New Song consists of a Monolithic Dome, 104’ diameter and 38’ tall, flanked by three conventional structures or wings and a memorial garden area.

From the air, the entire grouping looks like a giant cross. The front of the dome includes an arched entryway—a common religious design for churches worldwide.

Construction of the dome generated a lot of interest in New Bern, Pastor Jeff Severt said. New Song’s “clear span” design provides efficient seating for over 500.

The center stage, sound and lighting is excellent for services and performances. The first dome is the beginning of a seven-phase, 20-year building plan.

According to Pastor Severt, this first Monolithic Dome, which will serve as sanctuary for the next five years, constitutes Phase I.

He said, “What we have done so far is part of a larger strategy to make this a global thing, reaching church-seeking people and helping them become fully devoted followers of Jesus Christ. We want a Christian school for children and an adult training center, not only for the Bible and Christian ministry, but for new church development.”
Facility: Living Word Bible Church  
Architect: Frederick Crandall  
Engineer: Dr. Arnold Wilson  
Builder: Dome Technology  
Description: Three 150’ domes.  
  - Dome 1 — 2000 seat sanctuary  
  - Dome 2 — Classrooms, fellowship hall, 100 seat cafe / dinner theatre and a gymnasium.  
  - Dome 3 — Children’s Theme Dome  
Pastors: Dr. C. Thomas and Pastor Maureen Anderson  
Location: Mesa, Arizona  
Cost: $7.5 Million  
Started: June 2000  
Completed: July 2001  

John Hrimnak, vice president of marketing at the church, said, “The Children’s Theme Dome is one of the primary reasons why people try out and actually stay at our church. When kids are little, it’s really all about them, and much of that philosophy applies to selecting a church — as strange as that may sound. It’s about the kids and whether they want to become a part of it.”

In its 2000-seat sanctuary/auditorium, Living Word conducts televised religious services, as well as concerts, theatrical productions, conferences and conventions. Something is almost always going on in each of the domes.

In addition to church services, annual conferences, and concerts held in the sanctuary, classes and get-togethers for everyone from pre-kindergartners to senior citizens meet in the other two domes.

These include Club Coffee Grounds, the Business Connection (a network for members who own or operate local businesses), and various other ministries.

A central core of 17,000 square feet connects the domes and houses offices, a bookstore and rest rooms.

Outside, garden paths meander through a park with a waterfall.
Faith Chapel — Birmingham, AL

Facility: Faith Chapel Christian Center
Engineer: Jason South
Builder: Gary C. Wyatt, Inc. and Dome Technology
Description: 280' x 72', 87,000 total square feet, 3200 seats. Features grand entrance hall, classrooms, offices, as well as a state of the art sound, audio and acoustic system that is required for their television ministry.
Pastor: Pastor Michael D. Moore
Location: Birmingham, Alabama
Cost: $11.7 Million
Started: 2000
Completed: 2002

Faith Chapel Christian Center is housed in the largest Monolithic Dome built to date.

“I had no idea we were going to build a dome,” said Pastor Michael D. Moore. “I could see we were outgrowing our building. So I approached this as I do any other problem: I started praying and asking God to show us what He wanted us to do. I was envisioning a traditional type of building; dome was the furthest thing from my mind.”

Moore insists, “The Lord said ‘dome’ to me. That really threw me. I was no veteran to this kind of building. After some research, we found Monolithic Domes, began visiting them, and seeing some of the wisdom of this structure.”

Moore and other church members toured LeSea Ministries in South Bend, Indiana, a 190’ x 67’ church built by Monolithic in 1983 and Abundant Life Church in Denham Springs, Louisiana, a 190’ x 48’ dome constructed in 1995.

Faith Chapel’s Administrator Debra Blaylock says that, “We wanted a Monolithic Dome for three reasons: 1. safety, we get tornados; 2. the dome is quick to build and the cost is reasonable; 3. the ongoing energy efficiency and the resulting savings.”
Facility: Saint Agnes Baptist Church of the March of Faith Ministries

Architect: Frederick Crandall

Engineer: Dr. Arnold Wilson

Construction Manager: Monolithic Construction Management

Builder: Dome Technology

Description: Consisting of two Monolithic Domes for church with 12,000 members.

Cathedral: The first dome (200’ x 50’) has 32,270 square feet and is surrounded by a conventional structure that adds 18,000 square feet. The sanctuary has seating for 4,000. Additional space used for administration.

Dome of Restoration and Fellowship: The second structure is 100’ diameter and provides 7800 square feet of floor area for fellowship and Sunday School classes.

Pastor: Reverend Gene A. Moore Sr.

Location: Houston, Texas

Cost: $5 Million (Estimated)

Maranatha Church — Mont Belvieu, TX

Facility: Maranatha Church
Engineer: Dr. Arnold Wilson
Builder: Monolithic Constructors, Inc.
Description: Church consisting of one 208’ x 48’ dome which seats 4000, encompassing 34,000 square feet.
Pastor: Dr. Ronnie Trice
Location: Mont Belvieu, Texas
Started: January 1984
Completed: December 1984

In 1984 Pastor Ronnie Trice and his wife Sandy, opened the doors of Maranatha (the name means Come, Lord Jesus), consisting of one Monolithic Dome 208 feet in diameter and 48 feet tall.

Their former facility seated 600 people. Pastor Trice reports that 4000 can now be “comfortably seated” in their Monolithic Dome sanctuary, with its unobstructed view and comfortable acoustics.

He says, “The acoustics are excellent in our building. They seem very natural.”

Note the dark acoustic cloud is virtually hidden against the dark color of the dome.

Trice readily admits that their interest in a Monolithic Dome stemmed from a dream of a beautiful but practical, cost-efficient facility.

Maranatha began turning that dream into a reality by researching the operational cost-efficiency of various designs. Their study showed that a Monolithic Dome was their best bet.

Trice said that Maranatha’s average combined cooling and heating costs are about $1500 per month.

That yields a “conservative estimate of savings of about $60,000 per year.” He attributes those savings to operational costs that are far less than those of a conventional church of the same size.
Cathedral of Praise — South Bend, IN

**Facility:** Christian Center Cathedral of Praise  
**Architect:** Timeless Architecture, Inc.  
**Engineer:** Dr. Arnold Wilson  
**Builder:** Monolithic Constructors, Inc.  
**Description:** Church consisting of 190' diameter dome, 67' tall, buried up to the first 16 feet. Built in honor of founder Dr. Lester Sumrall on 45 acres. The entire facility includes a K-12 school, the Indiana Christian University, Feed the Hungry Program, a full-service travel agency, a TV and radio station, a Prayerline, World Harvest Magazine and Network, and Healthy Choices Vitamins. The sanctuary seats 3000 people.  
**Owner:** LeSea Ministries  
**Location:** South Bend, Indiana  
**Completed:** 1983  
**Awards:** Indiana Concrete Council Outstanding Concrete Construction Award 1985

Pilgrims United Church of Christ — Florida

**Facility:** Pilgrims United Church of Christ  
**Builder:** George Paul  
**Description:** Church consisting of two domes — a 74’ diameter sanctuary and a 62’ fellowship hall. A 40’ atrium connects the two domes.  
**Pastor:** Reverend Dr. Henry Ackermann  
**Location:** Fruitland Park, Florida  
**Constructed:** 1996  

After five years of continual use, most members of Pilgrims United Church of Christ in Fruitland Park, Florida are just as enthusiastic about their two Monolithic Domes as they were at that deciding meeting when eighty-four of the eighty-nine present voted for their construction.

Pilgrims United Church of Christ has not, to date, experienced a tornado, but they are in a tornado-prone area.

“For that reason,” Pastor Ackermann said, “we applied to the American Red Cross for certification as a designated shelter. They told us what kind of plywood to get for window coverings, and we did. Now we’re waiting for final approval.”

According to Ackermann the domes use little energy. “The air conditioning people told us how much to put in. But the builder and I talked with David South, and following his advice, we about halved what the air conditioning folks recommended, and it all works just fine.”

