Building Green With Black Tires

Jon Hagar

Designer & Builder of first of a kind tire bale house

http://www.hagartirebales.com

Our Story

- What and Why
- Biomimicry
- Our Implementation
- Systems view
- Data
- Picture show
- Lessons Learned
- Q&A

What is a tire bale house and Why would anyone build one?

- **WHAT?**
  - **A house built using tire bales as the foundation and structural support while providing thermal mass**
  - **<u>Not</u> the same as Earthship technology**
    (Compare Dennis Weaver's Earthship
    (3,000 tires + >350,000 aluminum cans in 8,500 sf) to ours
    (17,000 tires + >1,000 cans + >1,000 plastic jugs, bottles, plates + >200 wine bottles in 2,700 sf)
- **WHY?**
  - **Our solution to "going green" and have greater environmental impact**
  - **Offers one solution in building technology that also makes use of human's trash**
  - **To demonstrate the technology and provide a proof of concept**
  - **Showcase possibilities**

Tire Bales

Tires in a landfill or baled in the walls of a home?

Photo courtesy www.eagle-equipment.com/enviroblock.html

~100 used tires
compressed under ~35,000 lbs
pressure into a bale form
~ 5.5 x 5.5 x 2.5 feet
and weighs approx. 1 ton
held together by 5 steel bands
and can be stacked like bricks

- Why not turn used tires into something useful?
- Why not use something so prolific in our world?
- Why not re-use society's trash instead of creating something "new" all the time, which creates more waste in the waste stream?
- Why not?

Thermal Mass

- Thermal mass equivalent to solid material's ability to heat itself in sunlight
- Our home heats itself the same way the hillside it sits on does
- Thermal mass is a benefit of passive solar design
- Instead of paying utility company to heat, why not use what is available & free?

Surrounding earth + tire bales + concrete/slab + total building structure = Our Home's Thermal Mass

Thermal Mass provides non-mechanical heat storage and regulation

Biomimicry

- ***"NATURE DOES NOT BUILD WITH COLUMNS AND BEAMS, BUT WITH LAWS OF GROWTH. ITS CONSTRUCTIVE LOGIC IS THE SAVING OF ENERGY, ADAPTABILITY AND FLEXIBILITY"***

Lessons of Biomimicry taken from

-- http://www.cerveraandpioz.com/bionic_megacities_v.htm

Biomimicry – Model, Mentor, Measure

- Biomimicry (from *bios*, meaning life, and *mimesis*, meaning to imitate) is a design discipline that seeks sustainable solutions by emulating nature's time-tested patterns and strategies, e.g., a solar cell inspired by a leaf.
- The core idea is that Nature--imaginative by necessity--has already solved many of the problems we currently are facing.
- **Model**: Biomimicry is a new science that studies Nature's models and then emulates these forms, processes, systems, and strategies to solve human problems – sustainably.

  Mentor: Biomimicry is a new way of viewing and valuing nature. It introduces an era based not on what we can extract from the natural world, but what we can learn from nature.

  Measure: Biomimicry uses an ecological standard to judge the sustainability of our innovations. After 3.8 billion years of evolution, Nature has learned what works and what lasts.
  - Thermal mass – Think large animals
  - Solar – Ever see a bird or animal sunning?
  - Natural cooling – termite mounds
  - Recycle – everything in nature tends to recycle what it finds "naturally" – think natures fertilizer
  - Natural products – clay, silicon, earth, sun

Our Implementation

- Tire Bales as foundation and structural support, Thermal mass, as well as recycled tire materials
- Tires and other human “trash”
- Natural products: clay, silicon (glass), earth, sun
- Natural “beetle killed” wood








