



# ON SITE IN SAUDI ARABIA

HOW AIR ENTERPRISES IS PROVIDING VENTILATION SOLUTIONS FOR THE KING ABDULAZIZ CENTER FOR WORLD CULTURE BY ERIK CASSANO

The King Abdulaziz Center for World Culture is designed to take your breath away. Once completed in 2015, the sprawling complex in Dhahran, Saudi Arabia, will contain a document archive, library, learning center, art and history museum, and performing arts facility, among other features.

The total space will cover square footage equal to 10 soccer fields. The 217 miles of stainless steel architectural tubing on the facility, if laid end to end, would nearly cover the distance from Dhahran to the Saudi Arabian capital of Riyadh. And every square foot of the facility needs ventilation — in some cases, starkly different forms of ventilation and air quality controls from section to section.

That was the challenge facing Air Enterprises when it joined the project.

“This is a project that was funded by Saudi Aramco, the national oil company of Saudi Arabia,” says Glenn Swartz, vice president of contract administration for Air Enterprises. “They were looking to construct a complex that would both celebrate and contribute to the social and intellectual progress of Saudi Arabia and its people. The fact that it’s in Dhahran, very close to the site of the first oil-producing well in the country, is very significant.”

When Air Enterprises agreed to work on the project, the company soon discovered that the museum, archive and library had unique ventilation requirements. The archive and library needed air conditioning and humidity controls conducive to preserving paper, while the museum had different requirements for the artwork and exhibits housed within. But it all had to co-exist under one roof.



Photography courtesy of Snøhetta





“We started looking at that in 2011, when Saudi Aramco first came to us and asked about our interest in working on the project — not just in quoting the job, but in developing the final engineering and design prospectus for the HVAC,” Swartz said. “We had done other work for Aramco’s research facility, and they had been impressed with the results, so they had confidence that we could find solutions for this project, even with its incredible size and scope.”

### The climate

Maintaining constant, precise air quality is difficult even in a temperate climate with mild conditions, but Dhahran is far from that. Situated on a seam between the Arabian Desert and the marine climate of the Persian Gulf, Dhahran is subject to both blistering desert heat and wilting humidity. An HVAC system designer is fighting an arduous uphill battle against the elements, even before the first section of ductwork is hoisted into place.

“It’s not the dry desert you might expect,” Swartz says. “It’s both high temperature and high humidity. In that environment, adapting the outside air for the required ventilation needs of the building is a big challenge. It requires a great amount of energy to treat the outside air.”

Adding to the complexity of the project, Saudi Aramco aimed to construct a “green” building with limited energy consumption and a high level of sustainability.

“Because it is such a high-profile, iconic facility for their country, there was and is a major push for all forms of efficiency and energy sustainability,” Swartz says. “There is an across-the-board effort to reflect the best possible utilization of resources. We had some experience working with Saudi Aramco in that climate, with those types of conditions and expectations, so we were able to engineer some creative solutions.”

One of the main energy-saving features Air Enterprises is utilizing is a thermal energy recovery wheel to treat air. In cooling systems, a thermal wheel utilizes rotating honeycomb-shaped air pockets to absorb and dissipate heat from the outside air, cooling it and reducing the humidity before introducing it to the air conditioning system, where it undergoes final cooling and conditioning before entering the building’s occupied space.

“The wheel, which is also called an energy recovery wheel, was manufactured through a sister company, Thermotech Inc.,” Swartz says. “It was one piece of technology we could use to help minimize energy consumption in the facility.”

### A unique situation

Air Enterprises wasn’t the original supplier/designer of the center’s HVAC system. The company was called upon by Saudi Aramco to improve upon the initial design, to make it more efficient and effective.

That meant that Air Enterprises joined the project a year after construction had started, meaning the company had to retrofit the design, and devise creative ways to install the new components into sections of the center that had already been built.