Hand-crafted wood frames for gothic windows.
City Bible Church — Portland, OR

Facility: City Bible Church
Description: Two domes - 230' and 160'. 3000 seating
Pastors: Frank and Sharon Damazio
Location: Portland, Oregon
Completed: 1991

Since its opening in 1991, the two Monolithic Domes of City Bible Church have become somewhat of a landmark in Portland, Oregon. Art Johansen, facility administrator at City Bible, is very much in favor of that development.

“We’re up on a butte, so we are quite visible. People flying see us coming into the airport, and people driving see us from the freeway. There’s an instant recognition of the domes, but many people don’t know what we are. A laboratory? An airport facility? So they come and find out.”

What the curious discover is a huge, two-story Monolithic Dome, 230 feet in diameter and 75 feet high, that encompasses a sanctuary with seating for 3000, centered about a platform with seating for another 200. “Behind the platform, we have a choir room, orchestra room, bathrooms and a recording studio,” Johansen says.

City Bible currently has a membership of 8500. They have two Sunday morning services with an attendance of about 1500 at the first and 2000 at the second. Despite body heat and/or the weather, Johansen says it’s easy “to maintain a comfortable temperature in the dome. We set it (the thermostat) and forget it.”

In addition to the sanctuary, City Bible’s two-story, larger dome houses a Kindergarten through Grade Twelve school, nurseries and offices. The smaller dome, also with two stories, includes a gym, a commercial kitchen, additional classrooms and a library at its center.
Facility: First Church of Religious Science  
Engineer: Dr. Arnold Wilson  
Builder: Monolithic Constructors, Inc.  
Description: Church consisting of one 100’ diameter dome sanctuary that seats 300 and one 80’ diameter dome fellowship hall.  
Pastor: Reverend Michael Summers  
Location: Hemet, California  
Started: 1989  
Completed: 1991

Large, Gothic windows surround the perimeter of First Church of Religious Science in Hemet, California. The 100 foot dome houses the sanctuary and the 80 foot dome functions as the social hall.

Reverend Summers says that most members really like the church structure. “I think, for the most part, they are happy with the domes,” he says.

“They like the way they are set up because it is different and convenient. They like the uniqueness. The temperature is really nice inside. The domes are cool in the summer and warm in the winter, and we have no problem maintaining that.”

“The acoustics in the sanctuary are wonderful,” Summers continues. “The carpeting and fabrics absorb echo. It’s wonderful for concerts. We really don’t need amplification for the musical instruments.”

Until recently, acoustics in the smaller dome or social hall were not that satisfactory. Summers says, “There was such an echo that you couldn’t understand what people were saying.

We installed carpeting and that took care of most of the problem. Now we can talk and carry on conversations, but there’s still some work that needs to be done.”

The upper third of the sanctuary dome shell is painted dark green to reduce the expansiveness of the dome and promote a cozy feeling.

A large platform or stage, banked by a semicircle of seats, stands at the west side of the Monolithic Dome. The soft pink creates the background for the platform, and it along with soft lighting helps focus attention on the pulpit or the on-stage event.

“The domes are cool in the summer and warm in the winter, and we have no problem maintaining that.”
Cupolas

Facility: Our Lady’s Maronite Church
Architect: William Scarmardo
Builder: Perry and Perry Building and Monolithic Constructors, Inc.
Description: Church cupola which is 48’ diameter and 20’ tall. Constructed in-place 30 feet from the floor.
Pastor: Reverend Don Sawyer
Location: Austin, Texas
Constructed: 1999

If you want to see what a church in the Holy Land looks like, you don’t have to travel to the Middle East. Just come to Austin, Texas. “We got it!” says Rev. Don Sawyer, pastor of Our Lady’s Maronite Church, an Eastern Rite Catholic parish. “The term Maronite comes from St. Maron who lived in the fourth century.” Sawyer explained. “Maronites came from the Christological debate of the early church after the Council of Chalcedon in 451, so our tradition is from the church of Antioch. Our Liturgy (Mass) was composed by St. James the apostle. There’s a lot of Jewish influence in our Liturgy, our service, our worship — and our style of architecture,” he added.

Concentrating on these traditions, Our Lady’s Maronite 200-family parish constructed a new, 8500-square-foot church in January 1999.
Brooksville Assembly of God — Brooksville, FL

**Facility:** Brooksville Assembly of God  
**Builder:** Dome Technology  
**Description:** 176’ diameter and 58’ tall church. 24,328 square feet. Congregation of almost 1000  
**Pastor:** David Garcia  
**Location:** Brooksville, Florida  
**Completed:** 2003

Brooksville Assembly of God’s worship through music makes use of the fantastic acoustics in a dome. The church doubles as a local emergency shelter.

Trinity Christian Center — Soldotna, AK

**Facility:** Trinity Christian Center  
**Builder:** War Bonnet Construction  
**Description:** Church consisting of one 80’ diameter dome, 27’ tall, 8000 square feet, 100 member congregation  
**Pastor:** Ray Ansel  
**Location:** Soldotna, Alaska  
**Completed:** 1993

In 1995, with its congregation of 100 standing in worship and singing, the church successfully endured a significant earthquake. “We felt the floor move,” Ansel recalls, “but no heaving or any serious structural damage.”

Jubilee Christian Fellowship — Ontario, Canada

**Facility:** Jubilee Christian Fellowship  
**Designer:** Larry Byrne  
**Engineer:** Dr. Arnold Wilson  
**Builder:** Monolithic Constructors, Inc.  
**Description:** Church which is 120’ diameter and 38’ tall. Encloses a total of 11,310 square feet. Seats 350-400 comfortably.  
**Pastor:** Phillip Tuttle  
**Location:** Stratford, Ontario, Canada  
**Completed:** 1989

The Jubilee Christian Fellowship has been in continual use as a church for over 10 years now. Pastor Phillip Tuttle reports that the dome is wonderful and very functional.
Bishop Nevins Academy – Sarasota, FL

Facility: Bishop Nevins Academy
Architect: Rafael Moreu
Engineer: John Miller
Builder: D. E. Murphy Constructors, Inc. and Domtec International
Description: Dual school — St. Martha Catholic School and Dreams are Free.
Dome A: Central core is the chapel, the Wren Pavilion. In addition to the chapel, the 128’ diameter dome has administrative offices, computer labs and a library on its ground floor and classrooms.
Dome B: St. Martha’s School — pre kindergarten through eighth grade. 140 feet in diameter, classroom dome.
Dome E: 124’ diameter classroom dome.
Dome F: Dreams are Free — a non-graded school with programs for special-needs children, six to fifteen years old. 124 feet in diameter, 11,500 square feet of flexible class space. The Dome’s modern kitchen serves as a cafeteria for both schools.
Domes C, D and G: Two Domes with diameters of 124 feet for classrooms and one Dome with a diameter of 148 feet as a gymnasium, should see completion during Phase III.

The center Mall is 300 feet long and 50 feet wide. The mall functions as a gathering area and connects all of the domes.

Owner: Catholic Diocese of Venice, Florida
Pastor: Father Fausto Stampiglia
Location: Sarasota, Florida
Cost: $12.8 Million
Started: December 2000
Completed: January 2002
Thousand Oaks Retreat — Dresden, TX

Facility: Thousand Oaks Retreat  
Architect: Shade Architects  
Engineer: Dr. Arnold Wilson  
Builder: Monolithic Constructors, Inc.  
Description: 143' x 45' with 15,273 square feet on the main floor and 1089 square feet on the mezzanine. The Dome is the storm shelter for the 236 acre retreat.  
Owner: DFW Church of Christ Jesus in Carrollton, Texas  
Location: Near Dresden, Texas  
Cost: $500,000  
Completed: Summer 1998  

A Monolithic Dome, 143' in diameter and 45' in height, greets youths enjoying summer camp and adults attending retreats at the Thousand Oaks Retreat Center near Dresden, Texas.

According to Mark Beaman, administrator at DFW Church of Christ Jesus, “There are a lot of children who will be down for summer camp and the gym is going to be a great place for them—a safe place, with fun, indoor activities.”

