Why is the Monolithic Dome “Green”?

by Nanette South Clark July 24, 2008, 3:53 p.m. **Benefits-Green Building**

"Dome of a Home"
Pensacola, Florida

Braswell Fire

La Junta, Colorado

Snyder Home

We are often asked, “Why is the Monolithic Dome “Green?” As an answer to this question, we have outlined three of the most salient “green” points: Sustainability, energy efficiency, and use of green materials. The Monolithic Dome is a permanent structure that is easy to maintain, will save the dome owner around fifty percent on heating and cooling costs, and uses the smallest surface area to enclose a space. The Monolithic Dome is one of the most environmentally friendly, green buildings available.

1. Sustainability

Monolithic Domes have real strength. They can withstand the force of a tornado, hurricane or earthquake. They cannot burn, rot or be eaten by bugs. Their lifespan is measured in centuries. Hence they do not need to be replaced.

The Monolithic Dome is a permanent structure that is energy efficient, cost effective, disaster resistant and attractive.

Hurricanes and tornadoes seem to be making more and more headlines around the globe. In recent years, we have seen these forces devastate small and large communities alike. People are realizing the incredible benefit of safe, disaster-resistant housing and shelters.

The Federal Emergency Management Agency (FEMA) has made available to communities literature which provides guidance and technical information educating communities on how to become disaster resistant in the face of natural disasters.

The FEMA manual is a guidance manual for engineers, architects, building officials and prospective shelter owners. It presents important information about the design and construction of community shelters that will provide protection during tornado and hurricane events.

In the article, "FEMA — Design and Construction for Community Shelters and Its Application to Domes," Dr. Arnold Wilson, a prominent engineer and pioneer in thin-shell technology, said, "After reviewing the FEMA requirements for a structure capable of providing a safe shelter for people in areas where hurricanes and tornados represent a real danger, the Monolithic Dome, because of its very nature, heads the list for economy and strength to resist the extreme loads. The reinforced, concrete, double-curve surface of a dome is extremely aerodynamic. Domes have been designed to resist winds of 400 mph. Because of the egg-shaped surface the extreme winds can be resisted usually with only minor increases in materials and labor. Conventional buildings have walls connected to foundations and to roofs with specially designed connectors while a Monolithic Dome is continuously attached throughout with steel reinforcement greatly in excess of that required to resist extreme wind forces. **Therefore, the Dome solves the safety issue by utilizing the entire structure to provide "near-absolute" protection.**"

In 2004, Mark Sigler and a television crew from **MSNBC** decided to "ride out" hurricane Ivan inside the Sigler's "Dome of a Home," in Pensacola Beach, Florida. Valerie Sigler journaled her view of the hurricane during the night: "2:30 AM — The eye of Hurricane Ivan is now making landfall. Pensacola Beach is in absolutely the worst position (upper right hand quadrant – east) as the storm arrives. Most of the MSNBC crew is asleep. Asleep? I guess that is testament to the confidence the crew had in the home and the fact that the noise from the storm was not unbearable. Mark is awake listening as the wind intensifies and the water is crashing across the island. The storm surge and rain caused five feet of water to rise underneath the dome. Mark says he can hear debris crashing into the dome, but does not feel any movement of the dome from the surging Gulf although the water is flowing over the entire island. Although he has no visual confirmation, he said it sounds like there are tornadoes howling around the island. The most unnerving sensation is the realization that there is no land until you reach Gulf Breeze."

In the article "Vacationing in a Hurricane Survivor," Freda Parker wrote, "With batterings from Hurricane Ivan in 2004 and Dennis and Katrina in 2005, Dome of a Home has taken its lickings — and survived them with no significant damage to the dome itself.*"

On August 11, 2002, a brush fire was started in Calamesa, California. The

Braswell Family wasn't home when the fire began. When they arrived home, the fire was nearing their house and the fire captain gave them two minutes to rescue their belongings. The fire soon engulfed their home.