Our Implementation

- **Natural products (beetle killed wood ceilings)**

Our Implementation

- **Solar and natural heating/cooling**

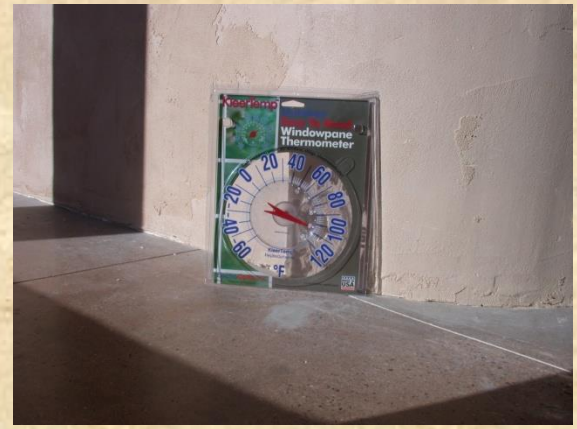
All images taken on same day in Feb. within minutes of each other in the sunshine
Outside AIR temp was ~40 degrees, 90 degrees in the sunshine
Sunny day: outside temp of 5 degrees, inside temp 80 degrees

Master bedroom

Note air temp of
77 degrees
on tire bale wall

Window next to front door

Hall outside master bath

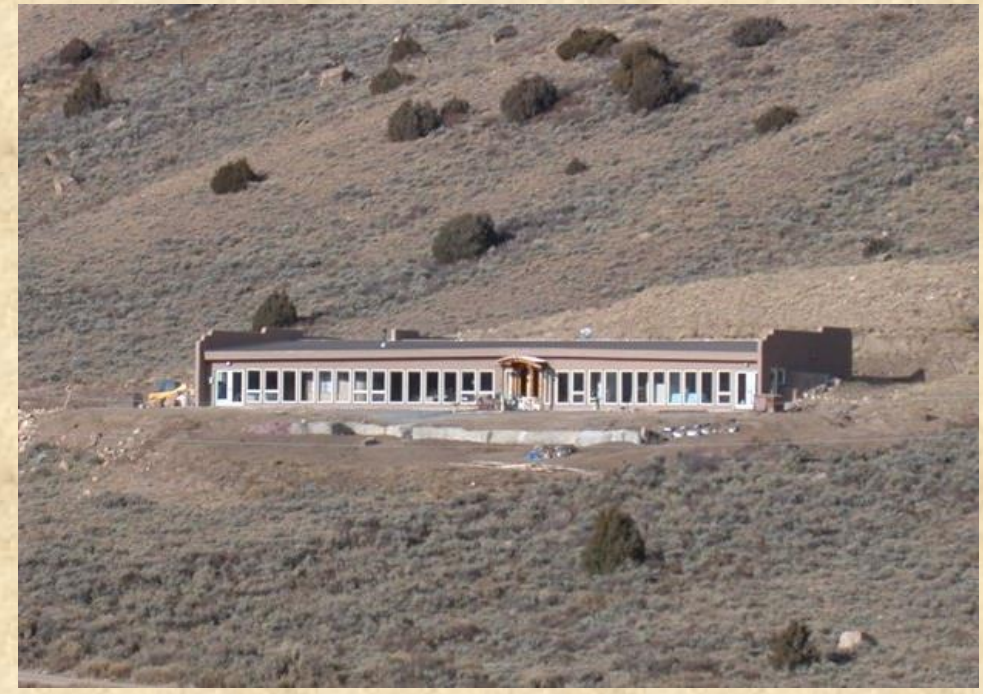


Living room within 2 feet of concrete floor

Window across from kitchen

Our Implementation

- **Thermal Mass**



- Back windows “vent” heat if house gets too hot

- A solid material’s ability to heat itself in sunlight providing non-mechanical heat storage and regulation

Systems View

- House as a whole system with “green” built in
  - Not viewed as green by some governmental agencies (USGBC), companies and publications
    - What do you think?

- Architecture – different but has “smart” house features
- Subsystems
  - PV
  - On-demand hot water (Rheem)
  - Long lasting materials – tire bales, stucco, polished concrete…
- What can be done differently?
  - Make house “thinner” to meet passive solar gain guidelines