Beaman said that the safety and security of a Monolithic Dome was a bonus they had not expected, but something they are very pleased to get by going with the Monolithic Dome.

“Initially, we thought about a pre-manufactured, metal building for a gymnasium,” said Architect Shade O’Quinn. “The estimates for that project were around $800,000 for a 14,000 square foot activities building. That was over our budget.”

“The Monolithic Dome was very straight-forward, so we felt very comfortable that by going with it, we would get a good product and everything we wanted within our budget restraints.

That was a very important second advantage,” O’Quinn said.

The third advantage O’Quinn cited had to do with the electrical power at Thousand Oaks. “This was a real biggy,” he said. “Because of the dome’s efficient insulation, we could heat and cool with single-phase power. That probably tipped the scale. We just had nightmares thinking of twenty small air conditioners to cool. The Monolithic Dome brought that down to possibly four units heating and cooling the whole facility. That was a big, big plus.”

A Monolithic Dome’s ability to withstand tornadoes and high winds constituted the fourth advantage. Administrator Beaman said, “The fact that the dome provided a safe shelter really appealed to us. We presented all our findings to the church board, and they concurred.”
Dear Pastor:

Enclosed is information, including a DVD, for your use in planning expansion or replacement of your present facility. Most churches grow or start to die. Many are in too small of quarters. The Monolithic Domes can be added for more space to most churches. They can be built to seat 100 people up to 20,000.

The Monolithic Dome provides:

- **Near absolute protection** from high winds, tornados, hail, fire, earthquakes and more.

- **Energy savings** equal to the cost of the building, including finish out, within 20 years.

- **A fantastic "Feeling"** of being in a church. A modern version of old church structures.

- **Quiet**, All outside noises cease when you are in a Monolithic Dome.

Monolithic can provide help with:

- Design Services including a feasibility study to get you started at a reasonable cost with no further obligations. It simply gives you options with budgets for planning purposes.

- **Financing help.** We know many of the financial institutions that can help you. We can introduce you and / or help with the applications.

- Help and advice through the whole process from concept to completion.

Sincerely,

David B. South, President

DBS/sd

Please call. Ask for Gary, Renee, any of the staff, or me.

May 3, 2004
<table>
<thead>
<tr>
<th>Church Name</th>
<th>Address</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faith Chapel Christian Center</td>
<td>800 Quebec Dr, Birmingham AL 35224</td>
<td>280' diameter and 72' tall dome with 87,000 total square feet. The sanctuary, which comprises only a portion of the total structure, seats 3200. Additionally the dome houses classrooms, offices and state of the art sound, audio and acoustics for television ministry.</td>
</tr>
<tr>
<td>Trinity Christian Center</td>
<td>37710 Kenai Spur Hwy, Soldotna AK 99669</td>
<td>8000 square foot church for 100 member congregation. 80' diameter dome.</td>
</tr>
<tr>
<td>Living Word Bible Church</td>
<td>3520 E Brown St, Mesa AZ 85201</td>
<td>Three 150' domes: Dome 1 -- 2000 seat sanctuary Dome 2 -- Classes, fellowship hall, cafe/dinner theatre, gym Dome 3 -- Children's Theme Dome</td>
</tr>
<tr>
<td>Faith Life Christian Center</td>
<td>4191 Corona Ave, Norco CA 91760</td>
<td>100' x 35' dome church built 1992</td>
</tr>
<tr>
<td>Michael Summers, Rev. First Church of Religious Science</td>
<td>40450 Stetson Ave, Hemet, CA 92343</td>
<td>Church consisting of one 100' diameter dome sanctuary that seats 300 and one 80' diameter dome fellowship hall.</td>
</tr>
<tr>
<td>Rev Dr Henry Ackermann Pilgrims United Church of Christ</td>
<td>509 County Rd 468, Fruitland Park FL 34731</td>
<td>Two-dome church with 74' diameter sanctuary and 62' diameter fellowship hall.</td>
</tr>
<tr>
<td>Brookville Assembly of God</td>
<td>20366 Cortez Blvd, Brookville, FL 34601-3802</td>
<td>Congregation of 1000. The 176' diameter and 58' tall dome church houses 24,328 square feet.</td>
</tr>
<tr>
<td>Victory Cathedral</td>
<td>Garnet Blakely, Pastor 16110 US Hwy 301 S, Wimauma, FL 33598</td>
<td>Small 5000 square foot church in Florida.</td>
</tr>
<tr>
<td>St Josephs Catholic Church</td>
<td>Father Cody 11730 Old Saint Augustine Rd, Jacksonville FL 32258</td>
<td>Cupola 60' diameter as focal point for conventional structure.</td>
</tr>
<tr>
<td>Organization</td>
<td>Address</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------------</td>
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</tr>
</tbody>
</table>
| St Martha's Roman Catholic Church    | Fausto Stampiglia, Father  
200 North Orange Ave  
Sarasota FL 34236  
941-366-4210 | Dual School – St. Martha Catholic School and Dreams are Free. Currently consists of 4 domes- 3 more planned for construction.                   |
| Home of Life Missionary Baptist Church | Johnny Henderson, Pastor  
4650 W Madison  
Chicago IL 60644  
773-626-8655 | 24,000 square feet. Sanctuary for 450, preschool for 100, fellowship hall for 200, offices. Two domes - a two story connector and adjacent building spaces provide a stadium seating theater in the round and a school with six classrooms. |
| LeSea Ministries                      | Ken Holderread  
530 East Ireland  
South Bend, IN 46624  
574-291-3292 | The Christian Center Cathedral of Praise is 190' in diameter and seats 3000 people.                                                                 |
| Jim Gilmore                          | North Grand Church of Christ  
919 30th Street  
Ames, IA 50010  
515-232-1060 | The 120' Monolithic Dome is the fellowship hall.                                                                                                 |
| Lamoni Stake Community of Christ     | Scott Murphy, Stake Pres.  
531 W Main  
Lamoni IA 50140 |                                                                                                                                                 |
| Salina Church of Christ              | Jim Keas, Pastor  
1646 N 9th Street  
Salina KS 67401  
785-827-2957 | 110' dome church built in 1996.                                                                                                                |
| Abundant Life Church                 | Richard Beatty  
206 Edgewood Dr  
Denham Springs LA 70727-1133  
225-665-7000 | The 3000 seat sanctuary resides in the 190' diameter free-span dome.                                                                            |
| New Life Christian Church            | C L Johnston, Pastor  
16410 Trenton RD  
Southgate MI 48195  
734-283-3260 | This 170' diameter church and preschool was torn down in 2000 and sold to a Lowe's Home Improvement Center. CL Johnston has a church in New Boston 734-753-7510. |
| New Life Family Church               | Pastor Jeff Holbern  
362 Popps Ferry Road  
Biloxi, MS 39531  
228-388-5183 | Just a half mile from the ocean, this beautiful church also has a preschool.                                                                    |
<table>
<thead>
<tr>
<th>Church Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth's Ancestral Voices</td>
<td>Native American Kiva covered in local flagstone.</td>
</tr>
</tbody>
</table>
| Zoe Bryant                                      | 302 Old Fellowship Rd  
Swannanoa, NC 28778  
828-298-3935                                           |
| City Bible Church                               | Two Monolithic Domes - 230' diameter and 160' diameter. The sanctuary seats 3000, and the rest of the space encloses a K-12 school. |
| Frank and Sharon Damazio, Pastors               | 9200 NE Fremont  
Portland, OR 97220  
503-252-4634                                           |
| New Song United Methodist Church                | One 104 foot diameter dome sanctuary flanked by three conventional structures to form a Cross. |
| Alton Sibley                                    | 521 W Grantham Rd  
New Bern SC 28562  
252-635-2621                                          |
| DFW Church of Christ Jesus                      | Thousand Oaks Retreat Gymnasium near Dresden, Texas. The Dome is the storm shelter for the 236 acre retreat as well as the main recreation hall. |
| Mark Beaman                                     | 1024 W Rosemeade Pkwy  
Carrolton TX 75007  
972-395-0082                                          |
| Corpus Christi Catholic Church                  | This economical multi-purpose Dome opens for worship on Sunday, can divide into classrooms and during the week keeps the local youth busy with basketball. |
| John Haugh, Father                              | 111 N Wood St  
Ferris TX 75125  
972-842-2288                                          |
| Living Stones Church                            | Monolithic Dome Church 176' diameter. Seats 2000.                            |
| Alan Jandl, Reverend                            | 1407 Victory Lane  
Alvin TX 77511  
281-331-9517                                          |
| Bread of Life Church                            | 182' diameter. Seats 2000.                                                  |
| Dusty Kemp, Pastor                              | 10800 Hammerly Blvd  
Houston, TX 77043  
713-932-1479                                          |
| St. Agnes Baptist Church                        | Dome of Restoration and Fellowship is 7800 square feet, 100' diameter for classes and more. The Cathedral will seat 4000 in its 200' diameter Dome. |
| Gene Moore, Pastor                              | 3730 South Acres Drive  
Houston, TX 77047  
713-733-0146                                          |
| Our Lady's Maronite Catholic Church             | 48' cupola centerpiece on conventional church.                             |
| 1320 E 51st St                                  | Austin TX 78723  
512-458-3693                                          |
<table>
<thead>
<tr>
<th>Church on the Rock</th>
<th>Church and bookstore - 125' diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dan and Susie Thompson, Pastors</td>
<td></td>
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<tr>
<td>6401 Bandera Rd</td>
<td></td>
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<tr>
<td>San Antonio TX 78238</td>
<td></td>
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<tr>
<td>210-684-2687</td>
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<tr>
<td>Maranatha Church</td>
<td>One of the oldest Monolithic Dome</td>
</tr>
<tr>
<td>Pastor Ronnie Trice</td>
<td>churches, this 208' x 48' dome</td>
</tr>
<tr>
<td>PO Box 865</td>
<td>seats 4000 square feet and</td>
</tr>
<tr>
<td>12319 Highway 146</td>
<td>encompasses 34,000 square</td>
</tr>
<tr>
<td>Mont Belvieu TX 77580</td>
<td>feet.</td>
</tr>
<tr>
<td>281-576-2259</td>
<td></td>
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<tr>
<td>Sri Sri Radha Krishna Temple</td>
<td>Onion dome - 24' x 18' for top of</td>
</tr>
<tr>
<td>6828 South Main Street</td>
<td>temple.</td>
</tr>
<tr>
<td>Spanish Fork UT 84660</td>
<td></td>
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<tr>
<td>801-798-3559</td>
<td></td>
</tr>
<tr>
<td>Jubilee Vineyard Christian Fellowship</td>
<td>500 seat church and fellowship -</td>
</tr>
<tr>
<td>Phillip Tuttle</td>
<td>120' diameter.</td>
</tr>
<tr>
<td>707 Downie Street</td>
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<tr>
<td>Stratford ON N5A 1Y8</td>
<td></td>
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<tr>
<td>Canada</td>
<td></td>
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<tr>
<td>519-273-4441</td>
<td></td>
</tr>
<tr>
<td>Betania Church</td>
<td>140' diameter church -- one of the</td>
</tr>
<tr>
<td>Katowice, Poland</td>
<td>largest church structures in</td>
</tr>
<tr>
<td></td>
<td>Poland.</td>
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</tbody>
</table>

