

# CONCRETE

SEPTEMBER 2008

## THE CHOICE FOR SUSTAINABLE DESIGN

### A LOOK INSIDE CONCRETE:

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Cover Photo: E2 City Homes uses ICFs, photo by Dana Wheelock, courtesy of LHB.

# ENERGY AND ENVIRONMENT

## CONCRETE AT ITS CORE.

BY JENNI PROKOPY

### FOCUS ON ENERGY EFFICIENCY

It might be materials that build the world, but today the design and construction industry is turning its gaze upon energy efficiency, the measure by which all new structures are now appraised as part of the evolving sustainability movement. If the greenest materials around don't result in a low-energy structure, why build with them?

That's where concrete comes in: "There is no other more energy-efficient building material known to man," explains Brian McCarthy, president of the Portland Cement Association (PCA). As a baseline, "Buildings with concrete external walls use up to 40 percent less energy than wood frame buildings," he says.

According to market research recently conducted by PCA, 77 percent of surveyed architects, designers, engineers and other design professionals say they chose concrete as their sustainable material for recent projects. In fact, energy efficiency was perceived as the most important attribute when selecting a building material, followed by durability and aesthetics.

This focus on energy use is part of a bigger effort by the building industry to step back and view sustainability as a big picture issue. "In a very practical sense, sustainable development means looking at the total life cycle," says McCarthy. This necessitates conducting more

life-cycle assessments (LCAs) for materials and processes. "We have to expand our definition — it goes beyond cement, into concrete," he says.

The industry is making strides in reducing its energy use and emissions. "We still have to make changes in the manufacturing process, and the industry has committed to voluntary targets," says McCarthy, "but true sustainable development does not begin and end with one component."

### NEW TECHNOLOGIES AND POLICIES

It's not just the design community's focus on energy efficiency that's driving change in the construction industry; new legislation — from the federal level down to the smallest municipalities — is demanding more sustainability when it comes to repairing and building new infrastructure. In Chicago, for example, an ordinance enacted in January 2008 creates more stringent requirements for stormwater management, spurring the use of pervious concrete pavement throughout the city in alleys, parkways, roadways and parking lots.

Ready mixed concrete companies are innovating, too, creating new products to solve fresh challenges posed by the sustainable movement. In Colorado, Recycled Materials Company created Biota from recycled concrete runways at the former Stapleton Airport in Denver; the

uniformly graded concrete rubble is used as a protective layer to keep rodents from burrowing into entombed environmentally sensitive material on neighboring land.

And where concrete itself can't be improved upon, firms like Dukane Precast in Naperville, Ill., are finding other ways to go greener, like using bio-based foam — that partially substitutes castor or soybean oil for petroleum products — in its precast double wall system.

### CEMENT'S FORECAST

Given the snowballing sustainability movement, the cement industry is currently engaged in a \$6 billion capacity expansion to accommodate the growing need for concrete. Ed Sullivan, chief economist for PCA, says that in the short term, some of this expansion will be postponed because of the current economy.

But he stresses that the cement industry is ready. The next couple years will be challenging, and then "strong growth rates in cement consumption are anticipated beyond 2010," Sullivan says in his most recent forecast.

"All that expansion is being built for a reason... by 2030 we're still looking at a 180 million ton market," says Sullivan. Demand will be driven by a large expected U.S. population increase: "Sixty-three million more people will be living in the United States in 2030 and they will need homes, schools, hospitals and roads. This construction will boost demand for cement to record levels."

In the residential sector alone, expected growth (to more than triple today's numbers) in the use of insulating concrete forms (ICFs) to build energy-efficient homes will have a major impact: "If these green conditions materialize residential concrete construction will add roughly eight million metric tons to the cement intensities in 2030," Sullivan says. ■

## SMALL TOWN TAKES CONCRETE TO THE EXTREME



Photo courtesy of Logix ICF

IN GREENSBURG, KAN., CONCRETE IS LITERALLY THE BUILDING BLOCK ON WHICH THE TOWN STANDS. OR WILL STAND, THAT IS — ON MAY 4, 2007, A MASSIVE TORNADO RIPPED THROUGH THE SMALL TOWN, DEVASTATING NEARLY EVERYTHING AND LEAVING A LONE CONCRETE SILO STANDING IN ITS WAKE.

IT TOOK ONLY A FEW DAYS FOR FORM SYSTEMS, A NEARBY INSULATING CONCRETE FORM (ICF) MANUFACTURER,

TO MOVE IN AND HELP KICK OFF THE REBUILDING OF GREENSBURG, STARTING WITH THE HOME OF THEN-MAYOR LONNIE MCCULLOM, USING ITS LOGIX BRAND OF ICF.