Swartz says the company utilized its SiteBilt™ process to deal with the logistical challenges of shipping products halfway around the world and installing them into an existing structure.

“Air Enterprises will manufacture the casing panels, structural base and other sub-assemblies, and take all of those parts and crate them for shipment,” he says.

There were 81 air handlers, which took 75 shipping containers to transport the SiteBilt™ units via ocean freight. The units will then be assembled at the job site.

In most instances, large components such as air handling units are assembled at the company’s Akron plant, as shipping

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Vice President of  
Contract Administration,  
Air Enterprises



and installing preassembled components provides the quickest and most efficient means of completing a job. But some jobs aren't well suited for the shipment and installation of ready-made components, and in those cases, SiteBilt™ provides an ideal alternative.

“It's an alternative in situations where you might have rigging access limitations, crane issues and other jobsite challenges,” Swartz says. “At the King Abdulaziz Center worksite, they can receive the materials, assemble the components and do final testing on them without disrupting the completed portion of the building structure.”

Air Enterprises is supervising the final assembly and installation of the components, although Saudi Aramco's workers are performing the actual work, due to their intimate knowledge of the building construction.

### Materials and maintenance

In a harsh climate like that of Dhahran, construction materials play a critical role in the life of building components. That's another reason that Saudi Aramco sought out Air Enterprises to complete the HVAC work on the King Abdulaziz Center.

Air Enterprises fabricates its components from aluminum, which doesn't rust and is resistant to other types of corrosion and deterioration. The durability of aluminum makes it an ideal material for use in extreme heat and humidity.

“It's particularly important for the air handling units,” Swartz says. “The interior and exterior of the air handlers are directly exposed to the elements, so they have to be extremely durable. That's why we use aluminum. It's durable, it has a low weight compared to steel, and it's going to last the life of the building. They won't have to tear everything out and replace it in 15 years, or incur high annual maintenance.”

However, the metal itself doesn't need to corrode in order

for problems to develop. If metal plates and joints aren't able to endure shifts in temperature and humidity, they can warp, causing seams to fail and allowing moisture to enter the system and cooled, processed air to escape. The net effect is an inefficient system that has to work exponentially harder to condition the air and that can potentially damage the interior of the building with leaking moisture, or pose building control issues.

“That's probably the most compelling argument for using aluminum,” Swartz says. “It helps maintain the performance efficiency of the system by helping to prevent air leakage and preventing outside contaminants from entering the system. That is what really helps keep utility costs low over the life of the building. In a hot, humid environment like that of Dhahran, that's obviously very important.”

Air Enterprises designed the HVAC system with maintenance in mind. Even with aluminum components, the system will need regular upkeep to ensure that it continues to run at its most efficient. That means regularly scheduled maintenance, which, in turn, means building a system that is relatively easy to maintain and control.

Because the system was, in effect, retrofitted to the building design, the engineers at Air Enterprises faced design challenges.

“Some of our units are configured in an over-under, stacked arrangement,” Swartz says. “That required us to build service platforms into the design, so the owner of the building can service the equipment on the stacked, double-deck units. It required us to utilize our collective engineering expertise to design configurations that would allow for relative ease of access, making service as easy as possible for the owner.”

Air Enterprises finished shipment of the final materials to Saudi Arabia in September 2013 and began supervision of the on-site construction process in October. With the facility slated for completion in less than two years, the timeframe is tightening for Air Enterprises to have the units assembled, tested and installed. But Swartz says it's a challenge that the company expects to meet.

“Each job has its own unique challenges, specifications and requirements, but we've been installing these systems for more than 45 years,” he says. “We've had experience building and installing our equipment in hot and humid environments. We've done work in Saudi Arabia, and we've built and installed units for pharmaceutical companies in Puerto Rico. We've done complicated work like this before, and we know how get it done, even in extreme climates. We're going to make sure Saudi Aramco and the people at the King Abdulaziz Center are thrilled with the final product.” ▲



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