2016 Honorable Mention

Dome Technology Corporate Headquarters

By Jason South

Dome Technology recently completed a new corporate office in Idaho Falls, ID. The office is a stunning achievement in concrete thin-shell construction.

The achievements showcased in the construction include an open free-span concrete thin-shell building exposed by arching openings and beautiful light window glazing around the building perimeter, a sleek porcelain tiled exterior with an insulated durable shotcrete interior, and geothermal cooling incorporated into the shotcrete shell.

"We wanted to be able to show people what we could do. We bring in people from all over the world to meet with us, and we needed an upgrade," said Dome Technology Project Manager Daren Wheeler.

With this building, the Dome Technology team did something with a concrete thin shell that has never been done before: constructing a free-span open thin-shell geometry using air-formed shotcrete technology without a single conventional concrete form or shore. We gave it a 100-plus-year roof, made it watertight and fully insulated, and we uniquely heat and cool the building using geothermal energy.

Fig. 1: Reinforcing bars and shotcrete are integral parts of the dome construction process

Dome Technology builds bulk-storage and architectural concrete thin-shell domes all over the world and specializes in customized solutions to meet customer needs. Because "technology" is part of its name, Dome Technology sought an architectural style for its new office that would complement its cutting-edge engineering and construction. "It's a modern office showcasing the stunning geometry achievable using Dome Technology's air-formed shotcrete construction process," Wheeler said, adding that visitors can't help but notice the open free-span area with open views and tremendous natural light.

The open spans of the building are made possible due to the strength and geometry of the reinforced concrete thin shell. Concrete thin shells are inherently strong due to their double curvature and robust concrete materials.

Application of the shotcrete and reinforcement followed Dome Technology's standard application process but was uniquely modified to achieve the large arched openings in the building—an elliptical air form fabricated with high-strength architectural polyvinyl chloride (PVC) fabric by Dome Technology's affiliate, Fabric Span, was inflated, and polyurethane foam insulation was applied inside, forming a layer 3 in. (75 mm) thick. Workers then applied layers of reinforcement and shotcrete in a strategic sequence. Multiple applications of shotcrete and steel reinforcing bar were applied until the necessary thickness was achieved and the dome met its strength requirement.

Arched openings were achieved by placing a thin amount of shotcrete and reinforcement in the area to be removed. This shotcrete was integral with the remainder of the shell. Later these areas were cut out and removed from the shell, leaving the arched opening.

The orientation of the building and placement of the arched openings in the shell were designed with the aid of a lighting study to shade the glazing like an eave or shade structure in the summer. This prevents unwanted thermal gain and cools the building in the summer. In the winter, however, the sun is lower in the sky, and the arched opening is sized to allow light to touch the glazing, providing thermal gain that aids in the heating of the building. The glazed window system is light and free of supports, showcasing the light, open span of the shell from the exterior.

The porcelain tile provided a sleek exterior. An earth-tone green color and smooth pattern were chosen to mimic the

Fig. 2: Workers apply shotcrete to form the thin shell

look of freshly placed green concrete. Similar porcelain tile has a life expectancy of more than 100 years.

A PVC membrane doubles as the air-supported concrete form and a single-ply membrane waterproofing system over the entire concrete shell. Three inches (75 mm) of polyurethane form provides superior insulation for the building. In addition to economically protecting against thermal gain or loss of the interior of the building, it protects the concrete shell from thermal stresses induced by uneven radiant heat gain from the sun.

Burns Concrete of Idaho Falls, ID, provided the shotcrete for the project, an easy choice based on a long-term working relationship between the two companies. "They have a good understanding of technical shotcrete mix designs, so they fit our style of construction very well, and they have good quality-control measures in place," Wheeler said. The interior surface of the shell was rodded and troweled smooth, leaving a beautiful 7500 psi (52 MPa) shotcrete finish that will be long lasting and durable.

Perhaps the most remarkable features of the building that are not obvious are the heating and cooling systems, both of which are housed within the shotcrete and the concrete. All heating is achieved through in-floor radiant heat with hot water routed through the floor in multiple zones for flexibility in climate control.

The innovative cooling system is radiant too. According to Justin Judy, a Principal at Engineering Systems Solutions (ES2) who performed engineering on the project, cooling begins with the concrete shell absorbing heat. "As lights are turned on, as people are in the building, and as computers are turned on, that heat rises, and the shell acts as a thermal battery. It essentially collects that heat, so you don't necessarily have to air condition the building because the heat is going into the shell," Judy said.

Fig. 3: Openings are made to the dome shell, which allow light to enter the completed office

Fig. 4: An innovative system of piping runs throughout the shotcrete

Because the shell holds heat exceptionally well, coming up with a way to discharge the energy was necessary. The ES2 team designed a system that circulates 55°F (13°C) ground water from an exterior well through 3 miles (5 km) of PVC tubing routed within the shell. As the water flows through the shell, it collects the heat, then is dumped into an injection well outside. "We aren't paying to air-condition a large portion of the dome because we're using groundwater to do it," Judy said.

Besides long-term cost savings, the heating system provides an ideal work environment for employees. "Particularly with all the openings we have, it's pretty remarkable we can stay as warm as we do with just the radiant heating," said Dome Technology Vice President of Sales, Rod South. "Because the dome shell and the floor are integrated into one concrete thermal mass and we have the radiant heating throughout, it stays nice and toasty through the winters," which can dip to –20°F (–29°C).

The heating and cooling systems provide an effective way to show potential customers the efficiency of heating

and cooling a dome. “Just having the concrete building reduces your cooling costs in the summer because it absorbs the heat,” Wheeler said.

“We feel really proud to be able to show people the office. It’s a highlight of our work. Without shotcrete, this building would not be economically feasible today. This building really highlights what shotcrete construction is capable of. Due to this outstanding showcase of construction (customers) have an inherent trust that the building we’re going to deliver to them is going to be a quality product as well,” South said.

Fig. 5: A view of the dome before exterior finishes were added

Fig. 6: The free-span area lends an open and spacious feel to the office

***Jason South**, Dome Technology Vice President of Engineering, has more than 15 years of international experience in the field of dome structural engineering and has been involved in projects throughout the world. He has been the Engineer of Record for the vast majority of reinforced concrete, thin-shell Dome Technology domes constructed globally. For the Dome Technology corporate office project, South acted as one of the building chief designers.*

HONORABLE MENTION

Project Name
Dome Technology Corporate Headquarters

Project Location
Idaho Falls, ID

Shotcrete Contractor
Dome Technology*

General Contractor
Dome Technology*

Architect/Engineer
Engineering System Solutions (ES2)
Ben Smith and Jason South

Material Supplier/Manufacturer
Schwing America, Inc.*

Project Owner
Dome Technology, Bradley Bateman, CEO

***Corporate Member of the American Shotcrete Association**

Fig. 7: The corporate office’s modern exterior complements the innovative work Dome Technology does