LITTLE MORE THAN A YEAR LATER, THE TOWN IS FULLY COMMITTED TO BUILDING GREEN ALL THE WAY, WITH THE HELP OF COMPANIES AROUND THE NATION AND UNDER THE WATCHFUL EYE OF THE PRESS. (LEONARDO DICAPRIO HAS EXECUTIVE-PRODUCED A TV SERIES, "GREENSBURG," DOCUMENTING THE TOWN'S PROGRESS FOR DISCOVERY NETWORKS' NEW STATION PLANET GREEN.)

ALMOST 25 STRUCTURES IN GREENSBURG ARE CURRENTLY BEING REBUILT WITH LOGIX ICFS, AND THE NEXT TWO YEARS SHOULD SEE MANY MORE, SAYS SCOTT RUDD, OPERATIONS MANAGER FOR FORM SYSTEMS.

DANIEL WALLACH, DIRECTOR OF GREENSBURG GREEN TOWN — A NONPROFIT HELPING MANAGE THE TOWN'S RECONSTRUCTION — SAYS FORMIDABLE CONCRETE STRUCTURES ARE JUST WHAT THE TOWNSPEOPLE NEED RIGHT NOW. "THERE IS A LOT OF COMMON SENSE TO IT," HE SAYS. "WHEN YOU'VE LOST YOUR HOME TO A TORNADO, CONCRETE SOUNDS PRETTY GOOD." AND AS A BONUS, SAYS RUDD, THOSE NEW ICF HOMEOWNERS WILL CUT THEIR HVAC SYSTEMS' INITIAL COSTS BY A THIRD AND EASILY ENJOY A 50 PERCENT SAVINGS ON ENERGY BILLS.



All articles in the concrete section are written by Jenni Prokopy and sponsored by the Portland Cement Association. Prokopy is the founder of Orange Grove Media, LLC, an independent communications firm providing writing and editing services, with almost 20 years in the communications business. She received her Bachelor of Science in Journalism degree from the Medill School of Journalism at Northwestern University, and has received numerous awards for her work as both a writer and as an activist with organizations like the Construction Writers Association. Contact her at [jenni@orangegrovemedia.com](mailto:jenni@orangegrovemedia.com).

# GROWING BENEFITS WHILE SHRINKING FOOTPRINTS

CEMENT INDUSTRY SETS SIGHTS ON ALTERNATIVE FUELS AND MATERIALS.

BY JENNI PROKOPY

“Avoid disposal of material that would otherwise end up in a landfill.”

That’s a primary goal in using alternative fuels and materials for the manufacture of cement, and according to Andy O’Hare, vice president of regulatory affairs for the Portland Cement Association (PCA), the cement industry is making huge strides toward maximizing this practice.

Assuming a plant is sourcing the materials close by, says O’Hare, there are significant environmental and cost benefits to using alternative materials (as opposed to mining virgin fuels or raw materials). Cement manufacturers also save money by purchasing alternative fuel sources; for example, many cement plants that burn scrap tires as fuel (45 plants in the U.S. are permitted to do so) receive those tires free of cost or for only a small transportation fee. And, says O’Hare, “in many cases, these alternative fuels are less carbon-intensive, so you get a benefit that’s related to climate change.”

Much of the alternative raw materials available to cement plants are recaptured industrial byproducts. The list includes mill scale, blast furnace slag, bottom ash, foundry sand, petroleum-contaminated soil, refractory brick and water treatment sludge.

The alternative fuels list also includes castoffs, like scrap tires, plastics, municipal refuse, oils or solvents, rice hulls, spent toner, spent activated carbon and coal tar sludge.



*Cemex's plant in Davenport, Calif., took home multiple honors in the 2008 Energy & Environment Awards sponsored by PCA and Cement Americas magazine. The plant has, among other things, received the 2007 U.S. Environmental Protection Agency ENERGY STAR award. Image courtesy of CEMEX.*

## CEMEX USA HEADQUARTERS PUTS PHILOSOPHY INTO ACTION

IN WEST HOUSTON, CEMEX USA – THE NATION’S LARGEST CEMENT AND READY MIXED CONCRETE COMPANY – IS SEEKING LEED CERTIFICATION OF ITS NEW HEADQUARTERS. IN EARLY 2009, THE MULTINATIONAL BUSINESS WILL MOVE INTO CEMEX CENTER, A 325,000-SQUARE-FOOT OFFICE BUILDING OF WHICH THE COMPANY WILL LEASE APPROXIMATELY HALF THE SPACE.

DEVELOPED BY METRONATIONAL AND DESIGNED BY MORRIS ARCHITECTS, THE BUILDING’S PRIMARY FOCUS IS ON ENERGY EFFICIENCY; MUCH OF THE CONCRETE WILL REFLECT SUNLIGHT DURING THE DAY AND RADIATE LESS STORED HEAT AT NIGHT, REDUCING THE URBAN HEAT ISLAND EFFECT AND CUTTING COSTS ON AIR CONDITIONING.

