and awareness of trickle drains and phantom loads, and an Earthship's electrical needs are about 25 percent of that of a conventional home. Most residents can meet their demand with one kilowatt or less of energy from solar panels.

Some owners also opt to add a small windmill to the system for gray, stormy climates.

sources: https://www.earthshipglobal.com/design-principles

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4. Water harvesting

Earthships collect all of their water from rain and snowmelt on the roof, storing this water in cisterns. Water from the cistern feeds a pump and filter system that cleans the water and sends it to a solar hot water heater and also to a pressure tank. From there, water is used for bathing, washing dishes, and laundry.

sources: https://www.earthshipglobal.com/design-principles

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5. Contained sewage treatment

The used gray water flows to interior botanical cells, where plants use up and treat the water until it's clean enough to be collected in a well at the end of the planter and pumped, on demand, to the toilet tank for flushing. The toilet water then goes to a conventional septic tank, which overflows into an exterior rubber-lined botanical cell filled with exterior landscaping plants.

sources: https://www.earthshipglobal.com/design-principles

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6. Food production

Interior, in-home, organic food production is the most recent design principle added to the Earthship concept. Earthship Biotecture employs a plant specialist who has experimented with the best plants for the interior gray-water botanical cells who has also designed mini-hydroponic planters in suspended buckets that have added vertical growing space in the greenhouses and have tremendous yields of herbs, peppers, tomatoes, kale, beets, cucumbers, and more.

sources: https://www.earthshipglobal.com/design-principles

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Earthship Movement

Earthships are self-sufficient homes built of recycled tires that try to embody the core values of sustainable living. They generate their own electricity, maximize solar heating and use only rainwater.

The issue is that Earthships tend to be built by people who want to live an alternative lifestyle, in remote areas where there are no utilities to begin with.

sources: https://www.nbcnews.com/id/wbna21755230

Earthship Biotecture

Earthship Movement

But most people live in cities and are fond of their modern conveniences. This is why Diego Mulligan of New Village Institute, (a non-profit organization promoting sustainable living) and others are trying to apply the ideas from earthships and other sustainable designs to communities that the majority of people could imagine living in.

One such development has begun construction in Santa Fe, N.M.
It's called Oshara Village and although there won't be any recycled tires, there will be solar heating and water reclamation. And unlike most earthships, there will be restaurants and businesses all within walking distance.

sources: https://www.nbcnews.com/id/wbna21755230

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Earthship Movement

The mainstream application of sustainable practices is the underlying principle of Oshara Village.

Built around a central plaza, the development's 470 acres will eventually have more than 750 housing units, priced around half a million dollars each. But interspersed between the homes will be restaurants, shops and offices.

sources: https://www.nbcnews.com/id/wbna21755230

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Earthship Movement

Some of the main ideas include cutting out driving by making Oshara a walkable community. Further, windows and walls will be positioned so as to let in winter sunlight, while providing shade in the summertime. And regarding water use, every drop that goes down a sink or toilet will be reused, either for landscaping or for toilets in commercials areas, reducing water consumption by half.

New Village Institute ran a study and found that residents of Oshara Village could lower their total energy bill — for car and home — by about 50 percent, as well as reduce their carbon footprint by 26,000 pounds of carbon dioxide per year.

sources: https://www.nbcnews.com/id/wbna21755230

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Earthship Movement

To promote sustainable building techniques, Earthship Biotecture offers extensive educational and training opportunities globally incorporating off-grid design principles, construction methods, and philosophy.

sources: https://www.earthshipglobal.com/academy-sessions

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Earthship Movement

This offer includes Academy classes, labs, tours, and hands-on construction techniques led by top Earthship builders, electricians, plumbers, and plant specialists. The Earthship Academy offers education for those who are excited to learn and live the Earthship philosophy and help expand it globally. The Academies happen several time a year in Taos, and sometimes also in different countries but according to the website (www.earthshipglobal.com) the core of the program and the quality of the teaching is always the same.