May 5, 2004
Building Survivability

Concrete Dome Seismic Analysis

The Monolithic Dome is the most disaster resistant building that can be built at a reasonable price without going underground or into a mountain.

A wind of 70 miles per hour blowing against a 30 foot tall flat walled building in open flat terrain will exert a pressure of 22 pounds per square foot (psf). If the wind speed is increased to 300 miles per hour the pressure is increased to 404 pounds per square foot (psf). Wind speed of 300 MPH is considered maximum for a tornado. It is far greater than that of a hurricane.

Cars can be parked on 100 psf. The side pressure on the building could equal the weight of cars piled 4 high. No normal building can withstand that much pressure. Many Monolithic Domes are buried up to 30 feet deep. They must withstand pressures up to 1 ton per square foot (2000 psf).

Against tornado pressure a Monolithic Dome 100 feet in diameter, 35 feet tall would still have a safety margin of nearly 1½ times its minimum design strength. In other words, the stress created by the 300 mile per hour wind would increase the compressive pressure in the concrete shell to 1,098 psi. The shell is allowed 2,394 psi using design strengths of 4,000 psi.

The fact is the Monolithic Dome is not flat and therefore never could the maximum air pressure against it of 404 pounds per square foot be realized. Neither is the concrete only 4,000 psi. It is always much greater. The margin of safety is

Membrane Forces

\[ p_z = p \cos b \sin a \]
\[ p_a = p \sin a \]
\[ p_{a-b} = p \cos b \]

Seismic Force (UBC 1985 Edition)

\[ V = Z S I C K W \] (Formula for the total design lateral force)
\[ Z = 1.0 \] (Zone IV — Seismic Zone Factor)
\[ CS = 0.14 \]
\[ I = 1.5 \] (Importance Factor = Hospital)
\[ K = 2.0 \] (Unusual building such as Dome — very conservative)

Therefore: \[ V = (1.0) (1.5) (0.14) (2.0) W = 0.420W \] — Note: \( V = 0.14W \) for normal shear wall building!

\[ V = (0.420) (100) = 42.0 \text{ psf (pounds/square foot)} \] — one square foot of shell 8" thick weighs 100 lbs.

The value of \( p = V = 42.0 \text{ psf} \).

For demonstration purposes assume \( p = 60 \text{ psf} \). This represents earthquake forces in excess of the most severe code requirement by a factor of 1.4.

Maximum stress due to \( N_{a-b} \) is -64.8 psi; \( N_{a} \) is -70.6 psi. Maximum bending moment is 909.3 lbs - ft/ft.

For a vertical live load of 40 psf in addition to the dead load of the shell the following stresses and moment are obtained. Maximum stress due to \( N_{a-b} \) is -82.5 psi; \( N_{a} \) is -70.7 psi or -146.5 psi. The maximum bending moment is 1,588.0 lbs-ft/ft.

The maximum allowable compressive force in the concrete is: \( f_c = 1.33 (0.45) (4000\text{psi}) = -2.394\text{psi} \). This is many times greater than the -70.6psi needed.

Conclusion

The forces caused by a major earthquake are considerably less than normal provided for when a dome is designed for nominal vertical loads.
probably more like three or four.

The Monolithic Dome at Port Arthur, Texas has now been hit by three hurricanes. A hurricane does not exert enough pressure on a dome to be even noticed. As shown above the dome can very easily withstand the stresses of a tornado.

However, debris carried by a tornado could cut the surface membrane. If the debris contained a large timber or metal object, it might be possible if conditions were just right to put a puncture into the dome. But the puncture would be very local and would certainly never cause serious collapse of the dome. Possibly damage to the doors or windows may occur if there was a rapid decompression caused by the tornado.

For most Monolithic domes the likely disaster will be earthquake. The worst areas in the United States are listed as seismic zone 4. From analysis (see “Concrete Dome Wind Analysis” sidebar) it is easy to see that earthquake forces do not even approach the design strength the Monolithic Dome is built to withstand under normal every day usage. It would take an external force many times as large as the earthquake to approach the design strength of the concrete itself.

Nuclear fallout is another disas-

Concrete Dome Wind Analysis

Example 1

Commercial building 30 feet high in exposure C (most severe exposure in open flat terrain). Using design wind pressure from UBC 1985 Edition, section 2311.d, of 70 MPH. \( V = 300 \text{ MPH} \).

\[
p = C_c C_e Q_s I
\]

\( I = 1.0 \) (Commercial Building)

\( Q_s = 13 \text{psf} \) (pressure from wind)

\( C_e = 1.3 \) (building height 30 ft. - exposure C)

\( C_c = 1.3 \) (method 2)

Therefore \( p = (1.3)(1.3)(1.3\text{psf})(1.0) = 22\text{psf} \)

Example 2

Assume same building and same exposure but with wind speed of 300 mph.


\[
p = 1/2 C_c C_e C_s P V^2 (H/h)(H/h)^{1/2}
\]

Assume everything is constant except the wind speed.

\[
p = C C_s V^2 \text{psf for } V = 70 \text{ mph (example 1)}.
\]

Therefore \( C = (22)/ (70) = 0.00449 \)

Then \( p = (0.00449) V^2 \text{ for } V = 300 \text{ mph}; p = 404\text{psf} \)

The maximum concrete stress in dome 100 feet in diameter by 35 feet high with \( p = 400\text{psf} \) is 1,098psi compression. From the “Concrete Dome Seismic Analysis” example we see the allowable stress is significantly higher at 2,394 psi.