THE BUILDING EMPLOYS CONCRETE MIXES WITH CLASS C FLY ASH (AN INDUSTRIAL BYPRODUCT) AT A 25 PERCENT REPLACEMENT RATE, HELPING MAKE THE CONCRETE STRONGER, DENSER, MORE DURABLE AND MORE WORKABLE. MOST OF THE MATERIALS USED IN THE CREATION OF APPROXIMATELY 32,000 CUBIC YARDS OF CONCRETE (FOR THE BUILDING AND ACCOMPANYING PARKING GARAGE) ARE MANUFACTURED WITHIN A 500-MILE RADIUS OF THE SITE.

“LOCATING OUR U.S. HEADQUARTERS IN AN OFFICE BUILT UPON SUSTAINABLE ECOLOGICAL AND ENVIRONMENTAL PRINCIPLES STRENGTHENS OUR COMPANY AND PRESERVES THE QUALITY OF LIFE FOR PRESENT AND FUTURE GENERATIONS,” SAYS GILBERTO PEREZ, PRESIDENT OF CEMEX USA.



*Image courtesy of CEMEX USA.*

The cement industry has a number of environment-related voluntary goals it's striving to meet, focusing on cutting CO<sub>2</sub> emissions, reducing the amount of cement kiln dust (CKD) that is landfilled, implementing auditable and verifiable environmental management systems and boosting energy efficiency. And while there is not yet any specific industry goal for alternative fuel use, O'Hare says it won't be long before it's added to the list and that PCA is currently working with the U.S. Environmental Protection Agency (EPA) to study options. "The future holds much more opportunity to use these materials," O'Hare says.

**ENERGY & ENVIRONMENT AWARDS INSPIRE**  
Sponsored every year since 2002 by PCA and *Cement Americas* magazine, the annual Energy & Environment Awards recognize cement plants in six categories: Environmental Performance, Land Stewardship, Outreach, Innovation, Energy Efficiency and Overall Environmental Excellence.

Elizabeth Dutrow, director of industrial sector partnerships for the EPA ENERGY STAR program, has served as a judge in recent years, and says the 2008 awards show real achievement in the industry. "Those plants which have qualified in either winning or becoming a runner-up for the Energy Efficiency award have developed more long-



At Lafarge North America, Inc.'s Sugar Creek, Mo., cement plant, 33 percent of raw materials come from alternative sources like local utility bottom ash, boiler slag, foundry sands, iron mill scale and limestone fines. Image courtesy of Lafarge North America.

term energy strategies that they have built upon previous successes, to mature the programs that they have," she says.

The top winner this year was CEMEX's plant in Davenport, Calif., which took home the Overall Environmental Excellence award, as well as the Land Stewardship award (in part for receiving the Forest Stewardship Council Smartwood Certification from the Rain Forest Alliance) and was a finalist in the Environmental Performance and Energy Efficiency categories.

Another success story is the California Portland Cement Company plant in Colton, Calif.,

winner of the Energy Efficiency award. Not only has the plant reduced energy use and CO<sub>2</sub> emissions, but it has also added a corporate director of energy services to oversee energy conservation — and in 2007, the plant received the ENERGY STAR Sustained Excellence Award.

**SUGAR CREEK PLANT LEADS IN USING ALTERNATIVE RAW MATERIALS**

Another cement plant that took home multiple 2008 Energy & Environment Awards is Lafarge North America, Inc.'s Sugar Creek, Mo. facility. The recognition is due in large part to its using 33 percent alternative raw materials in the manufacturing process, says Steve Kidwell, environmental and public affairs manager for the plant.

In 2007 alone, Sugar Creek used more than 375,000 tons of alternative raw materials including utility bottom ash, utility boiler slag, foundry sands, iron mill scale and limestone fines. Kidwell says the plant uses so much local utility bottom ash that the five generating stations nearby have stopped landfilling any of the byproduct, and at one location Lafarge is even mining material from the old ash pond for use at Sugar Creek. The key benefit of using raw materials is easy to explain, says Kidwell, "We send out good product, but it makes less CO<sub>2</sub> per ton."

Sugar Creek is also committed to using alternative fuels. In 2007, it opened an alternate solid fuels facility designed to turn industrial byproducts from regional manufacturing firms into fuel — reducing the plant's reliance on fossil fuels by 50,000 tons annually. ■

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The third annual "Concrete Thinking for a Sustainable World" student design competition, co-sponsored by Portland Cement Association (PCA) along with the National Ready Mixed Concrete Association (NRMCA) and administered by Association of Collegiate School of Architecture (ACSA), is just one way the concrete industry is working to inspire students to embrace sustainable design. With more than 800 students applying this year (studying at 33 architecture schools from around the world), judges had a wide variety of ideas to pore over in making their decisions.



# EARNING POINTS

CONCRETE CAN HELP EARN POINTS IN GREEN BUILDING RATING SYSTEMS.