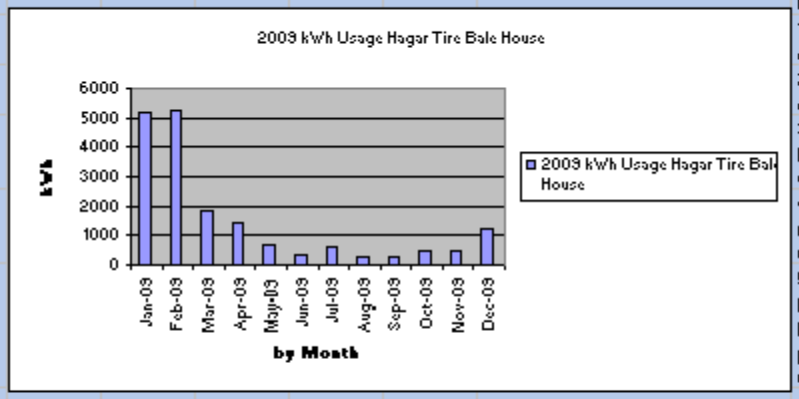
Data

- 17,000 tires in 170+ bales
  - Thermal mass
  - Bales in walls and foundation
- Tire bales were “free” although hauling them was not (tire bales paid for by recycle fees to State of CO from tire installers)
- Primary heat source: solar, secondary heat source: wood stove, backup heat source: baseboard HydroSil (sealed oil) electric heaters (a requirement of building codes)
- + 30% – wood recycled or “low impact” engineered products
- 2,700 Sq ft -- all living areas have solar heat
- 8,270 ft elev.
- Length ~120 feet with 35 windows (22% ratio)
- 53 can lights for interior lighting—all CFLs
- Each living area (bedrooms, living & office) has a string of LED rope lights
- Dec/Jan/Feb lows can be sub zero inside temps average 60+ degrees
- Still working analysis

Data: 2009 Energy Bills

2009 living in house full time

Jan-09	5175	1186
Feb-09	5234	10406
Mar-09	1829	4641
Apr-09	1429	-2566
May-09	679	
Jun-09	371	
Jul-09	616	
Aug-09	298	
Sep-09	268	
Oct-09	461	
Nov-09	476	
Dec-09	1210	
2009 usage (excludes Jan&Feb"")		**7637** **
Jan-10	1967	



Hagar:
Factors for solar sizing:

1) House construction (ceiling not totally enclosed) until Dec. 2009
2) Electric baseboard heat, heat tape, heavy equipment not plugged in daily
3) Triple cell blinds installed west end mid Feb.2009, styrofoam used in east end windows
4)All 2009 figures may not be totally representative of typical kWh usage due to utility billing errors
5) Utility bills are approximately 30 days behind (i.e., March bill is actually for February) and bills are not for consistent periods (could be 20 days vs. 30 or 31 days usage)

Some construction images…from 2005



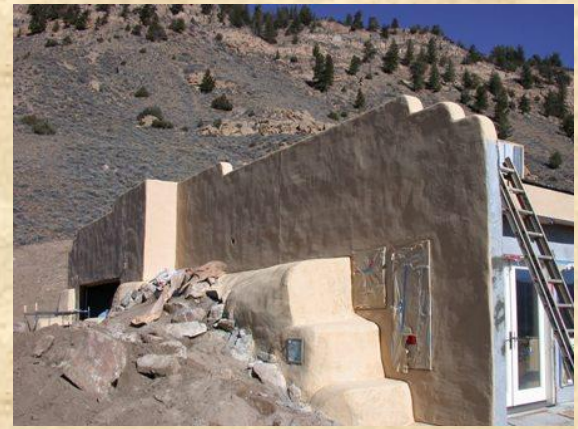






2006 images….