Conclusion

The forces caused by wind and earthquake on a concrete dome generally do not control the design. Domes are very strong and durable and in a realistic situation would probably still be standing when all conventional structures had failed.

This information was compiled by Doctor Arnold Wilson, a leading engineer in thin shell concrete construction.
Energy Savings Pay For A Church

One of the major benefits to a church, school or any institution in a Monolithic Dome is the energy savings. Recently, we completed a study of a 34,000 square foot church located near Houston, Texas.

The Monolithic Dome church has been in use for more than ten years. We verified the estimated savings with the pastor. He tells us that our numbers are very conservative when comparing the energy cost for the Monolithic Dome versus the conventional building of similar size in the Houston area. The numbers presented in the chart represent:

1. The annual energy savings: They are increased 2% per year through the 30 year study. The 2% is for inflation. It is a very conservative estimate.

2. The energy fund represents the accumulation of the energy savings deposited in an investment paying interest at seven percent per annum.

The church facility cost approximately 1.2 million dollars when it was constructed. Had the energy savings been invested as shown—in the thirteenth year the fund would equal the original price of the church. And at the end of thirty years the fund would be equal to more than four times the original price of the church.

What is not shown here is the reduced cost at the time of construction of the heating and cooling equipment, as well as the overall maintenance cost for the heating and cooling system. Not only is there less cost for the heating and cooling system, there is less cost for the electrical system because it does not have to service such a large heating and cooling system.

Note: Generally, fire insurance for a Monolithic Dome will be less than half of a conventional building. These insurance savings can often be very dramatic.

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<th>Annual Energy Savings</th>
<th>Energy Saving Fund</th>
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<tr>
<td>2</td>
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Total: $2,028,403.96 $5,800,893.46
A heavy wall must have two qualities in order to dampen diurnal changes in the exterior environment relatively constant: heat capacity — the ability to store heat, and low heat conductivity — the ability to resist, or to insulate against heat flow. If one intermittently exposes an adobe brick first to a blow torch and then to cold water (and if each exposure time is relatively short) the temperature of the brick never reaches either extreme, but oscillates somewhere in between. The heat capacity of the brick keeps its temperature from rising rapidly with the small heat addition, or dropping rapidly with the small heat extraction. The brick’s insulating quality prevents heat from entering or leaving very rapidly.

Adobe, however, does not happen to have the optimum combination of heat capacity and insulation. This problem can be resolved by the way the material is used which is as important as what material is used. The most effective way of maximizing the two qualities — heat capacity and insulation — in a building wall is to use two separate materials. Ideally, one would choose a material with little resistance to heat flow. By placing the insulating material next to the external environment, little heat is allowed into or out of the building and with the high heat capacity material next to the inside environment, what heat does enter or leave (primarily through windows and interior heat generation) cannot change the temperature of the heat capacity material rapidly. Thus, little heat is let in or out, and the high capacity material slowly stores heat. The building’s thermal mass damps out temperature fluctuations. Thus a more ideal wall than adobe alone would be one made of externally insulated adobe or externally insulated concrete. This concept of externally insulated, high mass construction is common to all of the passive concepts in this handbook except those using isolated heat storage arrangements such as the rock bed thermosiphon system.

“R” Fairy Tale

By David B. South

The Myth of Insulation’s R-value
One of the fairy tales of our time is the “R-value.” The “R-value” is touted to the American consumer to the point where it has taken a “chiseled in stone” status. The saddest part of the fairy tale is that the R-value by itself is almost a worthless number.

It is impossible to define an insulation with a single number. It is imperative we know more than a single “R” number. So why do we allow the R-value fairy tale to be perpetuated? I don’t know. I don’t know if anybody knows. It obviously favors fiber insulation. Consider the R-value of an insulation after it has been submersed in water or with a 20 mile per hour wind blowing through it. Obviously the R-value of fiber insulations would go to zero. Under the same conditions, the solid insulations would be largely unaffected. Again R-value numbers are “funny” numbers. They are meaningless unless we know other characteristics.

None of us would ever buy a piece of property if we knew only one dimension. Suppose someone offered a property for $10,000 dollars and told you it was a seven. You would instantly wonder if that meant seven acres, seven square feet, seven miles square, or what. You would want to know where it was — in a swamp, on a mountain, in downtown Dallas. In other words, one number cannot accurately describe anything. The use of an R-value alone is absolutely ridiculous. Yet we have Code bodies mandating R-values of 20’s or 30’s or 40’s. A fiber insulation having an R-value of 25 placed in a house not properly sealed will allow the wind to blow through it as if there were no insulation. Maybe the R-value is accurate in the tested material in the lab, but it is not even remotely part of the real world. We must start asking for some additional dimensions to our insulation. We need to know it’s resistance to air penetration, to free water, and to vapor drive. What is the R-value after it is subjected to real world conditions?

The R-value is a fictitious number supposed to indicate a material’s ability to resist heat loss. It is derived by taking the “k” value of a product and dividing it into the number one. The “k” value is the actual measurement of heat transferred through a specific material.

The Test used to determine the “R” value:

The test used to produce the “k” value is an ASTM test. This ASTM test was designed by a committee to give us measurement values that hopefully would be meaningful. A major part of the problem lies in the design of the test. The test favors the fiber insulations — fiberglass, rock wool, and cellulose fiber. Very little input went into the test for the solid insulations, such as foam glass, cork, expanded polystyrene or urethane foam.

The test does not account for air movement (wind) or any amount of moisture (water vapor). In other words, the test used to create the R-value is a test in non-real-world conditions. For instance, fiberglass is generally assigned an R-value of approximately 3.5. It will only achieve that R-value if tested in an absolute zero wind and zero moisture environment. Zero wind and zero moisture are not real-world. Our houses leak air, all our buildings leak air, and they often leak water. Water vapor from the atmosphere, showers, cooking, breathing, etc. constantly moves back and forth through the walls and ceilings. If an attic is not properly ventilated, the water vapor from inside a house will very quickly semi-saturate the insulation above the ceilings. Even small amounts of moisture will cause a dramatic drop in fiber insulation’s R-value — as much as 50 percent or more.

Vapor Barriers:

We are told, with very good reason, that insulation should have a vapor barrier on the warm side. Which is the warm side of the wall of a house? Obviously, it changes from summer to winter — even from day to night. If it is 20 F below zero outside, the inside of an occupied house is cer-
tainly the warm side. During the summer months, when the sun is shining, very obviously the warm side is the outside. Sometimes the novice will try to put vapor barriers on both sides of the insulation. Vapor barriers on both sides of fiber insulation generally prove to be disastrous. It seems the vapor barriers will stop most of the moisture but not all. Small amounts of moisture will move into the fiber insulation between the two vapor barriers and be trapped. It will accumulate as the temperature swings back and forth. This accumulation can become a huge problem. We have re-insulated a number of potato storages that originally were insulated with fiberglass having a vapor barrier on both sides. Within a year or two the insulation would completely fail to insulate. The moisture would get trapped between the vapor barriers and saturate the fiberglass insulation to the point of holding buckets of water. Fiber insulation needs ventilation on one side; therefore, the vapor barrier should go on the side where it will do the most good.