BY JENNI PROKOPY

As the green building industry has evolved, so has the way concrete helps structures become more sustainable. Concrete can help earn points toward LEED certification in every major credit category. And as LEED-NC has evolved, the way it treats concrete has, too.

One of the most striking changes is in the Materials & Resources category, says David Shepherd, director of sustainable development for PCA. “As green becomes more mainstream, what we did five years ago becomes more readily accepted as standard operating procedure,” he explains. Because USGBC’s mission is to transform the marketplace, he says, they raise the bar: where in earlier versions of LEED-NC a building could earn one point toward Credit 4.1 for using 5 percent recycled content, that has now doubled to requiring 10 percent recycled content, and the same goes for Credit 4.2 — doubled to requiring 20 percent recycled content.

“That revision touts the impact of concrete,” explains Shepherd. “They’re changing how concrete is specified, and giving more value to that part of concrete that has the biggest impact...and encouraging use of supplementary cementitious materials.”

## ENERGY EFFICIENCY: E2 CITY HOMES

One of the surest ways to earn points for energy efficiency in both residential and commercial construction is by using concrete in the building envelope. The Urban Project put this idea to use in its E2 City Homes development in Minneapolis. The two-story, four-unit residential complex used insulating concrete forms (ICFs) from Reward Wall Systems and was a LEED-H pilot project, earning Gold certification — and numerous awards.

ICFs are stay-in-place forms made of foam, into which reinforcing steel and concrete are placed to create a sandwich wall with a high R-value, extreme durability and strength, sound-dampening qualities, insect resistance and fire safety. In the case of the E2 City Homes, ICFs helped the homes earn a low HERS rating, a measure of energy efficiency that impacts how a home earns points toward LEED certification.

Donn Thompson, PCA’s program manager for residential technology, explains: If a home has a HERS rating of 100, it meets the minimum requirements of the model energy code — a prerequisite for LEED-H EA Credit 1.1. Each point reduction in a HERS rating refers to a 1 percent improvement in energy consumption above the prerequisite; the E2 City

PROJECT CHECKLIST: LEED – NEW CONSTRUCTION (NC) V2.2 HOW CONCRETE MAY CONTRIBUTE TO POINTS		
<b>CREDIT CATEGORIES</b>		
SUSTAINABLE SITES		POSSIBLE POINTS
CREDIT 3	BROWNFIELD REDEVELOPMENT	1
CREDIT 5.1	SITE DEVELOPMENT: PROTECT OR RESTORE HABITAT	1
CREDIT 5.2	SITE DEVELOPMENT: MAXIMIZE OPEN SPACE	1
CREDIT 6.1	STORMWATER DESIGN: QUANTITY CONTROL	1
CREDIT 7.1	HEAT ISLAND EFFECT: NON-ROOF	1
<b>ENERGY AND ATMOSPHERE</b>		
PREREQUISITE 2	MINIMUM ENERGY PERFORMANCE	REQUIRED
CREDIT 1	OPTIMIZE ENERGY PERFORMANCE	1-10
<b>MATERIALS AND RESOURCES</b>		
CREDIT 1.1	BUILDING REUSE: MAINTAIN 75 PERCENT OF EXISTING WALLS, FLOORS AND ROOF	1
CREDIT 1.2	BUILDING REUSE: MAINTAIN 95 PERCENT OF EXISTING WALLS, FLOORS AND ROOF	1
CREDIT 2.1	CONSTRUCTION WASTE MANAGEMENT: DIVERT 50 PERCENT FROM DISPOSAL	1
CREDIT 2.2	CONSTRUCTION WASTE MANAGEMENT: DIVERT 75 PERCENT FROM DISPOSAL	1
CREDIT 4.1	RECYCLED CONTENT: 10 PERCENT (POST-CONSUMER PLUS 1/2 PRE-CONSUMER)	1
CREDIT 4.2	RECYCLED CONTENT: 20 PERCENT (POST-CONSUMER PLUS 1/2 PRE-CONSUMER)	1
CREDIT 5.1	REGIONAL MATERIALS: 10 PERCENT EXTRACTED, PROCESSED AND MANUFACTURED LOCALLY	1
CREDIT 5.2	REGIONAL MATERIALS: 20 PERCENT EXTRACTED, PROCESSED AND MANUFACTURED LOCALLY	1
<b>INNOVATION AND DESIGN PROCESS</b>		
CREDIT 1.1	INNOVATION IN DESIGN: REDUCE CEMENT CONTENT	1
CREDIT 1.-1.4	APPLY FOR OTHER CREDITS DEMONSTRATING EXCEPTION PERFORMANCE	3*
CREDIT 2	LEED ACCREDITED PROFESSIONAL	1
<b>PROJECT TOTALS</b>	<b>25</b>	
*UP TO 3 ADDITIONAL POINTS CAN BE EARNED, MUST BE SUBMITTED AND APPROVED (NOT INCLUDED IN TOTAL)		

Homes had impressive HERS ratings ranging between 50 and 54.