Ruth Braswell commented about that day, "A fire captain from a neighboring county came over and asked, 'What's this thing (the dome) made of?' We told him, and he said, 'Well, you do know that if this structure had been made of normal construction that you would have a pile of ashes now.' He then told us that at one point the firefighters thought they would have to abandon fighting and give up on saving our house. **Then they saw that it could withstand the fire, so they decided that if any of their crew got in trouble, they were going to break the doors down and put the guys in the dome so they would be safe.**"

The only damage to the Braswell home was to the free-form, faux, rock wall about 30-feet long, built to conceal their swimming pool and protect pool equipment.

Ward Huffman, Senior Financial Specialist, Denver Regional Office, U.S. Department of Energy wrote that, "With the Monolithic Dome method of construction, **the homeowner or builder has the opportunity to be fully self-sufficient**. By using photovoltaics and/or wind generators to provide electrical power and ground source heat pumps for heating and cooling, the homeowner can become completely independent from the utility power grid. This fits all of the definitions of sustainability."

He continued, "This method of construction combined with the new technology in the conversion of solar energy to electrical energy, in geothermal heating and cooling, and in energy efficient windows makes it possible for new homeowners to be completely comfortable and self-sufficient – whether they live in California or the Yukon. At the same time, generating noxious emissions, greenhouse gasses and power outages would be eliminated. That truly defines sustainability." (**Click here to see Dr. Huffman's podcast**.)

2. Energy Efficiency

The Monolithic Dome is energy efficient. **It will usually save fifty percent** on heating and cooling costs compared to a comparable conventional building.

Monolithic is an Energy Star Partner. Energy Star is a voluntary program sponsored by the U.S. Department of Energy and the Environmental Protection Agency. Megan Edmunds, Manager of ERHC (Energy Rated Homes of Colorado), rated a Monolithic Dome home in Colorado and wrote that the "…home did pass with flying colors." She gave it a **5-Star Energy Star Rating**!

Perry Gray-Reneberg teaches sustainable industrial technology at Humboldt State University. He asserts that, "The dome's 40-plus tons of thermal mass – the ancient choice for passive solar heating and adobe-style cooling –

lengthens a dome's thermal cycle beyond conventional buildings to a longer cycle, closer to that of the earth's crust. If we add any available energy to the concrete shell, it will radiate back to us – rather than outdoors – when heat sources, like the sun, disappear. Polyurethane foam insulation, efficient windows and doors, along with the barrier Airform, assure that we (not the ambient environment) control the dome's energy cycle."

The U.S. Green Building Council has long recognized the need for green buildings. Recently, they have introduced **LEED for Homes** and **LEED for Schools**. According to the U.S. Green Building Council, "Building green homes is one of the best strategies for meeting the challenge of climate change because the technology to make substantial reductions in energy and CO2 emissions already exists. The average certified LEED home uses 30% to 40% less electricity and saves more than 100 metric tons of CO2 emissions over its lifetime. Modest investments in energy-saving and other climate-friendly technologies can yield homes and communities that are healthier, more comfortable, more durable, energy efficient and environmentally responsible places to live." **Monolithic Domes easily meet the energy saving criteria as detailed by LEED**.

According to David South, President of the Monolithic Dome Institute, the concrete in a Monolithic Dome is isolated from the outside world by insulation. Therefore it is used as a thermal battery. This means heat can be stored in the dome shell and then that heat is available to use at a later time. There is no other structure which offers this advantage.

In 1998, Chuck and Louise Snyder finished building their two-dome, 3,000 square foot home in Alaska overlooking the Kasilof River. The dome home's primary heating system is an oil furnace that heats the water for in-floor, radiant heat. For emergency purposes, the Snyders had a supplementary heating system consisting of a generator and wood stove placed between the domes.

Freda Grones wrote, "In January 1999, temperatures plummeted to minus 30 degrees, bringing with them a wind chill of minus 52 degrees Fahrenheit. One evening, Chuck noticed that the water was not as hot as it usually was. But Chuck simply thought they had temporarily overtaxed their hot water supply. The next day, however, they had no warm water. Chuck checked the furnace and discovered they were out of heating oil. At that point, **their Monolithic Dome had been without heat for two days. But had it not been for the water going cold, the Snyders still would not have known it**."