We understand air penetration through the wall of the house. In some homes when the wind blows, we often can feel it. But what most people, including many engineers, do not realize is that there are very serious convection currents that occur within the fiber insulations. These convection currents rotate vast amounts of air. The air currents are not fast enough to feel or even measure with any but the most sensitive instruments. Nevertheless, the air is constantly carrying heat from the underside of the fiber pile to the top side, letting it escape. If we seal off the air movement, we generally seal in water vapor. The additional water vapor often will condense (this now becomes a source of water for rotting of the structure). The water, as a vapor or condensation, will seriously decrease the insulation value — the R-value. The only way to deal with a fiber insulation is to ventilate. But to ventilate means moving air which also decreases the R-value.

**Air Penetration:**

What is the R-value of a furnace filter? The filter medium for most furnace filters is fiberglass — the same spun fiberglass used as insulation. Fiberglass is used for an air filter because it has less impedance to the air flow, and it is cheap. In other words, the air flows through it very readily. It is ironic how we wrap our house in a furnace filter that will strain the bugs out of the wind as it blows through the house. There are tremendous air currents that blow through the walls of a typical home. As a demonstration, hold a lit candle near an electrical outlet on an outside wall when the wind is blowing.

The average home with all its doors and windows closed has a combination of air leaks equal to the size of an open door. Even if we do a perfect job of installing the fiber insulation in our house and bring the air infiltration very close to zero from one side of the wall to the other, we still do not stop the air from moving through the insulation itself vertically both in the ceiling and the walls.

The best known solid insulation is expanded polystyrene. Other solid insulations include cork, foam glass and polyisocyanate or polyisocyanurate board stock. The later two being variation of urethane foam. Each of these insulations are ideally suited for many uses. Foam glass has been used for years on hot and cold tanks, especially in places where vapor drive is a problem. Cork is of course a very old standby often used in freezer applications. EPS or expanded polystyrene is seemingly used everywhere from throw away drinking cups and food containers to perimeter foundation insulation, masonry insulations, etc. Urethane board stock is becoming the standard for roof insulation, especially for hot mopped roofs. It is also widely used for exterior sheathing on many of the new houses. The R-value of the urethane board stock is of course better than any of the other solid insulations. All of the solid insulations will perform far better than fiber insulations whenever there is wind or moisture involved.

Most of the solid insulations are placed as sheets or board stock. They suffer from one very common problem. They generally don’t fit tight enough to prevent air infiltration. It matters not how thick these board stocks are, if the wind gets behind it. We see this often in masonry construction where board stock is used between a brick and a block wall. Unless the board stock is actually physically glued to the block wall air will infiltrate behind it. In this case it is virtually worthless as the air flows through the weep holes in the brick and around the insulation rendering it virtually useless. Great care must be exercised in placing the solid insulations. The brick ties need to be fitted at the joints and then sealed to prevent air flow behind the insulation.

The only commonly used solid insulation that absolutely protects itself from air infiltration is the spray-in-place poly-
urethane. When it is properly placed between two studs or against the concrete block wall or wherever, the bonding of the spray plus the expansion of the material in place will effect a total seal. This total seal is almost impossible to over-estimate. In my opinion most of the heat loss in the walls of the home have to do with the seal rather than the insulation. For physical reasons, heat does not conduct horizontally nearly as well as it does vertically. Therefore, if there were no insulation in the walls of the homes, but an absolute airtight seal, there would not necessarily be a huge difference in the heat loss. This would not be the case if the insulation was missing from the ceiling. Air infiltration can most effectively be stopped with spray-in-place polyurethane. It is the only material (properly applied) that will fill in the corners, the cripples, the double studs, bottom plates, top plates, etc. The R-value of a material is of no interest or consequence if air can get past it.

Anecdotes:

During the 1970s my firm insulated a bunch of new homes in the Snake River Valley of Idaho with 1.25 inches of spray in place polyurethane foam in the walls. In 1970 the popular number for the R-value of one inch of urethane foam was 9.09 per inch. Using this value, we were putting an R of 1.25 x 9.09 = 11.36 in the walls. This was much less than the R = 16 claimed by the fiberglass insulators. Today, using the charts from an ASHRAE book, we would only be able to claim an R-value for the 1.25 inches of 7.5 to 9. Neither of these numbers make for a very big R-value. The reality is that the people for whom we insulated their homes invariably would thank us for the savings in their heat bills. They would tell us their heating bill was half of their neighbor’s. They felt as if they saved the cost of the polyurethane in one, or at most two, years. This is anecdotal evidence, I know, but anecdotal evidence is also compelling and very real in our world. Most of these customers were savvy people. They would not have paid the extra to get the urethane insulation if it had not been better.

About mid 1975 I received a call from a division manager of one of the major fiberglass insulation manufacturers. The caller asked, “I understand that you are spraying polyurethane in the walls of homes?”

I told him that was true. He was calling because we were cutting into the fiberglass insulation sales in our area. He asked, “How can you do it?”

I knew what he meant. He wanted to know how I could look somebody in the eye and sell them a more expensive insulation than the cheap old fiberglass. I told him the way I did it is with a spray gun. Of course, that wasn’t the answer he wanted. He wanted to know how I could not feel guilty. I told him of insulating one of two nearly identical houses built side by side. We insulated the walls with 1.25 inches of urethane. The other house was insulated with full thickness fiberglass batts put in place by a reputable installer. Not only did we use only 1.25 inches of urethane as the total wall insulation, but we had the builder leave off the insulated sheathing. At the end of the first winter, the urethane insulated home had a heating bill half of their neighbor’s. I know that is not terribly scientific, but it is very real. I am not sure he was convinced, but it should be noted that same company jumped into the urethane foam supply business the next year.

One and a quarter inch of polyurethane sprayed properly in the wall of a house will prevent more heat loss than all the fiber insulation that can be crammed in the walls — even up to an eight inch thickness. Not only does it provide better insulation, but it provides significant additional strength to the house.

One of my early clients was Brent. I had insulated several potato storages for Brent. He knew what spray-in-place

“There is a problem with loose-fill fiberglass attic insulation in cold climates. It appears that, as attic temperature drops below a certain point, air begins to circulate into and within the insulation, forming ‘convective loops’ that increase heat loss and decrease the effective R-value. At very cold temperatures (-20°F), the R-value may decrease by up to 50%.”

In full-scale attic tests at Oak Ridge national Laboratory, the R-value of 6 inches of cubed loose-fill attic insulation progressively fell as the attic air temperature dropped. At -18°F, the R-value measured only R-9. The problem seems to occur with any low-density, loose-fill fibrous insulation.

urethane insulation could do. When he decided to build his new, very large, very fancy new home, he asked me to come insulate it. The builder pitched a fit. He “didn’t need any of that spray-in-place urethane in his buildings. He made his buildings tight, and fiberglass was just as good.”

Brent explained to the builder, “I know who is going to insulate the building. It is not as definite as to who is going to be the contractor. You can make up your mind. We are going to have the urethane insulation and you build the building, or we are going to have the urethane insulation, and I will have some one else build the building.” It didn’t take the contractor long to decide he wanted to use urethane insulation.

It was amazing to me how it worked out. We sprayed a lot of foam in Brent’s house, and it cost him quite a bit of money because it was such a large home. Always after when I would meet him, he would tell me his heat bill was less than any of his rent houses or homes of anybody else he knew. And his home was two or three times larger. Also, the builder started having me insulate most of his new custom built houses. He told me he would explain to his clients the best insulation was the spray in place urethane. It would cost a little more, but it was by far the best. Most of the owners opted for the urethane. Never have I had a customer tell me that he did not save money by using the urethane spray-in-place insulation. You can spend all the time you want with R-values and “k” factors, and “prove” on paper there is no way the urethane can do the insulation job that the fiberglass will. In the real world, I can assure anyone there is no way fiber insulation can be as effective as spray-in-place urethane — not even close.

R-value tables are truly part of the “Fairy Tale.” They show the solid and the fiber insulations side by side, implying they can be compared. The fact is, without taking installation conditions into account, comparisons are meaningless. Spray-in-place urethane foam provides its own vapor barrier, water barrier, and wind barrier. None of the other insulations are as effective without special care taken at installation. The fiber insulations must be protected from wind, water and water vapor. Again the tables need a second table to state installation conditions.