## DURABILITY

Concrete is built to last. Many concrete building systems can withstand the raw forces of wind, flood or fire. Because concrete structures are so solid and long lasting, their shells can often be maintained in reconstruction projects — earning points in the Materials and Resources category for Building Reuse Credits 1.1 and 1.2.

The use of supplementary cementitious materials like slag cement and fly ash is growing every year, and in many cases these

materials serve to strengthen concrete mixes and increase their structural resistance to sulfate attack or alkali-silica reactions, and to help them perform better in freeze-thaw conditions. These qualities help buildings become more durable than ever — and the incorporation of recycled materials earns even more points toward LEED credits.

## THINKING LOCALLY: NORTH CENTRAL COLLEGE RES/REC CENTER

In Naperville, Ill., students at North Central College are looking forward to the fall 2009 opening of a new fieldhouse with an indoor track,



The E2 City Homes development in Minneapolis used ICFs to earn low HERS ratings, which contributed to earning more points toward their eventual Gold certification in LEED-H. Photo by Dana Wheelock, courtesy of LHB.



The North Central College Res/Rec Center's precast concrete components include recycled slag aggregate in the mix. Image courtesy of Dukane Precast, Inc.

a 100,000-square-foot recreation center and four field courts — a much-needed resource improvement for a school with a track program with 47 national championships under its belt. Wrapped around the facility is a dorm for 350 students, a space-saving design that takes advantage of local land resources in the downtown area.

Dukane Precast's double-wall precast concrete components for walls and floors help the structure conserve resources, says the company's vice president of sales and marketing, Brian Bock. (A bonus: the use of recycled slag aggregate from a local plant makes the concrete both lighter and stronger.) The form-finished sandwich-like components are filled with high R-value bio-based foam, and the resulting interior walls need only a coat of paint to become warm and inviting for students — while minimizing energy demands. The facility will also use geothermal wells and radiant floor heating.

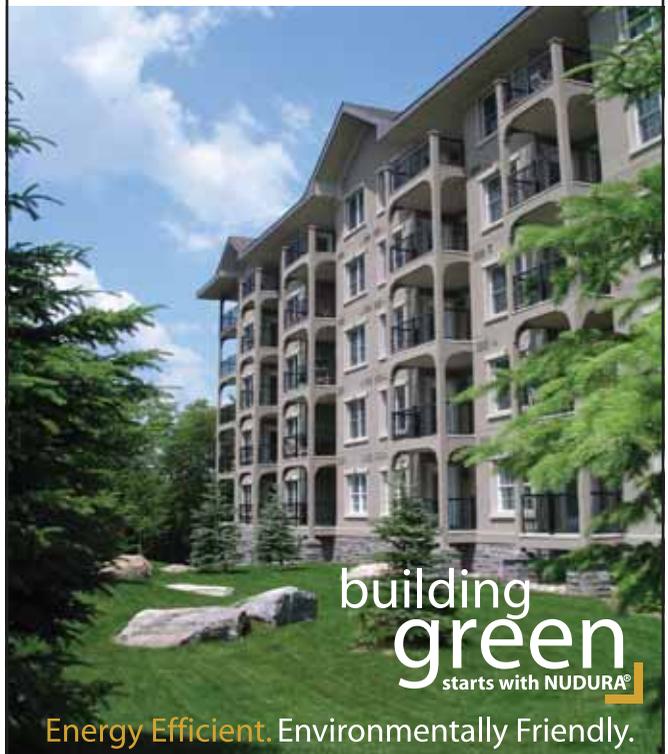
Bock says energy, performance and aesthetics drove the decision to create a unified facility. "The efficiency of heating one building instead of two is huge," he says, and because the exterior walls are made with a brick form liner and painted to look like the real thing, the building blends with surrounding downtown structures. Bock and his team hope for LEED Gold certification.

#### INDOOR AIR QUALITY

One of the strongest concerns for sustainability-savvy building tenants and consumers is VOC emissions, and here, concrete does an admirable job of reducing VOCs. Compared to concrete, acrylic latex paint, plywood paneling and water-based EVA wall and floor glue release and emit significantly higher amounts of VOCs. Employing exposed concrete surfaces (which can be stained and stamped to produce limitless colors and patterns) cuts VOCs immensely.

Plus, concrete more than three inches thick acts as an air barrier, reducing moisture infiltration (and the chance for mold development) and helping owners better control — and typically reduce — their HVAC needs.

