

## Magnificent Roof Structure



The five vaults are 92 feet (28 meters) above ground level.

<b>Resin</b>	Firepel® K133 fire retardant unsaturated polyester
<b>Composite Application</b>	Five huge architectural roof vaults
<b>Manufacturing Process</b>	Hand lay-up
<b>Length</b>	164 feet (50 meters)
<b>Front Dimensions</b>	52.5 by 30 feet (16 by 9.25 meters)
<b>Rear Dimensions</b>	26.2 by 19.7 feet (8 by 6 meters)
<b>Installed</b>	2006
<b>Location</b>	Manama, Bahrain

The new Library and Conference Hall in Bahrain enhances the island nation's reputation for dramatic architectural presentation. The complex is named in honor of the country's late Amir, Shaikh Isa bin Salman Al Khalifa, and is noteworthy for its elaborate designs and grand scale. The Library and Conference Hall is prominently seen from the nearby waterfront and bay.

Artistic expression is especially bold for the Conference Hall roof. Its five huge vault structures demonstrate the versatility of fiber-reinforced polymer (FRP) composites made with Firepel® K133 fire-retardant polyester from AOC. Installed atop the Conference Hall 92 feet (28 meters) above ground level, the vaults represent one of the largest composite roofing structures in the world. Furthermore, the Library and Conference Hall is adjacent to the famous Al Fateh Mosque, whose architectural focal point is the world's largest composite dome.

## Magnificent Roof Structure, cont.

Each vault is 164 feet (50 meters) long with a front overhang that is 52.5 feet (16 meters) wide and 30 feet (9.25 meters) high. The half-cone shape of the vault tapers to 26.2 by 19.7 feet (8 by 6 meters) at the rear.



Molds were built of reinforced concrete and finished with a cultured marble surface.

Engineering for the vaults was accomplished by Composite Designs & Technology of Pune, India. BFG International Ltd. Bahrain manufactured, assembled and installed the roof components following strict ISO 9000 procedures.

### Not viable in other materials

“The desired architecture would not have been economically viable in conventional materials,” said Suhas Kolhatkar, Director of Composites Designs & Technology. “Steel and concrete weigh about 40 to 50 percent more than composites and would have imposed tremendous dead weight on the building’s substructure and footing.”



The front fascia with overhang was one of the six sections that were preassembled on the ground.

In addition to its lightweight and high strength, composite construction offers:

- freedom of design to easily achieve an integral, decorative design on the front fascia;
- dimensional stability through thermal changes;
- excellent thermal insulating properties to reduce air conditioning costs, and
- superior resistance to environmental corrosion, including the effects of salt-sea air.

For ease of molding and handling, each vault was divided into six sections of approximately equal weight. Each section was an assembly of molded panels which were bolted together using rigid, molded-in flanges.

To eliminate the need to transport the large vault sections over a long distance, composite panels were molded in a manufacturing facility built at the job site.



A front section is crane-lifted for installation atop the Conference Hall.

CAD files were transferred to a CNC unit that cut wooden templates for each panel profile. Molds were then built of reinforced cement concrete and finished with a cultured marble surface.

Workers for BFG International Ltd. Bahrain used hand lay-up to mold the composite sections. To achieve high stiffness at a low weight, a honeycomb core was sandwiched between composite laminates of fiberglass chopped strand mat and woven roving in Firepel K133 flame-retardant polyester.

## Magnificent Roof Structure, cont.

### Firepel® K133 benefits

“Firepel K133 polyester resins are specifically designed to be blended with alumina trihydrate to cost-effectively achieve fire-retardant properties,” said Bruce Curry, AOC Product Leader for Firepel resins. “Laminates made with Firepel K133 series have passed ASTM E 84 class I flame spread and smoke development, UL 94-HB, UL94-5V and UL 94-V0 test requirements. The resin series also passed tests established by fire standards B 476 for building materials and construction and BS 6853 for passenger trains.”

Assembled vault sections were crane-lifted to the top of the Conference Hall and installed in back-to-front sequence. “Each vault was installed within a tolerance level of plus-or-minus three millimeters (0.19 inch), demonstrating the advantage of lightweight composite structures for fast installation,” said Kolhatkar. “The installation of a single vault took three days, including pre-assembly. The entire project, from concept design to final installation, took only 16 months.”

### About Composites Design & Technology

Based in Pune, India, Composites Design & Technology is a team of professionals with decades of multinational experience in composites technology. CDT offers total solutions to all design and engineering requirements for fiber-reinforced polymer (FRP) composites, especially for infrastructure, architecture, transportation, marine construction and corrosion-resistant structures.

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### About AOC

Headquartered in Collierville, Tennessee, AOC is a leading global supplier of resins, gel coats, colorants, additives and synergistic systems for composites and cast polymers. AOC is the North American leader in resins for corrosion-resistant applications. AOC products are manufactured in facilities strategically located in North America, Europe and Asia. AOC-owned manufacturing plants are ISO 9001:2000-certified, use proprietary technology to ensure resin batch-to-batch consistency, and follow Six Sigma-Lean principles for improved efficiency and quality.

Structural composites are a priority at AOC. For more information, contact Ben Bogner, P.E., C. Eng., by e-mail: [bbogner@aoc-resins.com](mailto:bbogner@aoc-resins.com), by phone: (630) 665-2675, or visit: [www.aoc-resins.com](http://www.aoc-resins.com).



The half-cone-shaped vaults taper from 52.5 by 30 feet (16 by 9.25 meter) dimensions in front to 26.2 by 19.7 feet (8 by 6 meters) at the rear.

  
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