Other Anecdotes:

Meadow Gold Company was going to build a freezer in Idaho Falls, Idaho. Chet, the plant manager, was a good friend of the local Butler dealer. The local Butler dealer and I had become good friends. A Butler building does not lend itself very well to a freezer if you are going to insulate the freezer with expanded polystyrene. So the three of us got together and planned a freezer that would accommodate the needs of Meadow Gold yet be built of a Butler building and be properly insulated. This was in my first year of spraying polyurethane foam, and at that time I believed all the literature and knew what we were doing was going to be just right. It turned out even better. The then current R-value table showed one inch of urethane equal to 2.5 inches of expanded polystyrene. So, I suggested we spray the metal building with four inches of urethane to replace the 10 inches of expanded polystyrene normally used by Meadow Gold for freezers.

I sprayed under the slab with four inches, the walls with four inches, and the underside of the roof with five inches of urethane (the fifth inch was added as a safety margin). Chet, the plant manager, was pretty worried because he stuck his neck out going with this non-traditional insulation and the non-traditional building for Meadow Gold Company. Well, the building progressed on schedule, but the equipment to cool the building did not arrive on time. By summer only one of the two refrigeration compressors had arrived. Two

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<td>2.06</td>
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With the lowest k-factor and the highest R-value, urethane foam can provide more thermal resistance with less material than any other insulation.

compressors were needed (per the Meadow Gold engineers) to handle needs of the building based on using 10 inches of expanded polystyrene.

Chet considered one alternative to his predicament was to turn one of the older freezers that had been used as a cooler back into a freezer. Then maybe he could make a cooler out of the new building with just the one compressor. It was not a satisfactory arrangement, but it maybe could work. The other thing Chet kept telling us was that he would know as soon as he turned on the freezer equipment whether or not the building would work. When I pressed him, he said that normally it takes five days to bring a freezer down to 10 F below zero — needed for ice cream. When he turned on the new freezer, with only the one compressor, the temperature dropped to 18F degrees below zero by the second morning. They had their freezer. It ran the entire summer using only the single compressor.
Urethane Conserves Energy

Excellent thermal resistance is the primary performance benefit of urethane foam insulation, but it is not the only one. Urethane also has these advantages as a construction material:

a) Its closed cell structure makes urethane most effective initially and in the long run.
b) When protected by skins or other covering, urethane will not absorb water. Consequently the x-factor (thermal conductivity) is virtually constant.
c) Sprayed-on foam has the advantage of no seams or joints.
d) Urethane’s thermal resistance means that only one thickness of material is need for most jobs.
e) It has a low moisture permeability (1-3 perms).

Where circumstances demand thinner walls or roofs, urethane — with its superior insulating capability — makes it possible to reduce the thickness of the insulation component with no loss of thermal resistance. Or the thermal resistance of an assembly can be increased without enlarging the size of the member. Urethane helps to offset the design restrictions imposed by the fact that most building materials are constant in thickness and weight.


A few weeks after start up of the freezer, I was visited by a Meadow Gold engineer from Chicago. He wanted to know exactly what we had done to insulate the freezer. One compressor should not be able to hold the temperature as it was doing. I explained to him exactly what we had done. He seemed satisfied and he left. A few weeks later he showed up again with his boss. We went to the plant and verified with an ice pick the thickness of the foam. It was indeed four inches in the walls and five inches in the ceiling. Here again they reiterated that the building should not be operating as it was. What they were telling me was that even though I had used one inch of urethane to replace 2.5 inches of expanded polystyrene, the building was still requiring only 50 percent of the normal compressor power for cooling. As you can imagine, the experience made me a lot more bold, and I used the information to sell more freezer insulation jobs.

One of our largest freezer insulation projects was a sixty thousand square foot freezer at Clearfield, Utah. I was able to talk the general contractor into letting us insulate with spray-in-place polyurethane foam the brand-new all-concrete freezer he was building. This building was the 12th in a chain of freezers. My friend Bob, the contractor, had taken it upon himself to make the switch from the ten inches of expanded polystyrene to four inches of urethane with a fifth inch on the roof. The building was built with tilt up concrete insulated on the interior side of the concrete with spray-in-place urethane. We then sprayed on a three-fourths of an inch thick layer of plaster as the thermal barrier. Over the pre-stressed concrete roof panels, we put five inches of spray in place urethane and then covered it with hot tar and rock. (This is an old CPR-specification).

I was on the job the last day. As we finished up the owner showed up. He had expected to see ten inches of expanded polystyrene, and here was four inches of urethane. I told him he would like the four inches of urethane as it would be even better than the expanded polystyrene, based on my previous experience. He told me he was sicker than a dog because he felt like there was no way that could be true. It was too late for him to do anything about it. If he could have, he would have changed the contract instantly, but he was stuck and felt stuck.

They had 12 other similar size freezers, except the others were insulated with expanded polystyrene. The normal way of operating them was to use three large compressor assemblies. Two of the compressors would be needed all summer to keep the building cold, and the third one would be a standby unit, in case one of the other two had problems.

About a year later, I received a phone call from one of the managers. He asked me if I had time to insulate another 60,000 square foot freezer in Clearfield, Utah. I assured him we had the time, the inclination, and the excitement to do it, but I thought the owner wanted nothing to do with urethane foam insulation. The manager explained to me that not only had the Clearfield freezer operated better than any other freezer in their line, it had operated for less than half the costs of any others. They were adding another 60,000 square feet without adding more compressors. The compressor power available to them because of the urethane insulation efficiency allowed them to do it. The building had run very nicely through the hot part of the summer with just one compressor. Now they would be able to run two buildings off of two compressors and still have a spare.

Again, this is anecdotal evidence, but let me assure you that you will get the same results if you do the same thing as we have. I have insulated too many buildings now that I know that this will happen in every case. Never can you use an R-value from a fiber insulation and compare it to the R-value of a foam insulation. Nor can you use the R-value of a foam insulation if it is in sheet form and compare it to the R-value of spray-in-place foam insulation. Spray-in-place polyurethane is a absolute minimum of three to ten times as effective as any other insulation available today.

During the late 1970s, the FTC went after the urethane foam suppliers for misleading advertising especially with regard to fire claims. A consent decree followed. It destroyed
Spray application of urethane foam is fast and efficient. Large wall areas can be covered in minutes. Urethane foam seals wall blocks and around furring to provide seamless, uniform insulated surface.

a tremendous amount of confidence in the use of urethane. Up to that point, Commonwealth Edison would give Gold Medallion approval for homes insulated with 1.25 inches of spray-in-place urethane in the side walls of masonry constructed homes. True, that was anecdotal evidence, but also true, it worked. Much work was done in the early 1970s using a 1.25 inches urethane as a replacement for wall insulation in a home. Not only did it replace the wall insulation, it also replaced the exterior sheathing. Buildings are stronger and better insulated when sprayed with the 1.25 inches of urethane.

Understanding the two purposes of insulation gives a standard to measure the insulations:

1) Heat loss

There is a little understood part about insulation that needs to be covered. There is a substantial difference between insulation for temperature control and insulation for heat loss control. For instance, the graph shows the heat loss control of the spray-in-place urethane foam insulation. Any insulation will have a similar graph but with thicker amounts of insulation. This graph points out that more insulation is not necessarily cost effective. There is a point where more insulation is pointless from a total heat loss perspective.

The graph shows that 70% of heat loss from conductance is stopped by a 1 inch thickness of spray-in-place urethane foam. (remember we are going to stop nearly 100% of the heat loss from air infiltration with the first one-fourth of an inch of urethane foam). The second inch of spray-in-place urethane stops about 90% of the heat loss and the third inch 95% and so forth.