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ONE OF THE WAYS PERVIOUS CONCRETE PAVEMENT (ANY CONCRETE PAVEMENT, IN FACT) CAN HELP EARN LEED POINTS AND HAVE AN OTHERWISE POSITIVE IMPACT IS BY REDUCING THE URBAN HEAT ISLAND (UHI) EFFECT. A HEAT ISLAND IS A LOCAL AREA OF ELEVATED TEMPERATURE IN A REGION OF COOLER TEMPERATURES; HEAT ISLANDS OCCUR WHERE THERE IS A PREPONDERANCE OF DARK EXTERIOR BUILDING MATERIALS AND PAVEMENTS, AND A LACK OF VEGETATION.

RESEARCH PERFORMED BY CTL GROUP IN 2007 EVALUATED THE REFLECTIVE PROPERTIES OF CONCRETE, USING THE LEED NC SS CREDIT 7.1 HEAT ISLAND EFFECT: NON-ROOF CRITERIA, AND FOUND THAT 45 DIFFERENT CONCRETE SAMPLES TESTED – REGARDLESS OF THE MIX (SOME OF WHICH INCLUDED RECOVERED MATERIALS LIKE FLY ASH AND SLAG CEMENT) – MET THE REQUIRED CRITERIA.



*The E2 City Homes development in Minneapolis shatter outmoded stereotypes of what a concrete home is like; the interiors are warm, comfortable and inviting — and award-winning, with accolades from the National Association of Home Builders and Insulating Concrete Form Association, among others. Photo by Dana Wheelock, courtesy of LHB.*

## RESOURCE EFFICIENCY: GREAT RIVER ENERGY HEADQUARTERS

The recently finished Great River Energy headquarters in Maple Grove, Minn., “Will be the most energy-efficient office building ever constructed in Minnesota and one of the most energy-efficient in the world,” says CEO David Saggau. Architects Perkins + Will and general contractor McGough Construction have designed and constructed a poured-in-place concrete structure that contains fly ash replacement of between 40 percent and 50 percent.

In line with the company’s goal to make best use of natural resources, the building will harvest daylight through multiple light-filled atriums; a two-way post-tensioned flat plate gravity load system does this by using floor plates made up of four long, narrow “pods” with either atrium or exterior spaces between them. The shallowest system available, it allows the project to use raised floors throughout to accommodate mechanical air distribution, and to have high ceilings and shallow floor-to-floor heights to maximize daylight penetration. The company is aiming for LEED Platinum certification. 🏡

# RECYCLED RESOURCES

BY JENNI PROKOPY

The use of recycled materials is not new in the concrete industry, but in the past some contractors have downplayed its inclusion because of (mistakenly) perceived lower value. That time is gone, says Jason Buesing, president of ReCrete Materials, Inc. His company, along with its affiliate, Recycled Materials Company, is setting new standards for use of recycled materials in concrete.

Recycled Materials Company's role in the movement started in 1987, and accelerated in 1999 when it received the contract for deconstruction of the former Stapleton Airport in Denver. (At the time, the company joined with the Colorado School of Mines to create concrete mix designs that included recycled materials.) Since starting the deconstruction of the airport, says Buesing, the company has sold 6.5 million tons of recycled concrete and asphalt — and still operates an urban recycling center at the site.

In 2006, Recycled Materials Company decided the demand for more highly-engineered recycled materials was growing fast enough that it needed to start up a separate venture to handle the prod-



ReCrete Materials, Inc. created "ToroStone" from pieces of recycled runway at the former El Toro Marine Corps Air Station.



Tilt-up buildings at Enterprise Park, located at the site of the former Stapleton Airport, contain a large amount of recycled concrete aggregate in both foundations and tilt-up components. Images courtesy of ReCrete Materials, Inc.

ucts, and ReCrete Materials, Inc. was formed. One of its first big jobs: Enterprise Park at Stapleton, developed by Etkin Johnson Group and home to three tilt-up buildings with 441,000 square feet of office and industrial space. (CAL Construction Company is providing tilt-up services on the project.) Construction began in March 2008.

According to Buesing, concrete foundations

for the structures will use approximately 620 tons of recycled aggregate and 115 tons of fly ash; concrete for the tilt-up panels will use approximately 1,570 tons of recycled concrete aggregate.

Much of the material is roughly 10 percent to 15 percent lighter in weight by volume, so the project requires less material overall. Plus,

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using materials recycled from the nearby decommissioned airport means reduced costs for fuel and truck miles, and fewer emissions from transport.

The success that the two companies have experienced at Stapleton did not go unnoticed. In April 2005, the City of Irvine, Calif., selected Recycled Materials Company to perform recycling and material removal operations at the former El Toro Marine Corps Air Station, handling a total of approximately 3.5 million tons of concrete and asphalt. While the project was recently put on hold, plans are still in place to turn El Toro into the Orange County Great Park — one of the largest metropolitan parks in the U.S., according to the Great Park Conservancy.

Mark Wachal, co-founder and partner in Recycled Materials Company, says the Great Park opportunity is a huge step forward in the recycled concrete movement. "Our program encompasses all things we have learned at Stapleton," Wachal says, maximizing every resource available at the site and creating almost 10 different recycled products.