2007 Images



2008 Images





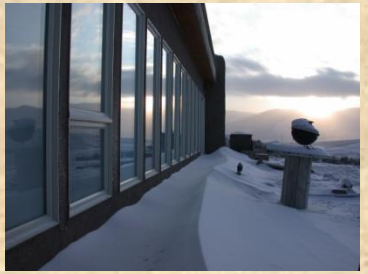




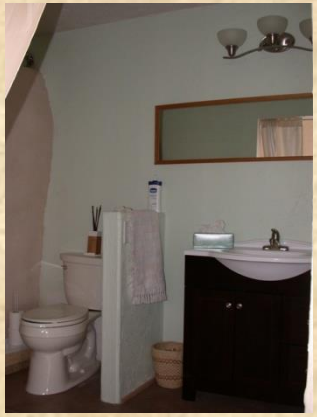





2009 Images



2010 Images



Issues and Lesson Learned

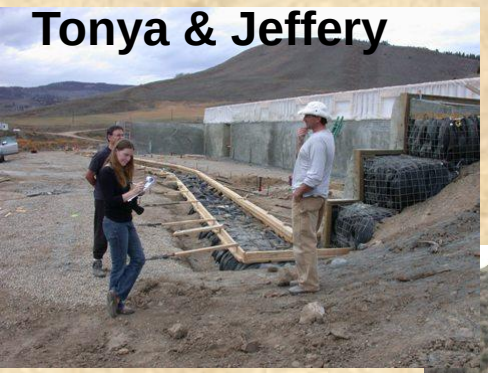
- Many engineer ideals to be “solved”
  - Use Civil Engineer to “work” with Build Dept.
- Banking and Mortgage industry are “clueless”
- More Solar to come – moving toward a zero carbon footprint
- Could be done with less expense
- Takes longer than you plan for it to
- *Be Agile*... plan more, be more specific with contractors, be more insistent with contractors
- The amount of money paid had nothing to do with the quality of workmanship
- Some bumps (will be in “book”)

Thanks to Friends & Volunteer Laborers


Family


Bobby
& Judy


Leonard Jones, P.E.


Tonya & Jeffery


Dr. Art & Trisha

& many others…

From there to here….

- Series of pictures to demonstrate “stacking of tire bale walls to green stucco”
- http://www.flickr.com/photos/26217766@N05/

- Our completed home http://www.hagartirebales.com/

- Our blog https://hagartirebales.wordpress.com/

Why not tire bales…?

Home About Engineering Apps Inquiry Resources Contact

Tire Bales

Finished Tire Bales

In 2003 the State of Colorado generated over 4 million waste tires, and currently there are over 30 million waste tires in inventory in the state as reported by the RMA. Tire Bales are a key product in the tire recycling process with a wide variety of uses.

Specifications of Tire Bales

Tire Bales are a solid compressed block of waste tires. Each bale is made up of 100-120 passenger and light truck tires. One Tire Bale weighs an average of 2,000 lbs. - one ton. The dimensions of the bale are 60 inches wide, 50 inches long and 30 inches high.. There are 5.9 gauge steel wires that hold the Tire Bale together. Each Tire Bale can sustain 375,000 lbs. of pressure before any failure occurs.

Agriculture

One of the largest markets for Tire Bales in Colorado is the agricultural sector. Tire Bales are a very versatile product that can serve a number of purposes. One of the primary uses for Tire Bales are windbreaks. This product makes for a durable long-term lasting portable windbreak. Material storage bins are also a very popular use for this product.

C-DOT

The Colorado Department of Transportation has approved Tire Bales in 2005 for highway construction. Tire Bales have been used in many road and bridge projects, including Texas, New Mexico and New York. The success rate for the Bales in these applications has been exceptional.

From Front Range Tire http://www.frtirerecycle.com/tire_bales.htm where our tire bales came from

Links of Interest

- http://www.touchtheearthranch.com/tirestart.htm
- Leonard Jones, P.E. site http://www.buildwithearth.com/
- http://www.biomimicry.net/
- http://www.biomimicryinstitute.org/
- http://www.biomimicryguild.com/
- http://www.asknature.org/
- www.eagle-equipment.com/enviroblock.html
- Tire bales create windbreak for dairy cows
- http://www.frtirerecycle.com/tire_bales.htm
- www.ecy.wa.gov/programs/swfa/tires/reuse.html
- http://freshare.net/article/the_stanleys_are_building_one_cool_home/

- Inspirations from.....
- Natural Home Magazine http://www.naturalhomemagazine.com
- Dwell Magazine http://www.dwell.com/
- Mother Earth News http://www.motherearthnews.com/

Future?

- **Looking for grants and/or cooperative study opportunities with institutions or universities**
  - **Structure**
  - **Energy**
  - **Carbon Foot Print**
    - **480+ tons of CO2?**
    - **Zero energy foot print – solar, wind**
  - **Where to apply (not every where)**

Summary

- First of a kind
  - Four more tire bale houses in Colorado under construction
- Proof of concept
  - Built on ideals such as Earthship
  - Show place
- Learning….still & every day

- Provide “engineering” for future users

- Many ideals, no one answer to all issues