**Thermal Diffusivity — Heat Sinks:**

It should be noted here that when the urethane is used on the exterior of a heat sink, such as concrete, the actual effective R-value is approximately doubled. This is why with the Monolithic Dome, we are able to calculate effective R-values in excess of 60. A heat sink is any substance capable of storing large amounts of heat. Most commonly we think of concrete, brick, water, adobe and earth as heat sink materials used in building. The property of a heat sink to act as an insulation is called thermal diffusivity. The simple explanation for the way it works is: As the temperature of the atmosphere cycles from cold to hot to cold to hot the heat sink absorbs or gives up heat. But because the heat sink can absorb so much heat it never catches up with the full range of the cycle. Therefore the temperature of the heat sink tends to average. Large heat sinks will average over many days, weeks or even months. An example is the adobe hacienda with its 2 to 6 foot thick walls. By the time

This graph illustrates the reduction in heat loss from a building when it is insulated with various thicknesses of spray-in-place urethane foam. Note: the insulation benefit tops off very quickly above three inches. The graph is not exact, but it shows in general what happens as additional insulation is added to the surface temperature. In other words, by super-insulating, the surface temperature of the inside of the exterior walls comes very close to the room temperature. This prevents the condensation, which prevents the growth of mold.
the adobe walls begin to absorb the daytime heat it is nighttime and the same heat then escapes into the cooler night. Therefore the temperature would average. Because the mass of the adobe is so large the temperature averages over periods of months. Adobe acts as an insulation even though adobe has a minimal “R” value.

You can see from the graph that urethane thicknesses beyond four or five inches is practically immaterial. We use three inches for most of our construction. Two inches will do a very superior job. We have insulated many metal buildings with one inch of urethane and the drop in heat loss is absolutely dramatic. Obviously the first quarter inch takes care of the wind blowing through the cracks (It usually takes an inch to be sure the cracks are all filled). The balance of the inch adds the thermal protection.

2) Surface temperatures control:

Surface temperature control is the second reason for insulation. In many cases it is the most important reason for the insulation. I noticed this phenomena first while insulating potato storages. We had various customers ask us to insulate the buildings anywhere from two to five inches of urethane. The building insulated with two inches would hold the temperatures of the potatoes properly, just as well as the building insulated with five inches. The difference came in the condensation. Potato storages are kept up at very high humidity levels. The buildings with the two inches of urethane would have far more condensation than those with the five inches.

An engineer from the Upjohn company explained this to me. He drew for me a graph as shown here. It shows that thicker insulation is absolutely necessary to maintain higher interior surface temperatures. One and a half inches of urethane on the walls and ceiling of a potato storage would control the heat loss from the building, but it took a minimum of three inches of urethane to control the interior surface temperature. Four inches was even better. With five inches did difference is practically negligible. The only place where we have felt the need for five inches of urethane was insulating the roof or ceiling of a sub-zero freezer.

Underground housing — surface temperature control vs. heat loss control

Most of the underground housing is in trouble from mold and mildew growth. The cause is not enough insulation to control interior surface temperatures. Rarely is there a problem with total heat loss. Water vapor condenses on the surface allowing mold to grow. Mold makes people sick. The only solution is lots of insulation for temperature control and ignore total heat loss as it will not be a factor.

My experience is that R-value tables can be used as indicators. They need modifications to make them equal to real world conditions. There needs to be allowances made. They must show equivalents. These equivalents will be more like one inch of spray-in-place urethane equal to four inches of fiberglass in a normal installation. Footnotes to the table will need to define degradation of insulations in real world conditions. Only then will the “R-value” Fairy Tale become a real world success story.
Monolithic Dome Church Pricing

How much does a car cost? It depends on the make and model and age and condition and more. So do church costs depend on -- where, when, what for, location, and more. But a few ideas are in order:

1. Generally a Monolithic Dome Church will cost the same as conventional church. It will cost less than a conventional church if the conventional church is constructed to meet the Type II or Type II FR designation (Fire safe code designations).
2. The lifetime of the Monolithic Church is measured in centuries. Remodeling may be needed from time to time to meet changing conditions over decades of use, but new structures will not be needed.
3. The dramatic difference in energy needs between the Monolithic Domes and conventional is where the big savings are. Less equipment is needed for heating and cooling. Less electrical is needed for the less HVAC equipment. Less equipment needs less maintenance and less replacement when it wears out. If the savings were accumulated in a bond account — it would be reasonable to have the accumulated savings equal the total cost of the facility in less than 20 years.
4. Inflation of construction will distort any numbers given here — So will other factors such as: It is more costly in the Northeast and California, prevailing wage states, and experience of builders and designers.
5. In general the churches have been finishing between $110 and $125 (2007 pricing) per square foot. And can even go higher. There are many factors which can raise and lower the price, such as: auditorium seats, commercial kitchens, television broadcasting lighting, etc.

How to Proceed? Our recommendation is to commission a feasibility study. The feasibility study is completed by one of the designers familiar with the attributes of the Monolithic Dome. A few thousand spent on the front end of the project pays very large dividends in useful information. You may still use your local architect for the final design.

The great part about a feasibility study is the “preliminary program” established. A solution is proposed and a rough budget is created. Then the decision can be made to proceed or make major changes. The Church is not obligated beyond the cost of the feasibility study.

Please let us know what we can do to help. We would like to start with coordinating a feasibility study.

May 5, 2004

UD June 14, 2007
Commercial Feasibility Study
Schools, Churches, Gymnasiums, Office Buildings, Storages, and more

A Feasibility Study is a preliminary study for a project comparing the Monolithic Dome Process to other building systems. The study defines for the owner the design and intent of the project and provides an estimated budget from the best available information. Monolithic Dome Institute offers to produce a feasibility study for assistance to MDI clients before architectural services are engaged. This study will not provide plans for construction purposes.

MDI will engage qualified design professionals to study the owners program. A budget will be established utilizing the information from the design professionals working with the Monolithic Construction Management personnel.

The Client will provide:
- A program describing rooms, space uses and equipment
- A site plan, survey, and / or plot description of the owners property

MDI will provide:
- A preliminary site schematic developed from information furnished by owner.
- A floor plan to scale showing all described space uses.
- An exterior sketch of proposed front building elevation.
- A factual report and estimate of cost for construction using a square foot method based on recent projects of similar type near the same location if possible.

Optional Services Available at extra cost:
- Space planning consultation $300.00
- Interior Volume Analysis Studies Call for Quote
- Dome openings and exterior attachment information $200.00
- Code compliance and testing information Call for Quote
- Acoustical Design Studies and Sound System Consultation $350.00
- Bulk storage layout, sizing and placement of inbound and outbound conveyors $200.00
- Full color rendering Call for Quote

With the study report and the budget, the owner can evaluate and decide to proceed with information to be given to a local architect, banker or building official. There is no obligation beyond the study itself. The basic fee is starts at $7,500.00, plus travel expenses, if needed (very large studies may require a larger fee.) Fifty per cent (50%) is due with the order for the study. The balance is due upon completion.

Accepted by: ____________________________ Date _________________

Print Name and Title ____________________________ Signature ____________________________
Free Evaluation for Church Facility

Name
Title
Church
Address
City, State, Zip
Phone Numbers
Email Address
Size of Congregation
Sanctuary Seating Capacity
Approximate Square Footage
One story or multi-story
Approximate budget
Choir Seating Yes/No How Many?
Orchestra/Band Yes/No How Many?

Special Requirements

Please indicate in the blanks provided your need for each type of room, how many and size each room needs to be.

Baptistry
Offices
Reception
Rehearsal Room
Classrooms
Gymnasium
Conference Rooms
Social Recreational Fellowship Hall
Kitchen
Garage
Television Room
Supply Storage (Robes, Communion Trays, etc.)
Visiting Pastor Lounge
### Nursery
- Display Cases
- Cry Room
- Bookstore

### Wedding Chapel
- Audio-visual Requirements
- Other Special Requirements

### Mechanical
- Heating Required Yes/No
- Natural Gas Available Yes/No
- Natural Warm Water Yes/No
- Other
- Air Conditioning Required Yes/No

### Electrical
- Service — Where located
- Underground/overhead
- Other

### Plumbing
- Water Supply (Well, City line, Other)
- Sewer (City, Private drainfield, Other)

### Site
- Size (Acres/Length & Width)
- Ground (Level, Slightly sloped, Moderate slope, Steep)
- Soil Type
- Parking Spaces How Many?
- Entry to Property Where?
- Ground Water