The resulting recycled concrete aggregate products include an aggregate base course (for use under pavement); a bedding product for underground utilities; landscaping material called ToroStone (essentially three by four-foot pieces of runway) that can be used for water retention, stream protection, park benches and water features; and — of course — fine and coarse aggregate components for ready mixed concrete.

## CONCRETE PUTS A BEAUTIFUL FACE ON RECYCLED MATERIALS AND ICFS



Southface Eco Office, image courtesy of Georgia Concrete and Products Association.

In Atlanta, a large staff at Southface Energy Institute is working to educate people about sustainable homes, workplaces and communities...so what better place to put green building practices into action? The organization has two buildings: One a residential-style structure, the other a new commercial building, the Eco Office. Both function to house staff and educational tools, and as demonstration projects for consumers and the construction community.

Both structures are built with insulating concrete forms (ICFs). "We think concrete is a great building material because it's very durable, termites won't eat it, it's easier to manage moisture issues with it—and the ICF system makes it a great energy performer," says Southface executive director Dennis Creech.

For the Eco Office, Southface used ICFs from PolySteel, creating a building that has a life beyond being a "show home," according to Will Oliver, president of Oliver Building Solutions and supplier of the ICFs. The energy efficiency of the ICF system allowed Southface to reduce their HVAC tonnage by eight tons on the 10,000-square-foot structure.

The savings will be tracked and documented, says Creech: "With support from PolySteel, we've fully instrumented this building. We'll be monitoring the moisture, mechanical and plumbing, and we've got thermocouples on the outside and inside of walls to measure flow of temperature." Data will be posted online for observers.

Concrete for the structure incorporated supplementary cementitious materials: in the ICFs, cement replacements were at 15 percent fly ash and 20 percent slag cement; in footings and slab on grade, that replacement level was pushed to substitute 20 percent with each material. "Being a green building demonstration project, we wanted to use as high a replacement amount as possible," says Frank Burdette, Southface's project manager with commercial green building services.

And concrete is sprinkled throughout the organization's campus: pervious concrete is used for sidewalks, plazas and driveways; concrete countertops adorn kitchens and public restroom facilities; exposed, colored concrete flooring in the main entryway serves to connect the office building with the 6,500-square-foot residential structure; and recycled concrete aggregate was used in landscaping. ■

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# PERVIOUS PAVEMENT SPREADS AS SOLUTION

BY JENNI PROKOPY

## PRIME OUTLETS EMPLOYS PERVIOUS

AS PART OF A MALL RECONSTRUCTION, PRIME OUTLETS IN WILLIAMSBURG, VA., RECENTLY COMPLETED A PARKING LOT REPLACEMENT THAT EMPLOYED APPROXIMATELY 7.5 ACRES OF PERVIOUS CONCRETE PAVEMENT AND 3.5 ACRES OF CONVENTIONAL CONCRETE PAVEMENT. (TITAN VIRGINIA READY MIX SUPPLIED ITS ENVIRA BRAND OF PERVIOUS PAVEMENT.) THE SYSTEM DIVERTS WATER INTO THE SOIL INSTEAD OF THE MALL'S OLD STORMWATER MANAGEMENT APPROACH: A DETENTION POND. THE POND HAS BEEN PAVED OVER, CREATING MUCH MORE LAND FOR DEVELOPMENT, AND ADDITIONAL WATER-HARVESTING TECHNOLOGY HELPS CAPTURE WATER FOR LANDSCAPE IRRIGATION.



At the Prime Outlets, conventional concrete was used for traffic lanes, while pervious concrete was used for parking stalls. Image courtesy of Titan Virginia Ready Mix.



Unilock's Eco-optiloc precast permeable concrete pavers were used to create the largest permeable parking lot on record at Chicago's U.S. Cellular Field. The park's drainage capacity is 1.15 million gallons—or 9.25 million 16-oz. sodas. Image courtesy of Rose Paving and Unilock.

One of the most pressing concerns for city planners today is stormwater. In some cities, new regulations dictate the management of stormwater from the minute the first raindrop falls; Chicago, one of the U.S. cities at the forefront of the sustainable movement, enacted a new stormwater management ordinance this year that requires any regulated development to have a city-approved plan in place that manages the rate and volume of runoff, among other things.

That's a lot to swallow for some, but in many cities pervious concrete pavement is helping meet new stringent stormwater management requirements.

**HOW IS PERVIOUS CONCRETE PRODUCED?** Unlike conventional concrete, pervious concrete mixes contain limited or no fine aggregates, producing concrete with approximately 20 percent voids. Those spaces allow water to flow through the pavement, then a bed of uniformly sized aggregate below, and into the soil—reducing or eliminating stormwater runoff. Average strengths of pervious concrete are from 500 to 4,000 psi, but can go higher depending on the application; percolation rates average from 288 to 770 inches per hour.

