NEW *Indianapolis Airport Parking Garage* Delivers Sustainability & *2.5 Million Square Feet of Parking Space*

Liz Vogel

Life expectancy was a key factor in creating a parking garage for the new Indianapolis International Airport. Planners wanted a structure that could withstand intense traffic, extremes of weather and corrosive de-icing chemicals for the next 75-years. They also hoped to achieve LEED (Leadership in Energy and Environmental Design) certification. That would indicate that their construction materials and techniques were environmentally responsible. With such a massive project and a tight timeline, choosing a durable concrete with early strength gains was crucial. High-performance concrete made with Silica fume helped planners meet all of their design and construction goals.

The entire project was targeted for completion in 16-months, at a cost of approximately $12,000 per parking space, compared with a price tag of $15,000 per space—more typical for garages of this size.

Located eight miles from downtown Indianapolis, the airport serves as a gateway to America's 13th largest city. More than 8.5 million passengers and 1.15 million tons of cargo travel through the facility each year.

When the new airport opens in 2008, a 2.5 million square foot parking garage will provide 7,100 parking spaces. The structure consists of five floors—each one with 11.5 acres of parking.

Indianapolis-based Turner Construction Company was

contracted to serve as the construction manager for the parking garage.

"Construction began in March 2006," explained Joe Estes, General Superintendent for Turner Construction. "By August, we were pouring 1,500 – 2,000 yards a week of concrete—that's a lot. The decision to use silica fume concrete helped us keep our promise to the Indianapolis Airport Authority to build a durable, environmentally sound structure, on a short schedule."

Silica fume is a by-product of silicon and ferro-silicon metal production. Very fine, non-crystalline silica is produced in arc furnaces as a smoke by-product of the production of elemental silicon. It's also known as condensed silica fume, microsilica, silica dust, and volatilized silica, and is commonly found in many high-performance concrete compositions.

Delivery of densified silica fume is very similar to bulk handling of Portland cement or any other cementitious material. Compressed air is used to transfer the silica fume from the tanker into the silo at the concrete plant.

Silica fume is a unique material with a high amorphous SiO^2 content. It is extremely small—about 100 times smaller than cement grains—and has a corresponding large surface area. As a highly-reactive pozzolan, silica fume added to concrete will dramatically increase the service-life of structures, while accelerating the strength gain at early ages.

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LIFE EXPECTANCY

According to Ramey Durbin, a member of the project's engineering team at Ter Horst, Lamson & Fisk, Inc., "Life expectancy was real important—you don't plan on having to rebuild the parking garage anytime soon. Here in the mid-west, we use a lot of de-icing salts. The silica fume performs really well because it makes the concrete more dense and refines its pore structure. Chemicals can't penetrate and start the corrosion process."

The very small size of the silica fume particles is one of the keys to its performance. It's estimated that when replacing 15% of Portland cement with silica fume, there are approximately two million particles of silica fume for each grain of cement. Since silica fume is so fine, it fills in spaces that, in traditional concrete, are voids. The concept of filling the spaces between cement with silica fume particles is called, "particle packing." Filling those tiny gaps significantly reduces permeability and prevents chlorides and other deleterious chemicals from entering into the concrete causing reinforcing-steel corrosion.

A software model called, "Life-365,™" was used to demonstrate the 75 year life-expectancy and life-cycle cost of concrete parking deck design. Life-365 was developed by an industry consortium to help predict the service life and provide a life-cycle costing for steel-reinforced concrete structures. The software is available for free download at *www.silicafume.org*.

LEED CERTIFICATION

One target set for the new airport and its parking garage was to obtain certification under the Leadership in Energy and Environmental Design (LEED) Green Building Rating System. This program encourages the global adoption of sustainable green building and development practices.

Because silica fume is considered recycled content in the concrete it helped the concrete receive credits under the "Materials and Resources" section of the LEED standards. The overall parking garage construction contributed to nine of the projected 31 credits needed to obtain LEED certification.

The Environmental Protection Agency recently added silica fume to the list of materials meeting the requirements for recycled materials under the Resource Conservation and Recovery Act (RCRA) for use in concrete. Before its widespread use in concrete, most silica fume ended up in land fills. Now very little is land-filled in the United States.

CONSTRUCTION SPEED

The airport's new garage is three times the size of the one it will replace. About 5,900

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spaces will be available to the public. Another 1,200 spaces will be reserved for on-site rental car companies. The design includes moving walkways to transport travelers down a central atrium to the airport terminal's ticketing area. ATM-style kiosks will be available in the garage for use by travelers without baggage. An electronic mapping system is being developed to guide motorists to open parking spaces.

"When you look at the size of this garage, speed of construction is a very important aspect," said Ter Horst, Lamson & Fisk's-Durbin. "Silica-fume concrete let us do that very well."

The garage construction was limited to a 16-month window. The high performance, silica-fume concrete developed early strength properties that enabled the team from F.A. Wilhelm Construction Company, Inc., to begin post-tensioning the deck slabs within 20-hours of pouring the concrete.

Columns in the garage design used 8,000 PSI concrete compressive strength to compliment the 6,000 PSI concrete used for the girders, beams and decks.

Since silica fume concrete provides higher strength than normal concrete, framing sizes can be smaller and spaced further apart. The bay spacing—60-feet by 54-feet, nine inches—combined with 12-feet floor to floor gives the Indianapolis Airport parking garage an open, unconfined feeling.

Silica fume concrete requires very little finishing. Other concretes bleed water that has to evaporate before putting the surface finish on it. A "one-pass" finishing method is used with silica fume concrete. The concrete is floated, broom-textured, and cured. Then it's done. The one-pass finishing method significantly reduces the labor needed to finish a section and has a significant impact on labor costs.

"Because of the availability of various concrete mixes with silica fume, we never missed a day due to weather or temperature," said Estes. "We were able to stay on schedule to complete a state-of-the art parking garage that will serve the people of Indianapolis well for nearly a century."

COST

Building the new airport parking garage cost about $3,000 per parking space less than one built with traditional concrete.

"Using silica fume concrete and post tensioning the deck slabs and girders doesn't take as much labor as other construction techniques," explained Joe Estes. "Post-tensioning is a method of reinforcing concrete to counteract the weight it will carry, and allows us to use less material. Concrete with silica fume costs a little more than other concretes, but we used much less concrete in the overall garage design."

The material savings include using significantly less steel rebar, as well as less concrete. The one-pass finishing method and post-tensioning the concrete also deliver significant labor savings.

"The use of silica fume concrete combined with post-tensioning produced a cost effective and durable approach to creating a parking garage that will stand the test of time," said Durbin. ■

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