David South points out that besides the thermal battery, a Monolithic Dome has a fresh-air battery. Monolithic Domes have a huge amount of air space in them — all within the insulated building envelope. This space is generally much more than that available within conventional buildings of a similar size. The fresh-air battery means that we can bring in fresh air when it's convenient for us and breath it when it is convenient for our occupants. Use of the fresh-air battery becomes especially significant for churches, schools and commercial facilities.

3. Green Materials

Owing much to their design, **Monolithic Domes require the smallest surface area** and employ the fewest materials to enclose space.

David South explains why a dome uses materials more efficiently than any other building: " How does a dome use materials more efficiently? Imagine you are building three small fences. You have 32 feet of material for each fence, and you want each fence to surround as much land as possible. What shape should you use? You experiment by building the first fence as a rectangle 12 feet long by 4 feet wide. The area bounded by the fence is 48 square feet. Next you try a square fence 8 feet by 8 feet. It's area is 64 square feet, or a little better. What if your last fence is circular? A circle with a radius of 5 feet 1 inch would use all 32 feet of material and it's area would be 81.5 square feet. That is 33.5 square feet more than the rectangular fence! Each fence used the same amount of material, but the circular one used the material best.

"This principle applies to spheres and cubes, too. Imagine you are building a water tank: 8 feet high, 8 feet wide, and 8 feet deep. You would need exactly 384 square feet of material to build it. It would hold exactly 512 cubic feet of water. A spherical tank measuring 5 feet 6 inches in radius will use all 384 square feet of material, too. But it will hold 707.6 cubic feet of water — 195.6 cubic feet more than the cubic tank. Again, both tanks used the same amount of material, but the spherical tank used it more efficiently.

" **A dome, therefore, will always use less material (generally 50% to 75% less) to cover the same space utilized by a 'square' conventional building.** Less material means less cost, or higher quality materials for the same cost, or both."

Dr. Arnold Wilson commented about the use of concrete as a building material: "Concrete is the most common building material used throughout the world, followed by wood, steel and a number of miscellaneous materials. It has proven to be available and economical in many locations. However, it takes a lot of energy to produce Portland Cement used to produce concrete. So, if we use concrete, we should use a type of building that requires a minimum amount of material, that, in turn, requires the minimum amount of energy for producing the material to build the building. If we build concrete thin shell buildings, such as domes, a much smaller volume of building materials will be utilized. This will result in a very efficient use of building materials and hence reduce energy use and pollution."

One of the U.S. Green Building Council's LEED certification credits is for using regional materials. According to the USGBC the intent of this credit is to, "Increase demand for building materials and products that are extracted and manufactured within the region, thereby supporting the use of indigenous resources and reducing the environmental impacts resulting from transportation." **The use of local aggregate and concrete easily meets**

the LEED criteria for using regional materials in LEED certification.

In his article **"Monolithic Domes: The Ultimate Green Building,"** Perry Gray-Renberg wrote, "Three of the four structural dome construction materials — Airform, polyurethane and concrete – serve to isolate the dome's internal environment from the outdoors. Other construction requires significantly more material, maintenance and expense to match the long life and energy-conserving ability of Monolithic Domes."

Maintenance is minimal for a Monolithic Dome. David South addressed this issue when talking about building Monolithic Dome stadiums: "Energy and Maintenance costs for a Monolithic Dome are generally 50% less than other conventional structures. We have found that energy savings amortized over 20 years often pay for the cost of the facility. Because the stadium is enclosed and out of the weather, maintenance on the field, track, bleachers, concession stands, bathrooms and locker rooms is greatly reduced. The dome itself is a virtually maintenance-free structure. **Over the years it will need to be washed, and perhaps painted, but the building is permanent. It won't rot or slowly fall apart like many traditional facilities.**"

Building a Monolithic Dome is an investment in our future. Permanent structures with low maintenance will reduce the need for new construction. The enormous energy savings and more efficient use of materials can help reduce the impact we have on the environment. And, we agree with the USGBC: "Making your home a greener place is a commitment –- to yourself, your family, your community and the world."

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