Dan Huffman, managing director of national resources for the National Ready Mixed Concrete Association, says pervious concrete is gaining

ground fast. "The U.S. Environmental Protection Agency recommends pervious concrete as a Best Management Practice with compliance with federal stormwater law, and that's a very powerful thing to say," he says. "We should be using greywater water all over the place; we waste so much water and we just don't have to," he argues.

### KEEPING IT CLEAN

The material not only helps manage runoff and capture water, but cleans it as well, according to Stew Waller, executive director of the Arizona Cement Association. "Some heavy metals and contaminants you find in the first flush of a rain storm, hydrocarbons...it washes off all the dirt and contaminants from the pavement," Waller says. In fact many pervious pavements develop a microbial system in the voids that attacks and consumes these pollutants, so water flowing into the soil is cleaner.

### USING LEAST-COST ANALYSIS TO DETERMINE VALUE

Waller points to new pervious pavement at the Glendale, Ariz., Park-and-Ride as an example of the technique at its best. While pervious pavement was more expensive than conventional asphalt pavement upfront, a least-cost analysis considering 20-year service life maintenance costs for both systems proved pervious concrete to be equal in cost in (the city chose to also incorporate additional sub-drainage systems and retention ponds). In



An alley off of Chicago's Rockwell Avenue, before (top) and after (bottom) pervious pavement was placed by the Chicago Department of Transportation. Images courtesy of Hitchcock Design Group.

more typical new paving situations, he says, using pervious to eliminate conventional sub-drainage infrastructure trumps asphalt in both initial cost and extended service life.

MANUFACTURER PUTS PAVEMENT INTO ACTION

An early adopter of pervious pavement for industrial use is Quality Block of Phoenix, Ariz. Owner Clem Hellman says his plant is known for its cleanliness — but the land where pallets of block were stored was plain soil, and operations in that area kicked up dust that collected on equipment.

In summer 2007, Hellman worked with Arizona Materials and Phoenix Cement Company to create pervious pavement for 20,000 square feet of plant yard, the first-known industrial application, he says. Eight inches of pervious concrete were placed over 12 inches of aggregate to create pavement strong enough to hold stacks of four cubes of concrete block — each cube weighing 3,000 pounds — and to withstand frequent forklift traffic.

"I have nothing but good things to say about it," says Hellman, who praises the resulting cleanliness of his yard, the more stable storage area that offers increased flexibility, and the ability to hold stormwater in the pavement — eliminating the need to buy extra land for a retention pond.

CHICAGO GOES GREEN...AND PERVIOUS

The impact of Chicago's new stormwater management ordinance is something the city's department of transportation (CDOT) has to deal with every day, and the Chicago Green Alley Program aims to deal with flooding that impacts much of the city's 1,900 miles of public alleys.

Created by CDOT and landscape architects at Hitchcock Design Group (along with civil engineering firm Knight E/A, environmental engineers Hey and Associates and material testers S.T.A.T.E. Testing), the program includes four pilot alley designs. There's also a Chicago Green Alley Handbook full of sustainable principles for residents who live adjacent to alleys, says Bill Schmidt, senior associate with Hitchcock Design Group, whose sketches — based on his own alley — helped form some of the project concepts.

The favorite design of David Leopold, project manager for CDOT, and Janet Attarian, the agency's project director and sustainability coordinator, uses pervious pavement for a center trench in the alley and conventional pavement on the sides for wheel traffic. "We have a lot of alleys with adjacent basements...the center trench keeps the infiltration away from a building," explains Attarian. They create a vertical approach by placing approximately five feet of aggregate beneath the pavement, surrounded by a waterproof membrane, to ensure water doesn't seep into neighboring basements.

The pervious concrete alleys do more than collect and divert stormwater. The high-albe-

do concrete increases reflectivity and reduces the urban heat island effect (UHI), says Attarian; the concrete incorporates recycled slag cement; and the base course is recycled concrete aggregate. Leopold points out that by reducing the UHI effect, residents save money on air-conditioning costs, and by diverting water from sewer systems the city saves money on energy costs for pumping and cleaning the water before it's returned to the Chicago River. By the end of 2008, about 60 alleys will be repaved with pervious concrete, and that number will continue to grow.

Even the Chicago sports community is jumping on the pervious bandwagon. U.S. Cellular Field, home to the White Sox, recently placed the largest permeable parking lot in the country: 265,000 square feet of mechanically installed Unilock precast pervious pavers that include recycled content (slag cement). Chuck Sampey, director of development and facilities for the Illinois Sports Facilities Authority (which owns the ballpark) says the cost savings is in the millions, compared to installing underground storage systems and high-maintenance asphalt paving. For future projects, he says, "everything is moving toward a green solution — no doubt we'll go for permeable pavers." +

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