sources: https://www.earthshipglobal.com/academy-sessions

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Earthship Movement

The Earthship Biotecture Academy partners with Western Colorado University's two-year Master in Environmental Management graduate degree, allowing participants in the academy to earn undergraduate credit to be applied to their bachelor's degrees in universities across the world.

sources: https://www.earthshipglobal.com/academy-sessions

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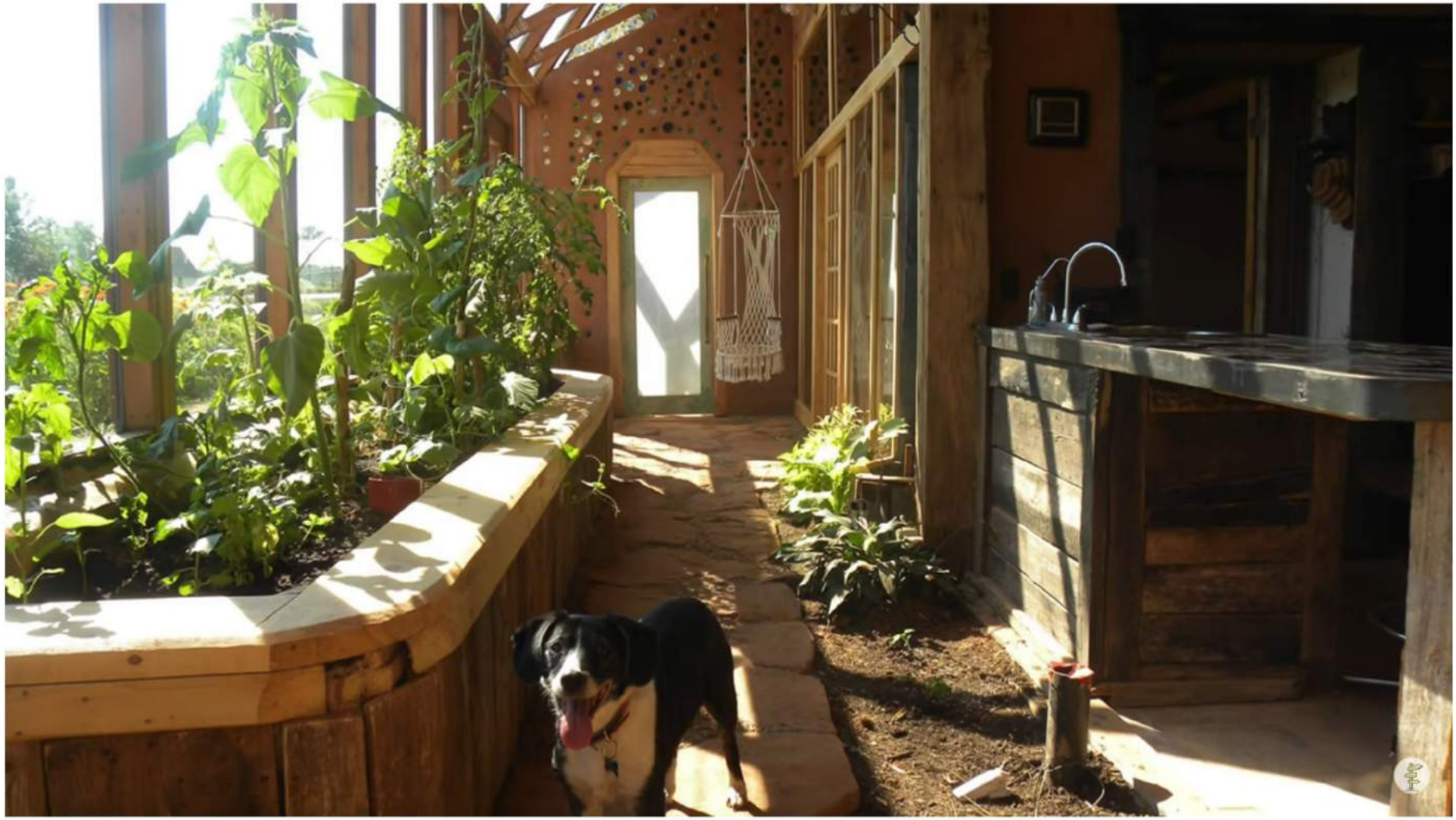

sources: https://www.youtube.com/playlist?list=PLslKBpzJILeszhgpmnHfNQwoRgAcXYBXr

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Video link: https://www.youtube.com/watch?v=xOUa78kH3k4&t=283s

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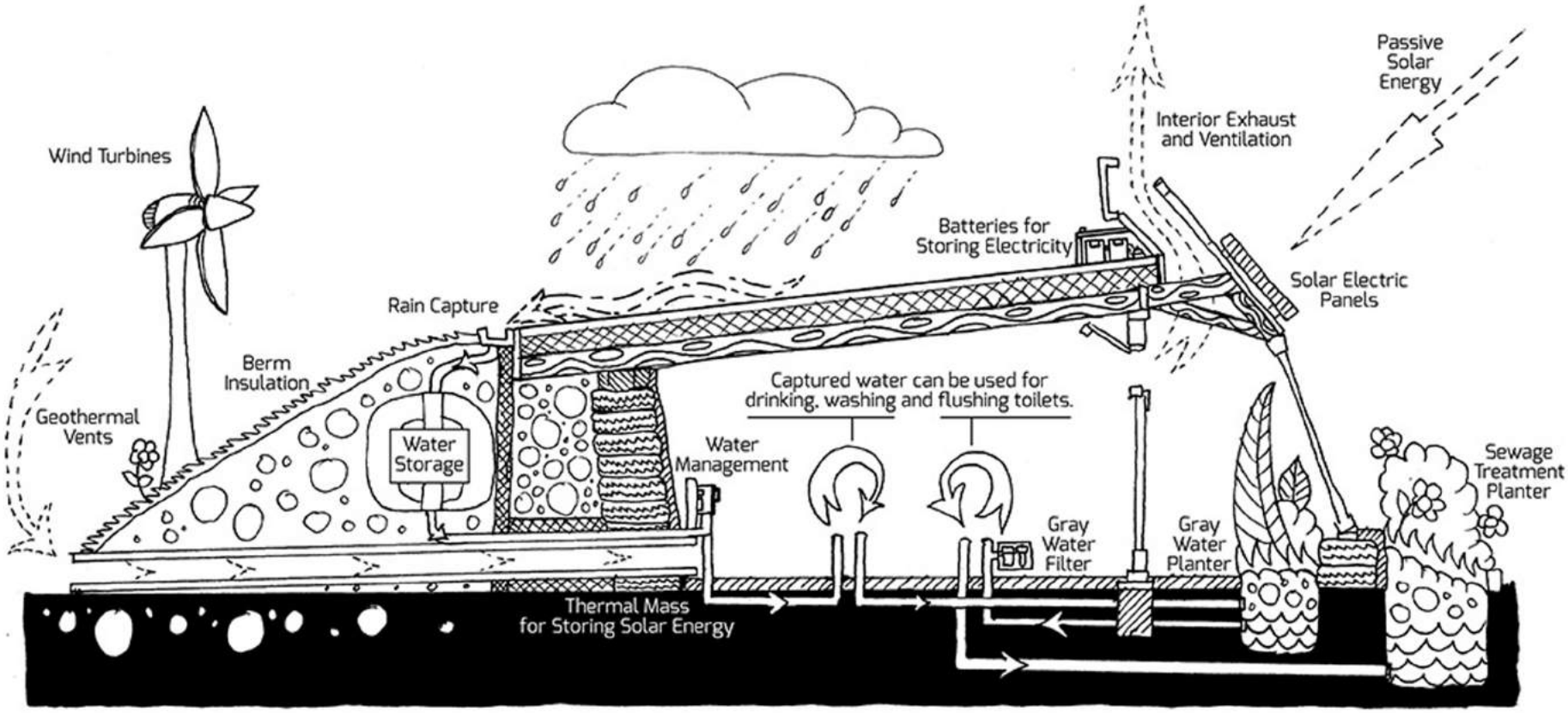

sources: https://earthshipbiotecture.com/three-earthship-questions/


thank you for your attention